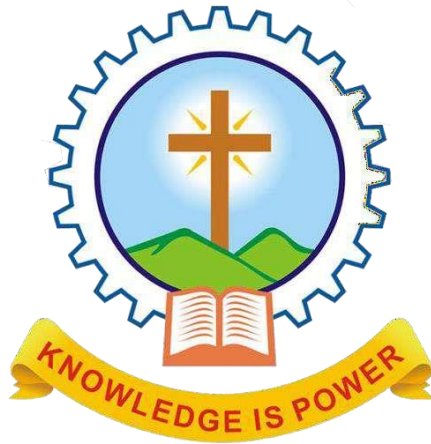


**MAR ATHANASIOUS COLLEGE OF ENGINEERING,
KOTHAMANGALAM 686666
(AUTONOMOUS)**



**BACHELOR OF TECHNOLOGY (B. Tech)
CIVIL ENGINEERING
SCHEME & SYLLABUS**

SEMESTER 1

SLOT	COURSE NO.	COURSES	L-T-P-S	HOURS	CREDIT
A	B24MA1T01	LINEAR ALGEBRA AND MULTI VARIABLE CALCULUS	3-1-0-5	4	4
B	B24ES1T01B	PROBLEM SOLVING AND PROGRAMMING TECHNIQUES (B)	2-1-0-4	3	3
C	B24CE1T01	INTRODUCTION TO CIVIL ENGINEERING	2-1-0-4	3	3
D	B24CE1T02	ENGINEERING MECHANICS	2-2-0-5	4	4
E	B24ES1T03C	GRAPHICS FOR CIVIL ENGINEERS	2-1-1-5	4	4
G	B24ES1L01B	PROGRAMMING LAB (B)	0-0-3-2	3	2
H	B24CE1L01	CIVIL ENGINEERING LAB	0-0-3-2	3	2
I	B24MC1T01	LIFE SKILLS	1-0-1-2	2	P/F
J	B24MC1T02	DESIGN THINKING	1-1-0-2	2	P/F
K	B24MC1L01	YOGA AND SPORTS	0-1-1-1	2	P/F
			TOTAL	30	22

SEMESTER 2

SLOT	COURSE NO.	COURSES	L-T-P-S	HOURS	CREDIT
A	B24MA1T02	ORDINARY DIFFERENTIAL EQUATIONS AND TRANSFORMS	3-1-0-5	4	4
B	B24PH1T01B	ENGINEERING PHYSICS (B)	2-1-0-4	3	3
C	B24CY1T01B	ENGINEERING CHEMISTRY (B)	2-1-0-4	3	3
D	B24ES1T04	BASIC ELECTRICAL AND MECHANICAL ENGINEERING	2-2-0-5	4	4
E	B24CE1T03	SURVEYING & GEOMATICS	2-1-0-4	3	3
F	B24ES1L03	MECHANICAL AND ELECTRICAL ENGINEERING WORKSHOP	0-0-2-1	2	1
G	B24CE1L02	ENGINEERING MECHANICS LAB	0-0-3-2	3	2
H	B24PC1L01B	PHYSICS (B) AND CHEMISTRY (B) LAB	0-0-2-2	2	1
I	B24MC1T03	PROFESSIONAL COMMUNICATION AND ETHICS	2-0-1-3	3	P/F
J	B24MC1L02	IDEA LAB	0-0-3-3	3	P/F
			TOTAL	30	21

SEMESTER 3

SLOT	COURSE NO.	COURSES	L-T-P-S	HOURS	CREDIT
A	B24MA2T03A	COMPLEX VARIABLES AND APPLICATIONS OF PDE	3-1-0-5	4	4
B	B24CE2T01	MECHANICS OF SOLIDS	3-1-0-5	4	4
C	B24CE2T02	FLUID MECHANICS & HYDRAULICS	3-1-0-5	4	4
D	B24CE2T03	FUNCTIONAL PLANNING OF BUILDINGS	2-1-0-4	3	3
E	B24HU2T02	ENTREPRENEURSHIP AND MANAGEMENT SKILLS FOR ENGINEERS	2-1-0-4	3	3
G	B24CE2L03	SURVEYING LABORATORY	0-0-3-2	3	2
H	B24CE2L04	HYDRAULICS LABORATORY	0-0-3-2	3	2
I	B24MC2T04	UNIVERSAL HUMAN VALUE AND CONSTITUTIONAL RIGHTS	2-0-0-2	2	P/F
J	B24MC2T05	ENERGY CONSERVATION AND ENVIRONMENTAL SUSTAINABILITY	2-0-0-2	2	P/F
M	B24CEM3x	MINOR	3-1-0-5	4	4
			TOTAL	32	22

SEMESTER 4

SLOT	COURSE NO.	COURSES	L-T-P-S	HOURS	CREDIT
A	B24MA2T04B	STATISTICAL ANALYSIS AND NUMERICAL METHODS	3-1-0-5	4	4
B	B24CE2T04	STRUCTURAL ANALYSIS	3-1-0-5	4	4
C	B24CE2T05	SOIL MECHANICS	3-1-0-5	4	4
D	B24CE2T06	HIGHWAY AND PAVEMENT ENGINEERING	3-1-0-4	4	3
E	B24HU2T01	BUSINESS ECONOMICS AND FINANCIAL MANAGEMENT	3-0-0-4	3	3
F	B24CE2T07	CONSTRUCTION TECHNOLOGY & MANAGEMENT	2-1-0-4	3	3
G	B24CE2L05	MATERIAL TESTING LABORATORY - I	0-0-3-2	3	2
H	B24CE2L06	CIVIL ENGINEERING DRAFTING LAB	0-0-3-2	3	2
M	B24CEM4x	MINOR	3-1-0-5	4	4
N	B24CEH4x	HONOURS	3-1-0-5	4	4
			TOTAL	36	25

SEMESTER 5

SLOT	COURSE NO.	COURSES	L-T-P-S	HOURS	CREDIT
A	B24CE3T01	DESIGN OF CONCRETE STRUCTURES	3-1-0-5	4	4
B	B24CE3T02	ADVANCED ANALYSIS OF STRUCTURES	3-1-0-5	4	4
C	B24CE3T03	WATER RESOURCES ENGINEERING	3-1-0-5	4	4
D	B24CE3T04	CONCRETE TECHNOLOGY	2-1-0-4	3	3
E	B24CE3T05	ENVIRONMENTAL ENGINEERING	3-1-0-5	4	4
F	B24CE3P1x	PROGRAM ELECTIVE I	2-1-0-4	3	3
G	B24CE3L07	SOIL MECHANICS LABORATORY	0-0-3-2	3	2
H	B24CE3L08	TRANSPORTATION ENGINEERING LABORATORY	0-0-3-2	3	2
M	B24CEM5x	MINOR	3-1-0-5	4	4
N	B24CEH5x	HONOURS	3-1-0-5	4	4
			TOTAL	36	26

PROGRAMME ELECTIVE I

B24CE3P11	REMOTE SENSING & GIS
B24CE3P12	MODERN CONSTRUCTION MATERIALS
B24CE3P13	GEO-ENVIRONMENTAL ENGINEERING
B24CE3P14	SAFETY IN CONSTRUCTION
B24CE3P15	ENGINEERING GEOLOGY
B24CE3P16	HIGHWAY MATERIALS AND DESIGN

SEMESTER 6

SLOT	COURSE NO.	COURSES	L-T-P-S	HOURS	CREDIT
A	B24CE3T06	DESIGN OF STEEL STRUCTURES	3-1-0-5	4	4
B	B24CE3T07	WATER AND WASTE WATER MANAGEMENT	3-1-0-5	4	4
C	B24CE3T08	QUANTITY SURVEYING AND VALUATION	3-1-0-5	4	4
D	B24CE3T09	FOUNDATION ENGINEERING	3-1-0-5	4	4
E	B24CE3P2x	PROGRAM ELECTIVE II	2-1-0-4	3	3
F	B24CE3G1x	OPEN ELECTIVE I	2-1-0-4	3	3
G	B24CE3L09	MATERIAL TESTING LABORATORY – II	0-0-3-2	3	2
H	B24CE3L10	CIVIL ENGINEERING DESIGN STUDIO	0-0-3-2	3	2
M	B24CEM6x	MINOR	3-1-0-5	4	4
N	B24CEH6x	HONOURS	3-1-0-5	4	4
			TOTAL	36	26

PROGRAMME ELECTIVE II

B24CE3P21	ADVANCED CONCRETE TECHNOLOGY
B24CE3P22	ENGINEERING LAW
B24CE3P23	SOLID AND LIQUID WASTE MANAGEMENT
B24CE3P24	GROUND IMPROVEMENT TECHNIQUES
B24CE3P25	PRESTRESSED CONCRETE
B24CE3P26	SEISMOLOGY AND EARTHQUAKE ENGINEERING

OPEN ELECTIVE I

B24CE3G11	SUSTAINABLE CONSTRUCTION MATERIALS AND PRACTICES
B24CE3G12	NATURAL DISASTER & MITIGATION
B24CE3G13	ENVIRONMENTAL RISK ASSESSMENT

SEMESTER 7

SLOT	COURSE NO.	COURSES	L-T-P-S	HOURS	CREDIT
A	B24CE4T01	TRANSPORT INFRASTRUCTURE ENGINEERING	2-1-0-4	3	3
B	B24CE4P3x	PROGRAM ELECTIVE III	2-1-0-4	3	3
C	B24CE4P4x	PROGRAM ELECTIVE IV	2-1-0-4	3	3
D	B24CE4G2x	OPEN ELECTIVE II	2-1-0-4	3	3
E	B24HU4T04	DISASTER MANAGEMENT AND INDUSTRIAL SAFETY	2-1-0-4	3	3
F	B24CE4L11	ENVIRONMENTAL ENGINEERING LABORATORY	0-0-3-2	3	2
G	B24CE4L12	PROJECT PHASE I	0-0-6-2	6	3
H	B24CE4L13	SEMINAR	0-0-4-1	4	2
I	B24CE4T02	VIVA-VOCE	0-0-0-0	-	1
M	B24CEM7x	MINOR	3-1-0-5	4	4
N	B24CEH7x	HONOURS	3-1-0-5	4	4
			TOTAL	36	23

PROGRAMME ELECTIVE III

B24CE4P31	ARCHITECTURE AND INTERIOR DESIGNING
B24CE4P32	AIR QUALITY MANAGEMENT
B24CE4P33	SOIL STRUCTURE INTERACTION
B24CE4P34	ADVANCED DESIGN OF CONCRETE STRUCTURES
B24CE4P35	AI APPLICATIONS IN CIVIL ENGINEERING
B24CE4P36	PAVEMENT ANALYSIS

PROGRAMME ELECTIVE IV

B24CE4P41	INTRUDUCTION TO BIM 2D DRAFTING AND ARCHITECHTURAL MODELLING FUNDAMENTALS
B24CE4P42	TRANSPORTATION ECONOMICS
B24CE4P43	ENVIRONMENTAL IMPACT ASSESSMENT
B24CE4P44	ADVANCED FOUNDATION DESIGN
B24CE4P45	STRUCTURAL DYNAMICS
B24CE4P46	SUSTAINABLE CONSTRUCTION MATERIALS AND PRACTICES

OPEN ELECTIVE II

B24CE4G21	ENERGY MANAGEMENT AND INTEGRATION
B24CE4G22	CLIMATE CHANGE AND SUSTAINABILITY
B24CE4G23	INTELLIGENT TRANSPORT SYSTEMS

SEMESTER 8

SLOT	COURSE NO.	COURSES	L-T-P-S	HOURS	CREDIT
A,B,C	B24MC400X	INTERNSHIP & MOOC COURSES (3 NUMBERS)	0-0-0-0	0	9
OR					
A	B24CE4P5x	PROGRAM ELECTIVE V	2-1-0-4	3	3
B	B24CE4P6x	PROGRAM ELECTIVE VI	2-1-0-4	3	3
C	B24CE4G3x	OPEN ELECTIVE III	2-1-0-4	3	3
AND					
H	B24CE4L14	PROJECT PHASE II	0-0-12-3	12	6
N	B24CEM8x	MINOR PROJECT	0-0-3-12	3	6
M	B24CEH8x	HONOURS PROJECT	0-0-6-9	6	6
			TOTAL	30	15

PROGRAMME ELECTIVE V

B24CE4P51	CONSTRUCTION PLANNING AND MANAGEMENT
B24CE4P52	SUSTAINABILITY AND ENVIRONMENTAL HEALTH
B24CE4P53	EARTHQUAKE RESISTANT DESIGN OF STRUCTURES
B24CE4P54	TRAFFIC ENGINEERING AND SAFETY
B24CE4P55	GEO- TECHNICAL INVESTIGATION
B24CE4P56	GEOINFORMATICS

PROGRAMME ELECTIVE VI

B24CE4P61	CHARACTERISATION OF CONSTRUCTION MATERIALS
B24CE4P62	DESIGN OF ENVIRONMENTAL FACILITIES
B24CE4P63	APPLIED SOIL MECHANICS
B24CE4P64	ADVANCED ANALYSIS AND DESIGN USING ETABS
B24CE4P65	URBAN TRANSPORTATION PLANNING
B24CE4P66	ARCHITECTURAL MODELLING AND ADVANCED BIM

OPEN ELECTIVE III

B24CE4G31	ENVIRONMENTAL HEALTH AND SAFETY
B24CE4G32	LAND USE AND TRANSPORT PLANNING
B24CE4G33	CONDITION ASSESSMENT OF STRUCTURES



HONOURS COURSES

BASKET 1: STRUCTURAL ENGINEERING	
B24CEH41	STRUCTURAL FORMS AND MATERIALS
B24CEH51	FUNDAMENTALS OF EARTHQUAKE ENGINEERING
B24CEH61	PRECAST STRUCTURES
B24CEH71	ADVANCED STEEL DESIGN
B24CEH81	MINI PROJECT
BASKET 2: STRUCTURAL HEALTH MONITORING AND REPAIR	
B24CEH42	NON-DESTRUCTIVE TESTING
B24CEH52	STRUCTURAL FORENSIC ANALYSIS
B24CEH62	REPAIR AND REHABILITATION
B24CEH72	HERITAGE STRUCTURES
B24CEH82	MINI PROJECT
BASKET 3: SUSTAINABLE ENGINEERING	
B24CEH43	CLIMATE CHANGE AND SUSTAINABILITY
B24CEH53	ECO-FRIENDLY MATERIALS AND GREEN BUILDINGS
B24CEH63	ECO-CONSCIOUS CONSTRUCTION
B24CEH73	URBAN PLANNING
B24CEH83	MINI PROJECT
BASKET 4: CONSTRUCTION MANAGEMENT	
B24CEH44	CONSTRUCTION SCHEDULING & PLANNING
B24CEH54	CONSTRUCTION CONTRACTS, METHODS AND EQUIPMENT
B24CEH64	ADVANCED CONSTRUCTION TECHNIQUES
B24CEH74	LEAN CONSTRUCTION
B24CEH84	MINI PROJECT
BASKET 5: TRANSPORTATION ENGINEERING	
B24CEH45	PUBLIC TRANSPORT SYSTEMS
B24CEH55	TRANSPORTATION SAFETY ENGINEERING
B24CEH65	LAND USE AND MOBILITY
B24CEH75	INTELLIGENT TRANSPORTATION SYSTEMS
B24CEH85	MINI PROJECT
BASKET 6: GEOTECHNICAL ENGINEERING	
B24CEH46	REINFORCED SOIL AND GEOSYNTHETICS
B24CEH56	GROUND MONITORING TECHNIQUES
B24CEH66	STRUCTURAL DESIGN OF FOUNDATION AND EARTH RETAINING STRUCTURES
B24CEH76	SOIL DYNAMICS AND MACHINE FOUNDATION
B24CEH86	MINI PROJECT

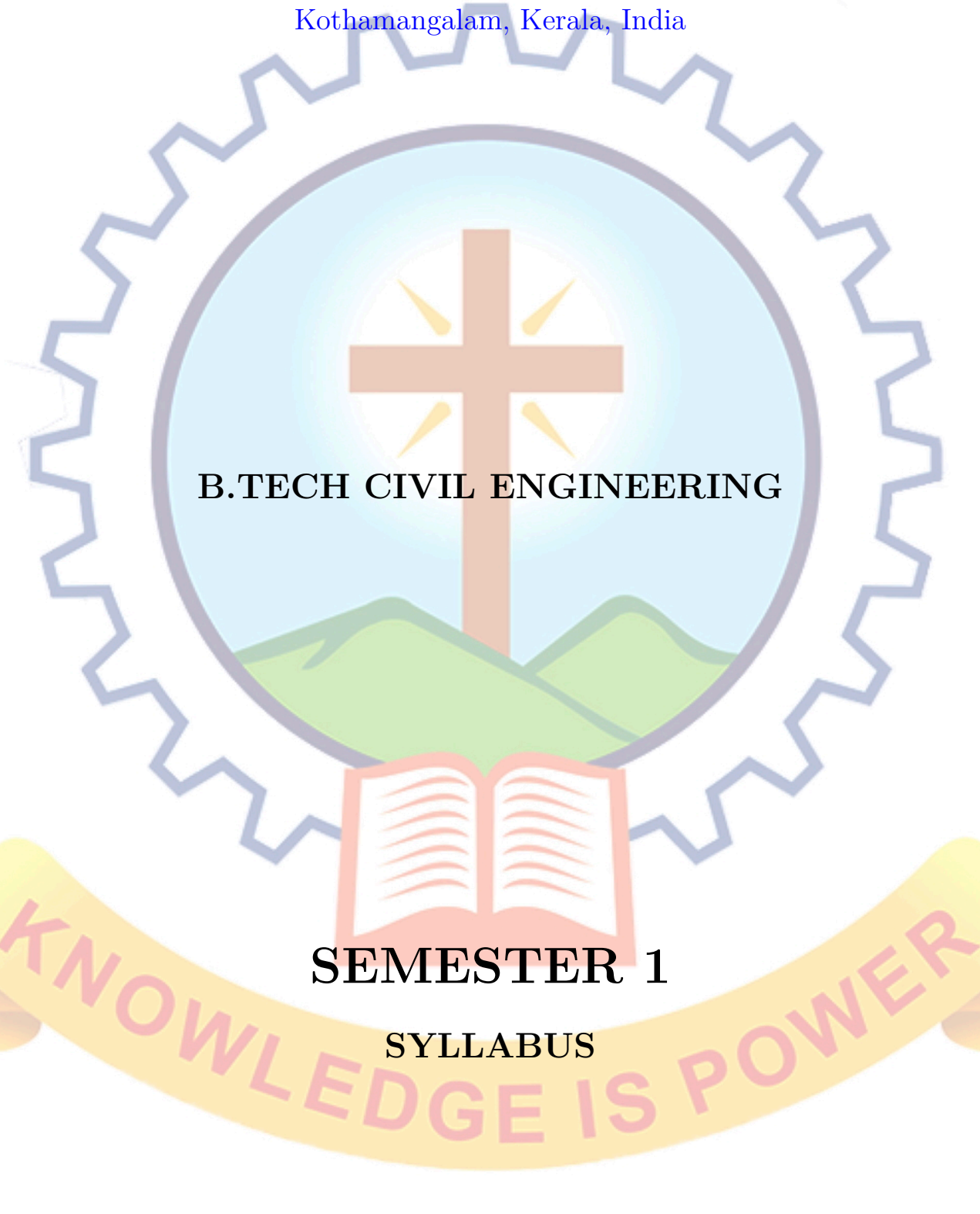
MINOR COURSES

BASKET 2:	
B24CEM32	WATER AND AIR QUALITY
B24CEM42	SOLID WASTE MANAGEMENT
B24CEM52	RENEWABLE ENERGY
B24CEM62	SUSTAINABILITY AND ENVIRONMENTAL HEALTH
B24CEM72	MINI PROJECT
BASKET 3:	
B24CEM33	TRAFFIC SAFETY
B24CEM43	LAND USE AND URBAN PLANNING
B24CEM53	SUSTAINABLE TRANSPORTATION
B24CEM63	TRANSPORTATION SYSTEMS
B24CEM73	MINI PROJECT



MAR ATHANASIOUS COLLEGE OF ENGINEERING

Government Aided, Autonomous Institution
Kothamangalam, Kerala, India



B.TECH CIVIL ENGINEERING

SEMESTER 1

SYLLABUS

KNOWLEDGE IS POWER

SEMESTER 1

SLOT	COURSE NO.	COURSES	L-T-P-S	HOURS	CREDIT
A	B24MA1T01	LINEAR ALGEBRA AND MULTIVARIABLE CALCULUS	3-1-0-5	4	4
B	B24ES1T01B	PROBLEM SOLVING AND PROGRAMMING TECHNIQUES (B)	2-1-0-4	3	3
C	B24CE1T01	INTRODUCTION TO CIVIL ENGINEERING	2-1-0-4	3	3
D	B24CE1T02	ENGINEERING MECHANICS	2-2-0-5	4	4
E	B24ES1T03C	GRAPHICS FOR CIVIL ENGINEERS	2-1-1-5	4	4
G	B24ES1L01B	PROGRAMMING LAB (B)	0-0-3-2	3	2
H	B24CE1L01	CIVIL ENGINEERING LAB	0-0-3-2	3	2
I	B24MC1T01	LIFE SKILLS	1-0-1-2	2	P/F
J	B24MC1T02	DESIGN THINKING	1-1-0-2	2	P/F
K	B24MC1L01	YOGA AND SPORTS	0-1-1-1	2	P/F
			TOTAL	30	22

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24MA1T01	LINEAR ALGEBRA AND MULTIVARIABLE CALCULUS	3	1	0	5	4	2024

Preamble

This course introduces students to some basic mathematical ideas and tools which are at the core of any engineering course. A brief course in Linear Algebra familiarises students with some basic techniques in matrix theory which are essential for analyzing linear systems. The calculus of functions of one or more variables taught in this course are useful in modelling and analyzing physical phenomena involving continuous change of variables or parameters and have applications across all branches of engineering.

Prerequisites: Nil.

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Solve systems of linear equations, diagonalize matrices and characterise quadratic forms (Cognitive Knowledge level: Apply)
CO 2	Compute the partial and total derivatives and maxima and minima of multi-variable functions (Cognitive Knowledge Level : Apply)
CO 3	Compute multiple integrals and apply them to find areas and volumes of geometrical shapes, mass and centre of gravity of plane laminas. (Cognitive Knowledge Level : Apply)
CO 4	Compute the derivatives and line integrals of vector functions and learn their applications (Cognitive Knowledge Level : Apply)
CO 5	Evaluate surface and volume integrals and learn their inter-relations and applications. (Cognitive Knowledge Level : Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	2	1	0	0	1	0	0	0	0	0	0
CO 2	2	1	0	0	0	1	0	0	0	0	0
CO 3	2	1	0	0	0	0	0	0	0	0	0
CO 4	2	1	0	0	0	0	0	0	0	0	0
CO 5	2	1	0	1	1	1	1	0	0	0	1

Assessment Pattern

LINEAR ALGEBRA AND MULTIVARIABLE CALCULUS			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	20	20	20
Understand	40	40	40
Apply	40	40	40
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course Project	: 10 marks
Self Study	: 5 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contain 10 questions carrying 3 marks each. Part B contains 2 questions from each module out of which 1 to be answered. Each question carries 14 marks and can have maximum 2 sub-divisions.

SYLLABUS

MODULE 1 (Linear Algebra)

(Text 2: Relevant topics from 7.3, 7.4, 7.5, 8.1, 8.3, 8.4)

Systems of linear equations, Solution by Gauss elimination, row echelon form and rank of a matrix, fundamental theorem for linear systems (homogeneous and non-homogeneous, without proof), Eigen values and eigenvectors. Diagonalization of matrices, orthogonal transformation, quadratic forms and their canonical forms.

MODULE 2 (Multivariable Calculus-Differentiation)

(Text 1: Relevant topics from sections 13.3, 13.4, 13.5, 13.8)

Partial derivatives, partial derivatives of functions of more than two variables, higher order partial derivatives, differentials and local linearity, The chain rule, Maxima and Minima of functions of two variables, extreme value theorem (without proof), relative extrema.

MODULE 3 ((Multivariable Calculus-Integration))

(Text 1: Relevant topics from sections 14.1, 14.2, 14.3, 14.5, 14.6, 14.8)

Double integrals (Cartesian), reversing the order of integration, Change of coordinates (Cartesian to polar), finding areas using double integrals, mass and centre of gravity of inhomogeneous laminas using double integral. Triple integrals, volume calculated as triple integral, triple integral in cylindrical and spherical coordinates (computations involving spheres, cylinders).

MODULE 4 (Calculus of vector functions)

(Text 1: Relevant topics from sections 12.1, 12.2, 12.6, 13.6, 15.1, 15.2, 15.3)

Vector valued function of single variable, derivative of vector function and geometrical interpretation, motion along a curve-velocity, speed and acceleration. Concept of scalar and vector fields, Gradient and its properties, directional derivative, divergence and curl, Line integrals of vector fields, work as line integral, Conservative vector fields, independence of path and potential function(results without proof).

MODULE 5 (Vector integral theorems)

(Text 1: Relevant topics from sections 15.4, 15.5, 15.6, 15.7, 15.8)

Green's theorem (for simply connected domains, without proof) and applications to evaluating line integrals and finding areas. Surface integrals over surfaces of the form $z = g(x, y)$, $y = g(x, z)$ or $x = g(y, z)$, Flux integrals over surfaces of the form $z = g(x, y)$, $y = g(x, z)$ or $x = g(y, z)$, divergence theorem (without proof) and its applications to finding flux integrals, Stokes' theorem (without proof) and its applications to finding line integrals of vector fields and work done.

Text Books:

1. H. Anton, I. Biven, S. Davis, "Calculus", Wiley, 10th edition, 2015.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10th edition, John Wiley & Sons, 2015.

Reference Books:

1. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
2. J. Stewart, Essential Calculus, Cengage, 2nd edition, 2017.
3. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 43rd Edition, 2015.
4. Peter O Neil, Advanced Engineering Mathematics, 7th Edition, Thomson, 2007.
5. Veerarajan T. Engineering Mathematics for first year", Tata McGraw - Hill, 2008.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Linear Algebra	9
1.1	Systems of linear equations, Solution by Gauss elimination	1
1.2	Row echelon form, finding rank from row echelon form, fundamental theorem for linear systems	2
1.3	Eigen values and eigen vectors	2
1.4	Diagonalization of matrices	2
1.5	Orthogonal transformation, quadratic forms and their canonical forms.	2
2	Multivariable Calculus - Differentiation	9
2.1	Partial derivatives	2
2.2	Differentials, Local Linear approximations	2
2.3	Chain rule, total derivative	2
2.4	Maxima and minima	3
3	Multivariable Calculus - Integration	9
3.1	Double integrals (Cartesian)-evaluation	2
3.2	Change of order of integration in double integrals, change of coordinates (Cartesian to polar)	2
3.3	Finding areas, mass and centre of gravity of plane laminas	2
3.4	Triple integrals, volume calculated as triple integral, triple integral in cylindrical and spherical coordinates.	3

4	Calculus of Vector Functions	9
4.1	Vector valued function of a scalar variable - derivative of vector valued function of scalar variable t-geometrical meaning	2
4.2	Motion along a curve-speed, velocity, acceleration	1
4.3	Gradient and its properties, directional derivative, divergence and curl	3
4.4	Line integrals with respect to arc length, line integrals of vector fields. Work done as line integral	2
4.5	Conservative vector field, independence of path, potential function	1
5	Vector Integral Theorems	9
5.1	Green's theorem and its applications	2
5.2	Surface integrals, flux integral and their evaluation	3
5.3	Divergence theorem and applications	2
5.4	Stokes theorem and applications	2
Total		45 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1): Solve systems of linear equations, diagonalize matrices and characterise quadratic forms.

1. A is a real matrix of order 3×3 and $X = \begin{bmatrix} x \\ y \\ z \end{bmatrix}$. What can you say about the solution

of $AX = 0$ if rank of A is 2 ? 3 ?

2. Given $A = \begin{bmatrix} 3 & 0 & 2 \\ 0 & 2 & 0 \\ -2 & 0 & 0 \end{bmatrix}$, find an orthogonal matrix P that diagonalizes A .

3. The matrix $A = \begin{bmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{bmatrix}$ has an eigenvalue 5 with corresponding eigenvector

$$X = \begin{bmatrix} 1 \\ 2 \\ -1 \end{bmatrix}. \text{ Find } A^5 X.$$

Course Outcome 2 (CO 2): Compute the partial and total derivatives and maxima and minima of multivariable functions.

- Find the slope of the surface $z = x^2y + 5y^3$ in the x -direction at the point $(1, -2)$.
- Given the function $w = xy + z$, use the chain rule to find the instantaneous rate of change of w at each point along the curve $x = \cos t$, $y = \sin t$, $z = t$.
- Determine the dimension of rectangular box open at the top, having a volume 32 cubic ft and requiring the least amount of material for its construction.

Course Outcome 3 (CO 3): Compute multiple integrals and apply them to find areas and volumes of geometrical shapes, mass and centre of gravity of plane laminas.

1. Evaluate $\iint_D (x + 2y) dA$ where D is the region bounded by the parabolas $y = 2x^2$ and $y = 1 + x^2$.
2. Explain how you would find the volume under the surface $z = f(x, y)$ and over a specific region D in the xy plane using triple integral?
3. Find the mass and centre of gravity of a triangular lamina with vertices (0,0), (2,1), (0,3) if the density function is $f(x, y) = x + y$.

Course Outcome 4 (CO 4): Compute the derivatives and line integrals of vector functions and learn their applications

1. How would you calculate the speed, velocity and acceleration at any instant of a particle moving in space whose position vector at time t is $\mathbf{r}(t)$?
2. Find the work done by the force field $\mathbf{F} = (e^x - y^3) \mathbf{i} + (\cos y + x^3) \mathbf{j}$ on a particle that travels once around the unit circle centered at origin having radius 1.
3. When do you say that a vector field is conservative? What are the implications if a vector field is conservative?

Course Outcome 5 (CO 5): Evaluate surface and volume integrals and learn their inter-relations and applications

1. Write any one application each of line integral, double integral and surface integral.
2. Use the divergence theorem to find the outward flux of the vector field $\mathbf{F}(x, y, z) = z\mathbf{k}$ across $x^2 + y^2 + z^2 = a^2$.
3. State Greens theorem. Use Green's theorem to express the area of a plane region bounded by a curve as a line integral.

MODEL QUESTION PAPER

QP CODE:

Pages: 3

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

FIRST SEMESTER B. TECH DEGREE EXAMINATION, YEAR

Course Code: B24MA1T01

LINEAR ALGEBRA AND MULTIVARIABLE CALCULUS

Common to all branches

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Determine the rank of the matrix
$$\begin{bmatrix} 1 & 2 & -1 \\ -2 & -4 & 2 \\ 3 & 6 & -3 \end{bmatrix}$$

2. Write down the eigen values of $A = \begin{bmatrix} 2 & 0 \\ 0 & -1 \end{bmatrix}$

3. Find $f_x(1,3)$ and $f_y(1,3)$ for the function $f(x,y) = 2x^3y^2 + 2y + 4x$.

4. Show that the function $u(x,t) = \sin(x-ct)$ is a solution of the equation $\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$.

5. Use double integral to find the area of the region enclosed between the parabola $y = \frac{x^2}{2}$ and the line $y = 2x$.

6. Use polar coordinates to evaluate the area of the region bounded by $x^2 + y^2 = 4$, the line $y = x$ and the y axis in the first quadrant.

7. Is the vector $\mathbf{r}$ where $\mathbf{r} = x\mathbf{i} + y\mathbf{j} + z\mathbf{k}$ conservative. Justify your answer.

8. Find a unit vector normal to the surface $x^3 + y^3 + 3xyz = 3$ at the point $(1,2,-1)$.
9. What is the outward flux of $\mathbf{F}(x, y, z) = x\mathbf{i} + y\mathbf{j} + z\mathbf{k}$ across any unit cube.
10. What is the relationship between Green's theorem and Stokes theorem?

PART B

Answer any one question from each module. Each question carries 14 marks

11. (a) Solve the following system of equations

$$y + z - 2w = 0$$

$$2x - 3y - 3z + 6w = 2$$

$$4x + y + z - 2w = 4$$

7

- (b) Find the eigen values and eigen vectors of the matrix

$$\begin{bmatrix} 2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & 2 & 0 \end{bmatrix}$$

7

OR

12. (a) Diagonalize the matrix

$$\begin{bmatrix} -1 & 2 & -2 \\ 2 & 4 & 1 \\ 2 & 4 & 1 \end{bmatrix}$$

7

- (b) What kind of conic section the quadratic form $3x^2 + 22xy + 3y^2 = 0$ represents? Transform it to principal axes.

7

13. (a) Find the local linear approximation to $f(x, y) = \sqrt{x^2 + y^2}$ at the point $(3,4)$. Use it to approximate $f(3.04, 3.98)$.

7

- (b) Let $w = \sqrt{x^2 + y^2 + z^2}$, $x = \cos\theta$, $y = \sin\theta$, $z = \tan\theta$. Use chain rule to find $\frac{dw}{d\theta}$ when $\theta = \frac{\pi}{4}$

7

OR

14. (a) Let $z = f(x, y)$ where $x = r\cos\theta$, $y = r\sin\theta$, prove that

$$\left(\frac{\partial z}{\partial x}\right)^2 + \left(\frac{\partial z}{\partial y}\right)^2 = \left(\frac{\partial z}{\partial r}\right)^2 + \frac{1}{r^2} \left(\frac{\partial z}{\partial \theta}\right)^2$$

7

- (b) Locate all relative maxima, relative minima and saddle points of $f(x, y) = xy + \frac{a^3}{x} + \frac{b^3}{y}$, $(a \neq 0, b \neq 0)$.

7

15. (a) Evaluate $\iint_D (2x^2y + 9y^3) dx dy$ where D is the region bounded by $y = \frac{2}{3}x$ and $y = 2\sqrt{x}$.

7

- (b) Evaluate $\int_0^4 \int_{\sqrt{y}}^2 e^{x^3} dx dy$ by changing the order of integration. 7

OR

16. (a) Find the volume of the solid bounded by the cylinder $x^2 + y^2 = 4$ and the planes $y + z = 4$ and $z = 0$. 7
(b) Evaluate $\iiint \sqrt{1 - x^2 - y^2 - z^2} dx dy dz$, taken throughout the volume of the sphere $x^2 + y^2 + z^2 = 1$ 7
17. (a) Prove that the force field $\mathbf{F} = e^y \mathbf{i} + xe^y \mathbf{j}$ is conservative in the entire xy-plane. 7
(b) Find the work done in moving a particle along a straight line from (0,0,0) to (2,1,3) by the force $\mathbf{F} = 3x^2 \mathbf{i} + (2xz - y) \mathbf{j} + z \mathbf{k}$ 7

OR

18. (a) Find the divergence of the vector field $\mathbf{F} = x^3 y^2 z \mathbf{i} + xyz^3 \mathbf{j} + xyz^2 \mathbf{k}$ at (1,1,1). 7
(b) Find the work done by the force field $\mathbf{F}(x, y, z) = xy \mathbf{i} + yz \mathbf{j} + xz \mathbf{k}$ along C where C is the curve $\mathbf{r}(t) = t \mathbf{i} + t^2 \mathbf{j} + t^3 \mathbf{k}$. 7
19. (a) Use divergence theorem to find the outward flux of the vector field $\mathbf{F} = 2x \mathbf{i} + 3y \mathbf{j} + z^3 \mathbf{k}$ across the unit cube bounded by $x = 0, y = 0, z = 0, x = 1, y = 1, z = 1$. 7
(b) Find the circulation of $\mathbf{F} = (x - z) \mathbf{i} + (y - x) \mathbf{j} + (z - xy) \mathbf{k}$ using Stokes theorem around the triangle with vertices A(1,0,0), B(0,2,0) and C(0,0,1). 7

OR

20. (a) Use divergence theorem to find the volume of the cylindrical solid bounded by $x^2 + 4x + y^2 = 7, z = -1, z = 4$ given the vector field $\mathbf{F} = x \mathbf{i} + y \mathbf{j} + z \mathbf{k}$ across surface of the cylinder. 7
(b) Use Stokes theorem to evaluate $\int_C \mathbf{F} \cdot d\mathbf{r}$ where $\mathbf{F} = x^2 \mathbf{i} + 3x \mathbf{j} - y^3 \mathbf{k}$ where C is the circle $x^2 + y^2 = 1$ in the xy-plane with counterclockwise orientation looking down the positive z-axis. 7

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24ES1T01B	PROBLEM SOLVING AND PROGRAMMING TECHNIQUES (B)	2	1	0	4	3	2024

Preamble

This course shall prepare the student to write efficient and robust Python programs for solving computational problems. Through a combination of theoretical concepts and practical applications, students will explore the fundamentals of Python programming, including data types, control structures, and functions. The course will also cover essential libraries and frameworks used in engineering applications, emphasizing best practices in coding. By the end of the course, students will be equipped with the skills needed to implement algorithms, and develop programs meet engineering standards.

Prerequisites: Nil.

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Understand fundamental computing concepts, including algorithms, pseudocode, flowcharts, and algorithmic problem-solving techniques. (Cognitive Knowledge Level: Apply)
CO 2	Develop proficiency in using Python's data structures, control flow statements, and loops to effectively manage and manipulate data. (Cognitive Knowledge Level: Apply)
CO 3	Acquire skills in defining and calling functions, using modules and packages, and working with Python's standard libraries to create modular and efficient code (Cognitive Knowledge Level: Apply)
CO 4	Learn file handling techniques in Python (Cognitive Knowledge Level: Apply)
CO 5	Utilize Python for mathematical computations and understand its role in data analysis. (Cognitive Knowledge Level: Analyse)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	3	3	0	0	0	0	0	0	0	1
CO 2	3	3	3	0	0	0	0	0	0	0	1
CO 3	3	3	3	0	0	0	0	0	0	0	1
CO 4	3	3	3	0	0	0	0	0	0	0	1
CO 5	3	3	3	3	2	0	0	0	0	0	1

Assessment Pattern

PROBLEM SOLVING AND PROGRAMMING TECHNIQUES (B)			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	20	20	20
Understand	60	60	60
Apply	20	20	20
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course Project	: 10 marks
Self Study	: 5 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contain 10 questions carrying 3 marks each. Part B contains 2 questions from each module out of which 1 to be answered. Each question carries 14 marks and can have maximum 2 sub-divisions.

SYLLABUS

MODULE 1 (6 hours)

Introduction to programming languages : low level & high level, compiler, assembler, and interpreter. Fundamentals of computing – Algorithms, pseudocode, flowchart, algorithmic problem solving. Introduction to Python, brief history of Python, installing Python, IDE, Python coding introduction, keywords and Identifiers, Python statements, comments in Python, getting user input, variables, data types, numbers, strings, Python operators, precedence of operators.

MODULE 2 (8 hours)

Data Structures - Lists, Tuples, Dictionary. Control flow and Operators Control flow and syntax, if statement, if-else statement, nested conditionals, logical operators, Loop in Python - while Loop, break and continue, for loop, pass statement

MODULE 3 (7 hours)

Function in Python - introduction of function, defining and calling a function, function arguments, built in function, scope of variables. Modules and Packages – creating custom modules, importing modules, standard modules- sys, os, datetime, math, random, introducing Python packages – numpy, pandas, matplotlib.

MODULE 4 (5 hours)

File handling - files, and directories, modes for opening a file, reading data from a file, writing data to a file, saving a file, deleting an existing file, try and except, navigating directories using os and pathlib, creating and removing directories

MODULE 5 (10 hours)

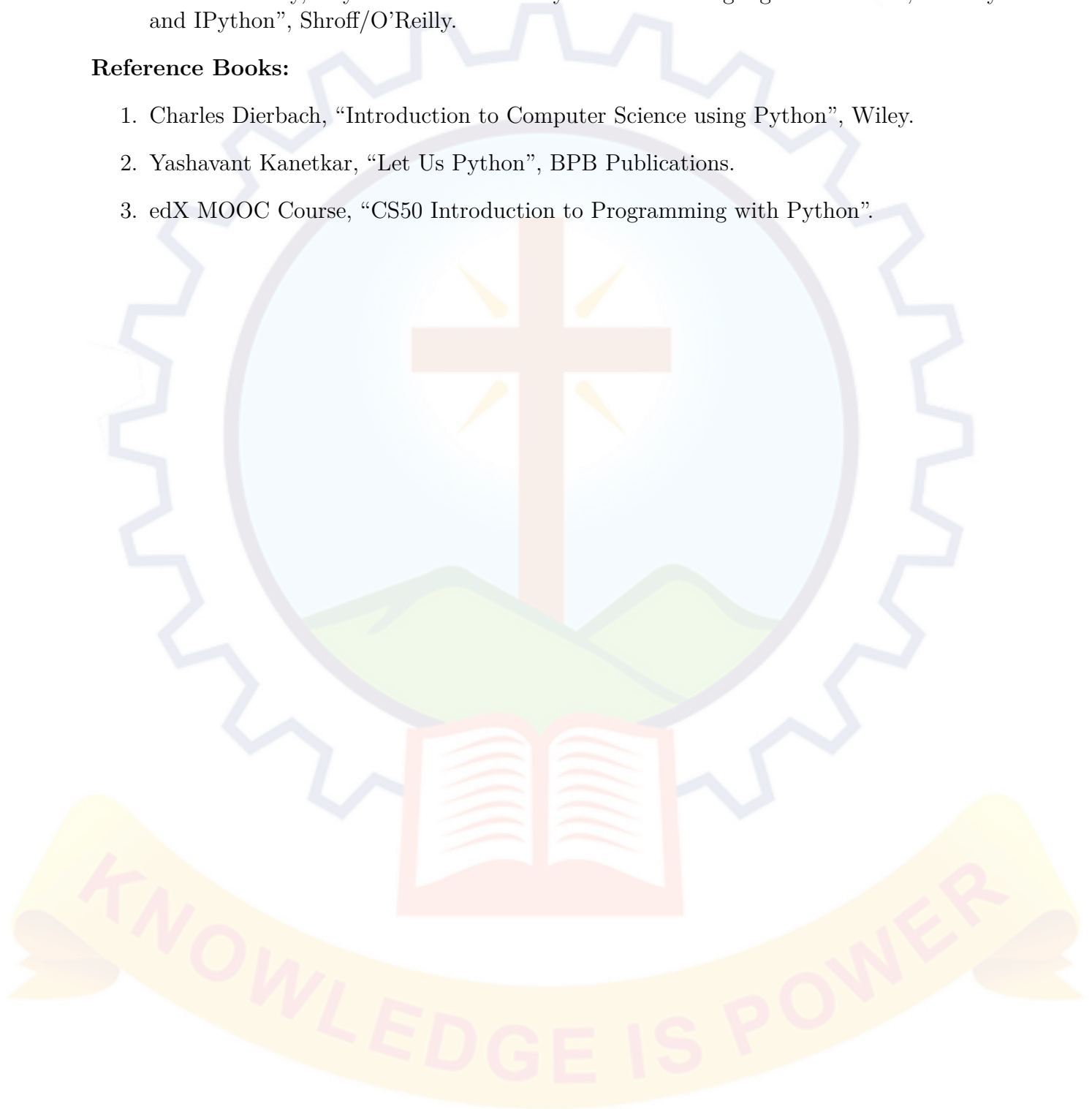
Data analysis - overview of numpy and pandas, numpy – array creation, special arrays, indexing, slicing, reshaping, flattening, concatenation, splitting, using numpy for mathematical computations - element wise addition, subtraction, multiplication, division, statistical operations - mean, median, variance, standard deviation, matrix multiplication, basic functions - sin, cos, tan, exp, power, log, sum, product, min, max, broadcasting, logical operators, creating dataframes – from csv/txt file, data frame manipulation - indexing, selecting, filtering, saving a dataframe as csv/txt file, line plot and scatter plot using matplotlib, customizing plots.

Text Books:

1. Allen B Downey, “Think Python”, O’Reilly.
2. Wes McKinney, “Python for Data Analysis: Data Wrangling with Pandas, NumPy and IPython”, Shroff/O’Reilly.

Reference Books:

1. Charles Dierbach, “Introduction to Computer Science using Python”, Wiley.
2. Yashavant Kanetkar, “Let Us Python”, BPB Publications.
3. edX MOOC Course, “CS50 Introduction to Programming with Python”.



COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
	Module 1	6
1.1	Introduction to programming languages – low level & high level, compiler, assembler, and interpreter.	1
1.2	Fundamentals of computing – Algorithms, pseudo code, flow chart, algorithmic problem solving.	2
1.3	Introduction to Python, brief history of Python, installing Python, IDE.	1
1.4	Python coding introduction, keywords and Identifiers, Python statements, comments in Python.	1
1.5	Getting user input, variables, data types, numbers, strings, Python operators, precedence of operators.	1
	Module 2	8
2.1	Data Structures - Lists, Tuples, Dictionary.	2
2.2	Control flow and Operators Control flow and syntax, if statement, if-else statement, nested conditionals, logical operators.	2
2.3	Loop in Python - while Loop, break and continue.	2
2.4	For loop, pass statement.	2
	Module 3	7
3.1	Function in Python - introduction of function, defining and calling a function, function arguments	2
3.2	Built in function, scope of variables.	1
3.3	Modules and Packages - creating custom modules, Importing Modules, standard modules- sys, os, datetime, math, random.	2
3.4	Introducing Python packages - numpy, pandas, matplotlib.	2

	Module 4	5
4.1	File handling - files, and directories	1
4.2	Modes for opening a file, reading data from a file, writing data to a file, saving a file, deleting an existing file, try and except.	2
4.3	Navigating directories using os and pathlib, creating and removing directories.	2
	Module 5:	10
5.1	Data analysis - overview of numpy and pandas .	1
5.2	Numpy – array creation, special arrays, indexing, slicing, re-shaping, flattening, concatenation, splitting.	2
5.3	Numpy for mathematical computations - element wise addition, subtraction, multiplication, division.	2
5.4	Statistical operations - mean, median, variance, standard deviation, matrix multiplication.	1
5.5	Basic functions - sin, cos, tan, exp, power, log, sum, product, min, max, broadcasting.	1
5.6	Logical operators.	1
5.7	Creating dataframes – from csv/txt file, data frame manipulation - indexing, selecting, filtering, saving a dataframe as csv/txt file, line plot and scatter plot using matplotlib, customizing plots.	2
Total		45 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Discuss about pseudocode, algorithm, and a flow chart. What is the importance of writing an algorithm before writing the actual program?
2. Draw a flow chart to check if a given number is an Armstrong number.

Course Outcome 2 (CO 2):

1. Write a Python program that determines whether a given year is a leap year. Explain the logic used to make this determination
2. Write a Python program to calculate the factorial of a number using either a for loop or a while loop. Discuss why you chose the specific type of loop for this task.

Course Outcome 3 (CO 3):

1. How do Python modules and libraries simplify programming tasks? Provide examples of using a standard library to perform file handling operations.
2. Write a Python program to calculate the tax for an Indian citizen using both the old and new tax regimes. Utilize appropriate Python modules, libraries, and functions to structure your program.

Course Outcome 4 (CO 4):

1. How would you write a Python script to read data from a text file, process the data to remove any blank lines, and save the cleaned data to a new file?
2. How to check if a file exists in a particular directory? Give an error message if it doesn't exist.

Course Outcome 5 (CO 5):

1. How would you use NumPy to create an array of 10 random numbers and then convert it into a Pandas DataFrame?
2. Given a CSV file containing numerical data, explain how you would use NumPy and Pandas to calculate the mean and standard deviation of a specific column.

MODEL QUESTION PAPER

QP CODE:

Pages: 2

Reg.No.:

Name:

**MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM**

FIRST SEMESTER B. TECH DEGREE EXAMINATION, YEAR

Course Code: B24ES1T01B

PROBLEM SOLVING AND PROGRAMMING TECHNIQUES (B)

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. What is the main difference between a compiler and an interpreter?
2. What is the difference between a high-level programming language and a low-level programming language?
3. What is the main difference between a list and a tuple in Python?
4. How does a for loop differ from a while loop in Python?
5. What is the scope of a variable in Python?
6. How can you import a specific function from a module in Python?
7. How can you list all files in a directory using Python?
8. Discuss the various modes for opening a file?
9. How do you create a NumPy array with random integers between 1 and 10?
10. What is the primary purpose of the pandas library in Python?

PART B

Answer any one question from each module. Each question carries 14 marks

11. Compare and contrast high level and low level programming languages. Discuss the advantages and disadvantages of each with examples and explain how a compiler, interpreter and assembler play a role in executing programs written in these languages.

OR

12. Describe the steps involved in solving a problem using an algorithmic approach. Write an algorithm to find the maximum number in a list, present it using both pseudocode and a flowchart. Write a code for the same in Python.
13. Explain the key differences between lists, tuples, and dictionaries in Python. Provide examples of scenarios where each data structure would be most appropriately used, and discuss how their unique properties affect performance and usability in a program.

OR

14. Discuss the control flow mechanisms in Python, including conditional statements and loops. Explain the role of logical operators within control flow, and demonstrate using a Python program how they can be used to find the factorial of a number.
15. Explain the concept of functions in Python, including the use of arguments and return values. Illustrate with examples how defining and calling functions can improve code organization and reusability, and discuss the importance of variable scope in function design.

OR

16. Describe how modules and packages are used in Python to manage code complexity. Explain the process of creating a custom module and importing standard libraries. Write a Python program to create an array of random numbers in the range 1 to 100 and find its mean, median and standard deviation by defining a function. You can use the standard libraries of Python.
17. Explain the process of reading from and writing to files in Python. Discuss the different modes of file access. Provide an example of a program that reads the names of 30 students and total marks scored from a user and save the data to a file after the entry is complete.

OR

18. Write a Python program to read the contents of file, replace a particular name in the file with another one and save the updated contents as a new file.
19. Describe the role of NumPy in data analysis. Explain how NumPy arrays differ from Python lists and demonstrate how NumPy can be used to perform efficient mathematical operations on large datasets.

OR

20. Explain how the pandas library is used for data manipulation and analysis in Python. Provide an example of loading a dataset into a pandas DataFrame, performing filtering, and discuss how pandas simplifies data analysis tasks.

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE1T01	INTRODUCTION TO CIVIL ENGINEERING	2	1	0	4	3	2024

Preamble

This course delves into the fundamental principles of civil engineering, exploring the fundamental science and engineering involved. Through comprehensive study, students will gain a deep understanding of pivotal infrastructure systems in transportation, water resources, environmental science and structural engineering. The subject aims to impart a deep understanding of the essential principles of Civil Engineering to students, illuminating the pivotal role of civil engineers in addressing societal needs and fostering sustainable development.

Prerequisites: Nil.

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Describe the multifaceted role of civil engineers.(Cognitive Knowledge Level: Understand)
CO 2	Identify various building systems, methodologies, and materials, and apply them effectively in practical real-world scenarios.(Cognitive Knowledge Level: Apply)
CO 3	Understand different types of building structures, including framed and load-bearing wall structures. (Cognitive Knowledge Level: Understand)
CO 4	Gain insight into building area definitions, classifications, site planning regulations, smart environment concepts, and infrastructure services. (Cognitive Knowledge Level: Apply)
CO 5	Apply various surveying methods (chain, compass, plane table, theodolite, EDM, Total Station, and GPS) and techniques for measuring linear distances and angles. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	1	0	0	1	2	1	0	1	0	1
CO 2	3	2	1	0	1	1	0	0	1	1	1
CO 3	3	2	1	1	1	1	0	0	1	1	1
CO 4	3	1	1	1	2	1	0	1	2	2	1
CO 5	3	1	0	0	1	2	1	2	3	1	2

Assessment Pattern

INTRODUCTION TO CIVIL ENGINEERING			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	30	30	30
Understand	40	40	40
Apply	30	30	30
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course Project	: 10 marks
Self Study	: 5 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contain 10 questions carrying 3 marks each. Part B contains 2 questions from each module out of which 1 to be answered. Each question carries 14 marks and can have maximum 2 sub-divisions.

SYLLABUS

MODULE 1 (7 hours)

Civil Engineering: Past, Present and Future, Sustainable Development Goals: Environmental Protection, Social Responsibility, Economic Development, Smart, Clean and Safe infrastructure development.

Role of Civil Engineers – Planning, Designing, Execution, and Maintenance.

Introduction to Major Disciplines of Civil Engineering: Construction Management, Environmental Engineering, Geotechnical Engineering, Hydraulics & Water Resources Engineering, Structural Engineering, Surveying, Transportation Engineering.

MODULE 2 (7 hours)

Conventional Construction Materials: Types, Properties and Uses. Concrete: Materials, Manufacturing, Properties and Applications. Steel: Types, Properties and Applications. Modern Construction Materials: Glass, Ceramics, Polymers, Composite Materials etc.

MODULE 3 (6 hours)

Types of Structures: Framed Structures and Load Bearing Wall Structures. Components of a Building: Sub-structure: Foundation - Types of foundations - Shallow and Deep foundation. Super Structure: Masonry – Brick and Stone masonry, Columns, Beams, Partitions and Roofing – Materials and Types.

MODULE 4 (8 hours)

Building Area: Definition of terms, Classification of Buildings based on Occupancy (NBC, KMBR). Site Planning and Building rules: Selection of Site - Site Plan, Preparation for Buildings - Relevance of NBC, KMBR & CRZ Norms - Exterior and Interior Open Spaces, Floor Area Ratio as per KMBR, General provisions regarding site and building requirements.

Smart built-environment: Intelligent Buildings and Green Buildings, Energy Efficiency, Recycling, Temperature and Sound Control, Security Systems. Basic Infrastructure Services: MEP, HVAC, Elevators, Escalators and Ramps (Civil Engineering aspects only), Fire Safety in buildings.

MODULE 5 (8 hours)

Basic Principles of Surveying: Definition, objectives, and fundamental principles (accuracy, precision, working from whole to part).

Types of Surveying: Chain surveying, Compass surveying, Plane table surveying, Levelling, Theodolite surveying.

Modern techniques- Total Station and GPS surveying. Linear Distance Measurements: Direct and indirect methods - Chains, tapes, EDM devices. Angle and Direction Measurements: Horizontal and vertical angle measurement techniques.

Text Books:

1. "Basic Civil Engineering" by Dr. B.C. Punmia, Ashok Kumar Jain, Arun Kumar Jain
2. "Building Materials" by S.K. Duggal
3. "Surveying (Vol. 1, 2 & 3)" by Dr. K.R. Arora
4. "Civil Engineering Materials" by S.V. Deodhar
5. "Surveying Vol .I & II" by Dr. B. C. Punmia Publication Laxmi Publication Delhi

Reference Books:

1. Chudley, R., Construction Technology, Vol. I to IV, Longman Group, England (2011)
2. Chudley, R. and Greeno, R., Building Construction Handbook, Addison Wesley, Longman Group, England (1998)
3. Mamlouk, M. S., and Zaniewski, J. P., Materials for Civil and Construction Engineering, Pearson Publishers (2011)
4. McKay, W. B. and McKay, J. K., Building Construction, Vol. 1 to 4, Pearson India Education Services.(2013)
5. Rangwala,S.C and Dalal,K.B., Building Construction, Charotar Publishing House (2017)
6. Kerala Municipal Building Rules (latest revision)

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	7 hours
1.1	Civil Engineering: Past, Present and Future	1 hour
1.2	Sustainable Development Goals: Environmental Protection, Social Responsibility, Economic Development, Smart, Clean and Safe infrastructure development.	2 hour
1.3	Role of Civil Engineers – Planning, Designing, Execution, and Maintenance.	1 hour
1.4	Introduction to Major Disciplines of Civil Engineering: Construction Management, Environmental Engineering, Geotechnical Engineering, Hydraulics & Water Resources Engineering, Structural Engineering, Surveying, Transportation Engineering.	3 hour
2	Module 2	7 hours
2.1	Conventional Construction Materials: Types, Properties and Uses.	2 hour
2.2	Concrete: Materials, Manufacturing, Properties and Applications.	3 hour
2.3	Steel: Types, Properties and Applications.	1 hour
2.4	Modern Construction Materials: Glass, Ceramics, Polymers, Composite Materials etc.	1 hour
3	Module 3	6 hours
3.1	Types of Structures: Framed Structures and Load Bearing Wall Structures.	1 hour
3.2	Components of a Building: Sub-structure: Foundation - Types of foundations - Shallow and Deep foundation.	2 hour

3.3	Super Structure: Masonry – Brick and Stone masonry, Columns, Beams, Partitions and Roofing – Materials and Types	3 hour
4	Module 4	8 hours
4.1	Building Area: Definition of terms, Classification of Buildings based on Occupancy (NBC, KMBR)	2 hour
4.2	Site Planning and Building rules: Selection of Site - Site Plan, Preparation for Buildings - Relevance of NBC, KMBR & CRZ Norms	2 hour
4.3	Exterior and Interior Open Spaces, Floor Area Ratio as per KMBR, General provisions regarding site and building requirements.	1 hour
4.4	Smart built-environment: Intelligent Buildings and Green Buildings, Energy Efficiency, Recycling, Temperature and Sound Control, Security Systems.	1 hour
4.5	Basic Infrastructure Services: MEP, HVAC, Elevators, Escalators and Ramps (Civil Engineering aspects only), Fire Safety in buildings.	2 hour
5	Module 5	8 hours
5.1	Basic Principles of Surveying: Definition, objectives, and fundamental principles (accuracy, precision, working from whole to part)	1 hour
5.2	Types of Surveying: Chain surveying, Compass surveying, Plane table surveying, Levelling, Theodolite surveying.	3 hour
5.3	Modern techniques- Total Station and GPS surveying	1 hour
5.4	Linear Distance Measurements: Direct and indirect methods - Chains, tapes, EDM devices.	1 hour
5.5	Angle and Direction Measurements: Horizontal and vertical angle measurement techniques.	2 hour
Total		45 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Discuss the evolution of civil engineering from past to present, emphasizing how sustainable development goals have influenced modern civil engineering practices.
2. How do these disciplines contribute to the overall goals of sustainable development?
3. How the roles of Civil Engineers contribute to smart, clean, and safe infrastructure development.

Course Outcome 2 (CO 2):

1. Discuss the types, properties, and uses of conventional construction materials such as wood, brick, and concrete.
2. Explain the process of concrete manufacturing and discuss the properties that make concrete a widely used material in construction.
3. Discuss the properties, advantages, and applications of modern construction materials in the construction industry.

Course Outcome 3 (CO 3):

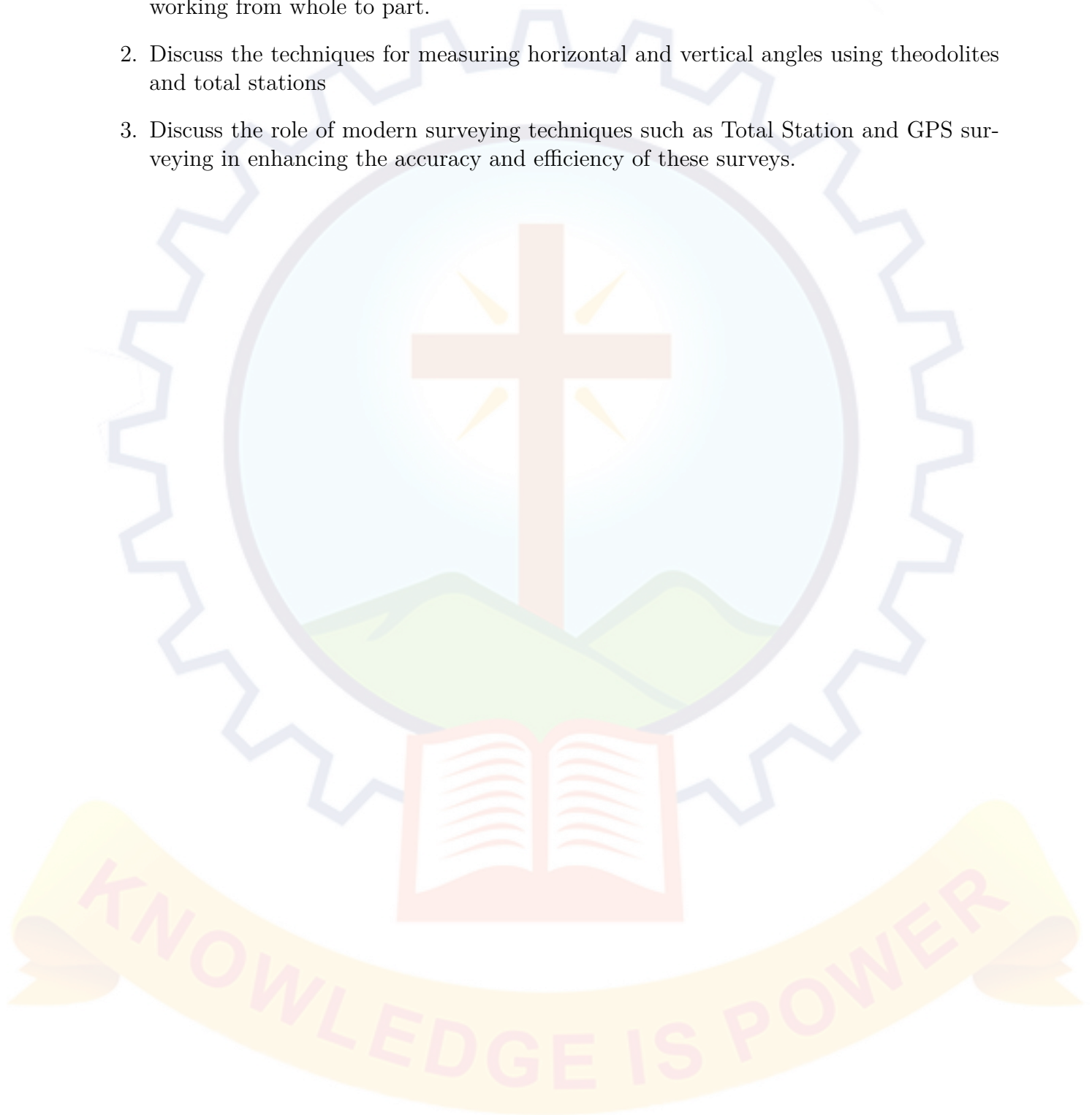
1. Compare and contrast framed structures and load-bearing wall structures.
2. Describe the conditions under which shallow foundations are preferred over deep foundations and vice versa.
3. Describe the key components of a building's superstructure, including masonry (brick and stone), columns, beams, partitions, and roofing.

Course Outcome 4 (CO 4):

1. Define the key terms related to building area and explain the classification of buildings based on occupancy as per the National Building Code (NBC) and Kerala Municipal Building Rules (KMBR).
2. Explain the relevance of NBC, KMBR, and CRZ norms in site planning.
3. Explain the civil engineering aspects of basic infrastructure services such as MEP, HVAC, elevators, escalators, ramps, and fire safety in buildings.

Course Outcome 5 (CO 5):

1. Explain the fundamental principles of surveying, including accuracy, precision, and working from whole to part.
2. Discuss the techniques for measuring horizontal and vertical angles using theodolites and total stations
3. Discuss the role of modern surveying techniques such as Total Station and GPS surveying in enhancing the accuracy and efficiency of these surveys.



MODEL QUESTION PAPER

QP CODE:

Pages: 2

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

FIRST SEMESTER B. TECH DEGREE EXAMINATION, YEAR

Course Code: B24CE1T01

INTRODUCTION TO CIVIL ENGINEERING

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Highlight specific technological advancements or innovative solutions that have been employed to achieve sustainability goals in urban areas?
2. Provide examples of significant projects or initiatives that showcase the integration of sustainability into civil engineering practices.
3. Elaborate different types of steel used for reinforcement bars and structural sections contribute to the strength, durability, and overall performance of steel structures in construction?
4. How do the properties of bricks influence their suitability for specific applications in building construction?
5. How does the design of a roof contribute to the overall functionality of a structure?
6. Describe the key differences between shallow foundations and deep foundations, and provide one example of each type commonly used in construction.
7. Discuss the economic and environmental benefits associated with green buildings.
8. Compare the infrastructure challenges commonly faced in the development and maintenance of urban roads with those in rural areas.
9. What are the fundamental principles of surveying, and how do different surveying instruments and methods contribute to accurate measurements?

10. Discuss the objectives of surveying, and why are accuracy and precision important in this field?

PART B

Answer any one question from each module. Each question carries 14 marks

11. In the context of infrastructural development, particularly in the concept of Smart Cities, how do civil engineers play a pivotal role in addressing challenges related to urban air pollution management? (14)

OR

12. How has the role of civil engineers evolved over time in contributing to sustainable development, considering aspects such as environmental protection, social responsibility, and economic development? (14)
13. (a) Elaborate on the role of modern construction materials. (7)
(b) Discuss the sustainability aspects of using polymers in construction. (7)

OR

14. Describe the materials used, the manufacturing process, and the key properties of concrete in construction. (14)
15. (a) How do header and stretcher bonds contribute to the stability of a brick wall? (7)
(b) What are the considerations when deciding to use a combination of bonds in a brick structure? (7)

OR

16. How do the various components work together to create a functional and safe structure? Explain with neat sketch. (14)
17. Discuss the importance of site planning in optimizing the use of available space, incorporating green spaces, and ensuring compliance with local building regulations. (14)

OR

18. (a) How does the plinth area differ from the built-up area of a structure? (4)
(b) Discuss specific strategies for optimizing plinth area and built-up area using KBR principles. (10)
19. In leveling, explain the key features and applications of different leveling instruments? (14)

OR

20. Scrutinise modern techniques such as Total Station and GPS surveying, and compare their advantages over traditional methods. (14)

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE1T02	ENGINEERING MECHANICS	2	2	0	5	4	2024

Preamble

The objective of this course is to introduce students to the fundamental concepts of mechanics and improve their problem-solving abilities. The course focuses on the effect of applied force systems and the geometric characteristics of rigid bodies, whether they are at rest or in motion. The course provides a framework through which students will acquire the ability to solve problems in real-world situations with precision and ingenuity.

Prerequisites: Nil.

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Understand the concepts and theorems connected with rigid body mechanics and solve the problems with the system of forces acting on a rigid body (Cognitive knowledge level: Apply)
CO 2	Analyse the beams and apply the Principle of virtual work to beam members. (Cognitive knowledge level: Analyse)
CO 3	Apply the conditions of equilibrium to various practical problems using the vector approach. Develop skills in solving practical problems involving friction (Cognitive knowledge level: Apply)
CO 4	Solve problems involving rigid bodies, applying the properties of distributed areas. (Cognitive Knowledge Level: Apply)
CO 5	Utilise concepts of linear and curvilinear motions to solve problems on rigid bodies. (Cognitive knowledge level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	3	1	1	2	1	0	0	0	0	1
CO 2	3	3	2	2	1	1	0	0	0	0	1
CO 3	3	3	2	1	1	1	0	0	0	0	1
CO 4	3	3	1	1	1	1	0	0	0	0	1
CO 5	3	3	2	2	1	1	0	0	0	0	1

Assessment Pattern

ENGINEERING MECHANICS			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	10	10	10
Understand	30	40	30
Apply	40	50	40
Analyse	20	-	20
Evaluate	-	-	-
Create	-	-	-

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course Project	: 10 marks
Self Study	: 5 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contain 10 questions carrying 3 marks each. Part B contains 2 questions from each module out of which 1 to be answered. Each question carries 14 marks and can have a maximum of 2 sub - divisions.

SYLLABUS

MODULE 1 (10 hours)

Introduction to Mechanics: Idealisation of Mechanics - Rigid Body - Point force - Particle - Vector and Scalar quantities. Principles of Statics - Newton's laws of motion, Parallelogram law of Forces, Principle of transmissibility, Newton's law of Gravitation.

Force Systems: Coplanar, Collinear, Concurrent and Parallel - Components and Projections of Force - Free body diagrams - Resolution of forces - Resultant and equilibrium equations.

Moment of a Force - Varignon's Theorem – Couple - Resolution of a force into force couple system - Conditions of static equilibrium of Rigid bodies - Numerical examples using scalar approach.

MODULE 2 (9 hours)

Support reactions of beams: Degree of freedom - 2-dimensional and 3-dimensional (concept only). Types of Supports- Types of load- Point load, uniformly distributed load and uniformly varying load - Support reactions of Simply supported Beams - Numerical examples.

Principle of Virtual work: Real work of a force, Principle of virtual displacements - Concepts, Application and Numerical examples in beams.

MODULE 3 (7 hours)

Forces in space: Introduction to Vector approach - Elements of Vector algebra -Position vector- Resultant and Equilibrium Equations for Concurrent Forces in Space - Moment of a Force about a Point - Numerical examples.

Friction: Types of Friction, Laws of Friction, Angle of Friction, Angle of Repose, Cone of Friction, Application in bodies on horizontal or inclined plane subjected to forces - Two bodies in contact, Application to solution of ladder problems.

MODULE 4 (10 hours)

Centroid and Moment of Inertia: Centroid of Areas: Simple and Composite areas - Numerical examples. Pappus Guldinus Theorems – Centre of Gravity, Centre of mass

(concept only).

Moment of Inertia of laminae - Parallel axis and Perpendicular axis theorems- Polar Moment of Inertia - Radius of Gyration, Moment of inertia of composite sections - Numerical examples. Mass moment of Inertia(concept only).

MODULE 5 (9 hours)

Dynamics of rigid bodies: Kinematics - Rectilinear motion of a particle under variable acceleration - Kinetics of particles - Newton's Laws of Motion of Translation - D'Alembert's Principle - Motion of connected bodies -Numerical examples.

Circular motion with Uniform and Variable Acceleration - Relations between Angular and Rectilinear motion.

Introduction to Mechanical Vibrations: Free vibration, Natural frequency, Time Period, Undamped free vibration of spring mass system – springs in parallel and series system.

Text Books:

1. S. Timoshenko, D.H. Young, J.V. Rao, Sukumar Pati, Engineering Mechanics, 5th Edn.
2. S.S Bhavikkatti, Engineering Mechanics, New Age International Publishers.
3. S Rajasekaran and G Sankarasubramanian, Engineering Mechanics - Statics and Dynamics, Vikas Publishing House Pvt Ltd.
4. R. C. Hibbeler and Ashok Gupta, Engineering Mechanics, Vol.I statics, Vol. II Dynamics, Pearson Education.
5. Shames, I. H., Engineering Mechanics - Statics and Dynamics, Prentice Hall of India.
6. R.K. Bansal - Engineering Mechanics - Laxmi Publications.

Reference Books:

1. Merriam J. L and Kraige L. G., Engineering Mechanics - Vols. 1 and 2, John Wiley.
2. Tayal A K, Engineering Mechanics – Statics and Dynamics, Umesh Publications.
3. F.P.Beer and E.R.Johnston (2011), Vector Mechanics for Engineers, Vol.I- Statics, Vol.II-Dynamics, 9 th Edn, Tata McGraw Hill.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	10 hours
1.1	Introduction to Mechanics - Idealisation in Mechanics: - Rigid body- Point force - Particle - Vector and Scalar quantities. Principles of statics: Newton's laws of motion, Parallelogram law of forces, Principle of transmissibility, Newton's law of gravity.	2 hour
1.2	Force Systems - Coplanar, Collinear, Concurrent and Parallel -Components and Projections of Force - Free body diagrams	2 hour
1.3	Resolution of forces - Resultant and equilibrium equations	2 hour
1.4	Moment of a Force - Varignon's Theorem – Couple - Resolution of a force into force couple system.	2 hour
1.5	Conditions of static equilibrium of Rigid bodies - Numerical examples using the scalar approach.	2 hour
2	Module 2	9 hours
2.1	Support reactions of beams: Degree of freedom – 2-dimensional and 3-dimensional (concept only), Types of Supports - Types of load: Point load, Uniformly distributed load and uniformly varying load.	2 hour
2.2	Support reactions of beams- Simply supported Beams - Numerical examples.	4 hour
2.3	Principle of Virtual work - Real work of a force, Principle of virtual displacements - Concepts, Application and Numerical examples in beams.	3 hour
3	Module 3	7 hours
3.1	Forces in space: Introduction to Vector approach - Elements of Vector algebra -Position vector - Resultant and Equilibrium Equations for Concurrent Forces in Space.	1 hour
3.2	Moment of a Force about a Point – Numerical examples .	2 hour

3.3	Friction - Types of Friction, Laws of Friction, Angle of Friction, Angle of Repose, Cone of Friction.	2 hour
3.4	Application in bodies on horizontal or inclined plane subjected to forces - Two bodies in contact - Application to solution of ladder problems.	2 hour
4	Module 4	10 hours
4.1	Centroid and Moment of Inertia: Centroid of Areas: Simple and Composite Areas - Numerical examples.	3 hour
4.2	Pappus Guldinus Theorems, Centre of Gravity, Centre of mass (concept only).	1 hour
4.3	Moment of Inertia of laminas - Parallel axis and Perpendicular axis theorems - Polar Moment of Inertia - Radius of Gyration.	2 hour
4.4	Moment of inertia of composite sections - Numerical examples.	4 hour
4.5	Mass moment of Inertia(concept only).	1 hour
5	Module 5	9 hours
5.1	Dynamics of rigid bodies: Kinematics – Rectilinear motion of a particle under variable acceleration.	2 hour
5.2	Kinetics of particles - Newton's laws of Motion of Translation - D'Alembert's Principle .	1 hour
5.3	Motion of connected bodies- Numerical Examples.	2 hour
5.4	Circular motion with Uniform and Variable Acceleration- Relations between Angular and Rectilinear motion.	2 hour
5.5	Mechanical vibrations: Free vibration, Natural frequency, Time Period, Undamped free vibration of spring mass system – springs in parallel and series system.	2 hour
Total		45 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1): Review the concepts and theorems connected with rigid body mechanics and analyse the components of a system of forces acting on the rigid body.

1. State and explain the principle of transmissibility of forces.
2. Concurrent forces of 1,3,5,7,9,11 N are applied to the centre of a regular hexagon acting towards its vertices, as shown in Figure 1. Determine the magnitude and direction of the resultant.

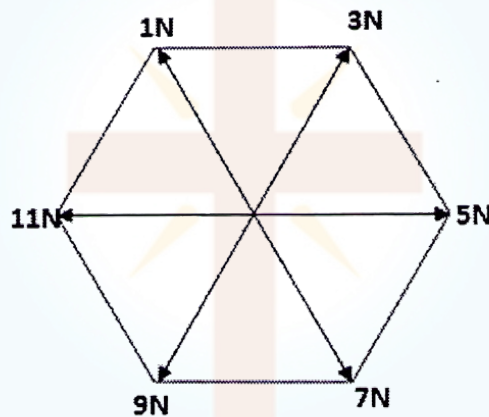


Figure 1

3. Find the resultant moment at a point O shown in Figure 2.

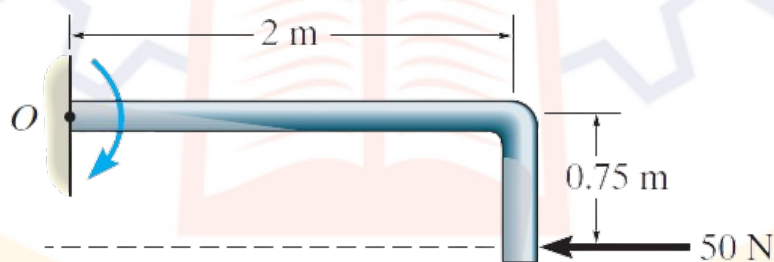


Figure 2

Course Outcome 2 (CO 2): Analyse the beam and apply the Principle of virtual work to beam members.

1. Determine the reactions at the supports A & B.

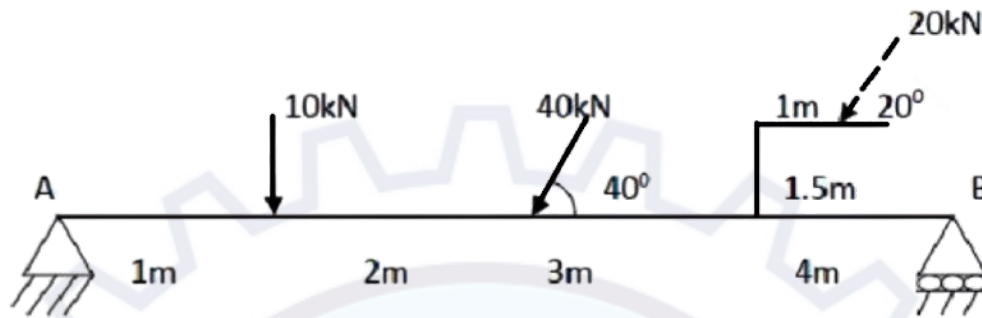


Figure 3

2. Using principle of virtual work determine the support reactions at A and B of the beam shown below.

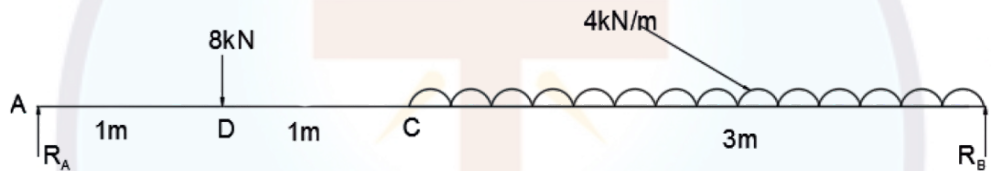


Figure 4

3. A beam AB of span 10m is carrying a point load of 20kN at its centre. Determine the reactions at the supports, using principle of virtual work. (See Figure 5).

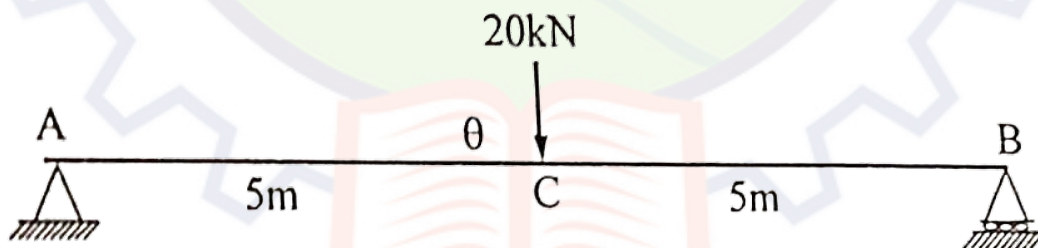


Figure 5

Course Outcome 3 (CO 3): Apply the conditions of equilibrium to various practical problems using the vector approach. Develop skills in solving practical problems involving friction

1. The three cables are used to support the 40kg flowerpot as shown in Figure 6. Determine the force developed in each cable for equilibrium.

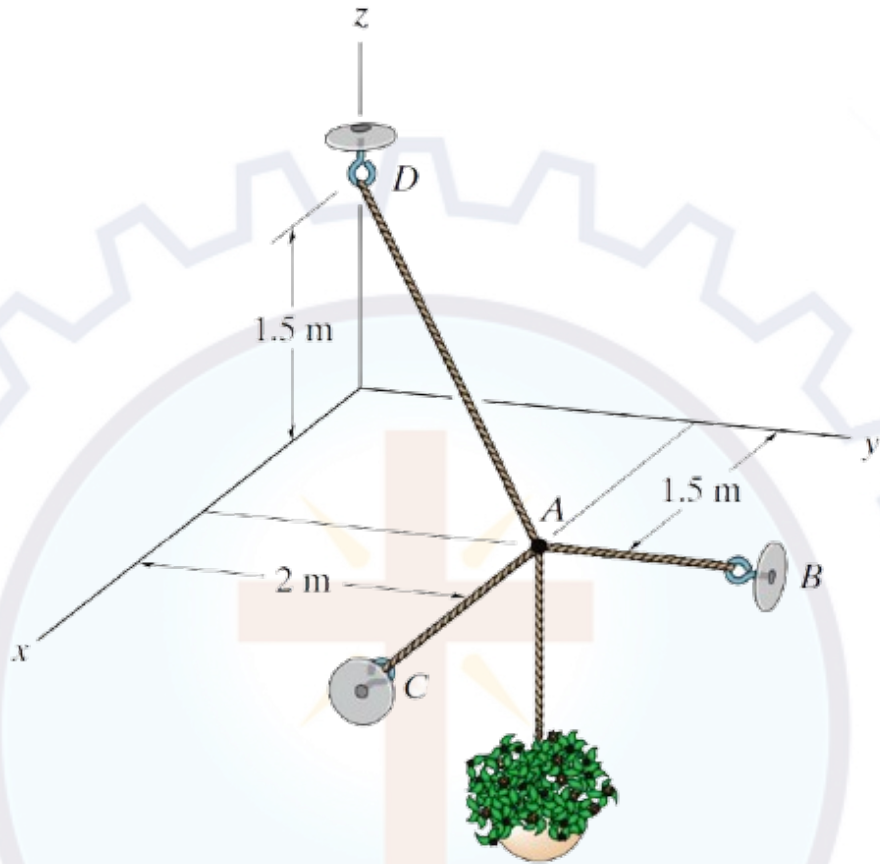


Figure 6

2. A uniform ladder of weight 100N and length 5 m is placed against a vertical wall in a position where its inclination to vertical is 30° . A man weighing 800 N climbs the ladder. At what position will the ladder slip? The coefficient of friction for all contact surfaces is 0.2.
3. What is the value of 'P' required to cause the motion impend, the system shown in Figure 7 below. Assume coefficient of all contact surfaces as 0.2.

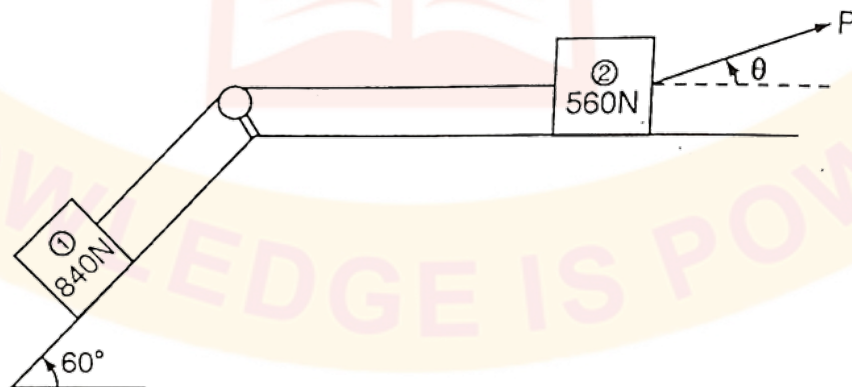


Figure 7

Course Outcome 4 (CO 4): Solve problems involving rigid bodies, applying the properties of distributed areas.

1. Locate the centroid y of the T-beam shown in Figure 8.

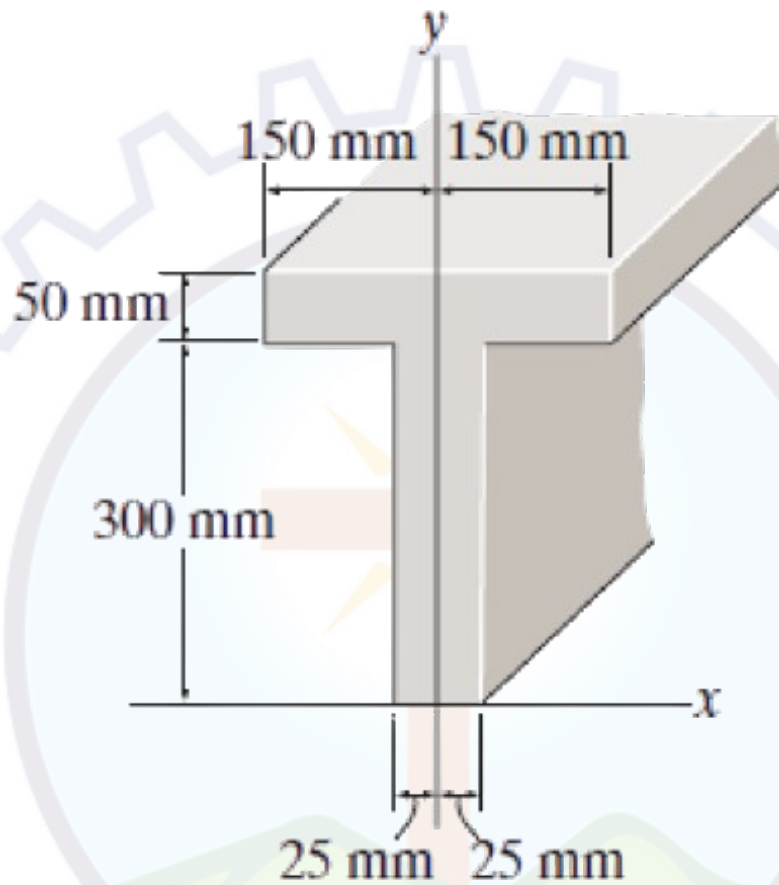


Figure 8

2. State and explain Pappus Guldinus Theorems
3. Determine the moment of inertia of the cross-sectional area of the T-beam with respect to the x axis passing through the centroid of the cross-section.

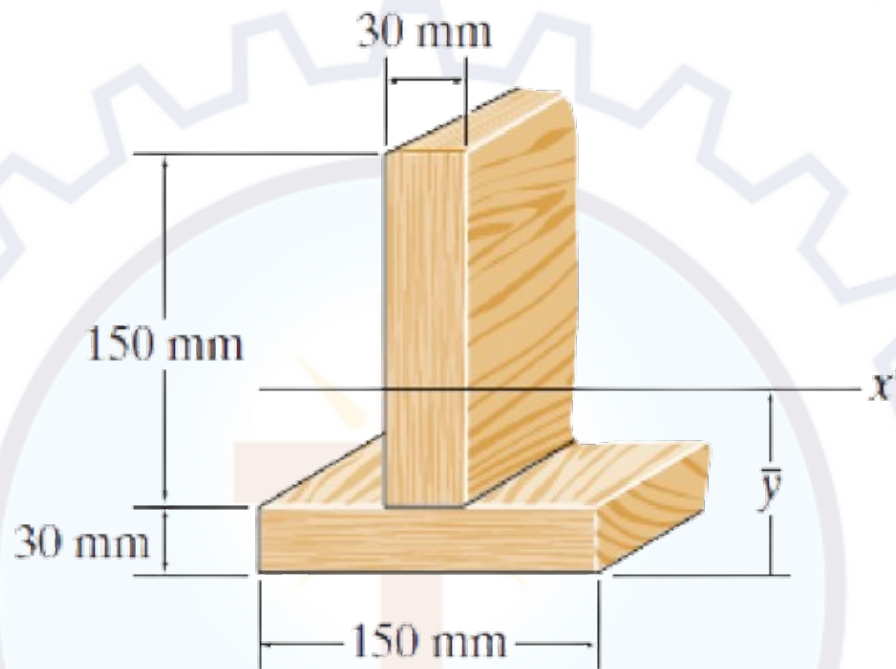


Figure 9

Course Outcome 5 (CO 5): Analyse linear and curvilinear motions of rigid bodies.

1. State and Explain D' Alemberts Principle
2. Two bodies of weights 60N and 40N are connected to the two ends of a light inextensible string, which passes over a smooth pulley. The weight 60N is placed on a smooth inclined plane of angle of inclination 10° , while the weight 40N is hanging free in air. Determine acceleration and tension in the string.
3. A wheel rotating about a fixed axis at 20 revolutions per minute is uniformly accelerated for 70 seconds during which it makes 50 revolutions. Find the (i) Angular velocity at the end of this interval and (ii) Time required for the velocity to reach 100 revolutions per minute.

MODEL QUESTION PAPER

QP CODE:

Pages: 7

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

FIRST SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CE1T02
ENGINEERING MECHANICS

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Explain the concept of free body diagrams.
2. Find the magnitude of the two forces, such that if they act at right angles, their resultant is $\sqrt{10}N$. But if they act at 60° , their resultant is $\sqrt{13}N$.
3. Explain Degrees of freedom.
4. State and explain Principle of virtual work.
5. A force of 30kN is acting in the direction of $9i+6j-2k$ through a point A (4,-1,7). Find the moment of the force about a point B (1,-2, 3).
6. Establish the relation between them angle of friction and angle of repose.
7. What is meant by radius of gyration of an area?
8. Discuss the generation of area by the theorems of Pappus Guldinus.
9. Explain the terms natural frequency and time period of a system.
10. State and explain the D'Alembert's principle. Write the equations of dynamic equilibrium for the motion of a lift moving downwards with an acceleration 'a' m/s^2 carrying a weight of 'W' N.

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. Two cylinders of diameters 100 mm and 50 mm weighing 200 N and 50 N, respectively are placed in a trough as shown in Figure 1. Neglecting friction, find the reactions at contact surfaces 1,2,3 & 4. (14 Marks)

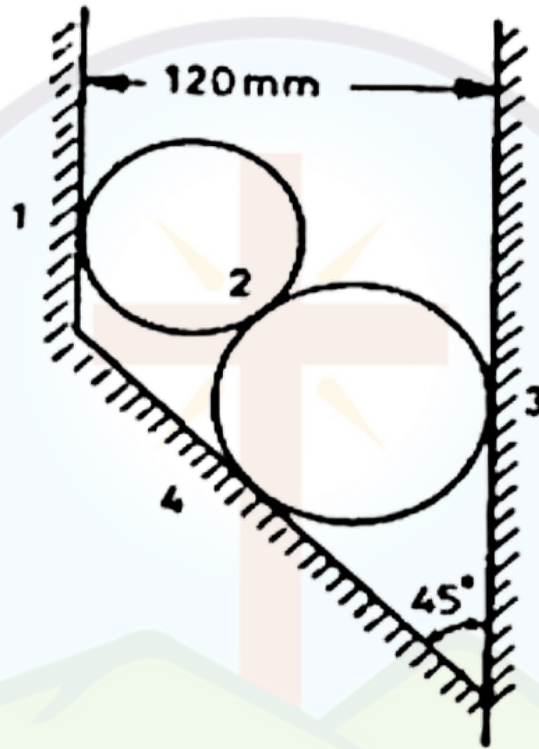


Figure 1

OR

12. A roller of radius 300mm and weight 1000N is to be pulled over a rectangular block of height 150mm as shown in Figure 2. Determine
- (a) The horizontal force required to be applied through the centre and
 - (b) The required horizontal force when it is applied through the top end of vertical diameter.
- (14 Marks)

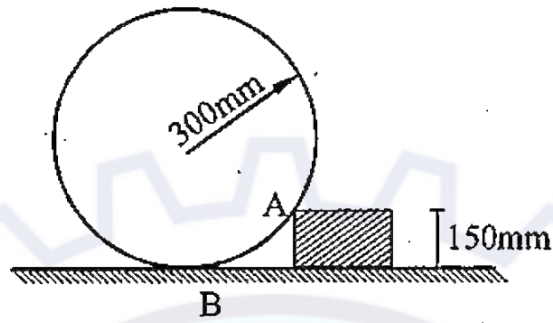


Figure 2

MODULE 2

13. (a) Find the support reactions for the beam loaded as shown in Figure 3. (9 Marks)

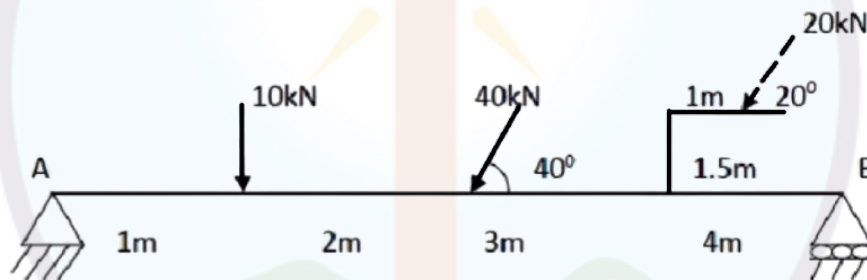


Figure 3

- (b) A beam AB of span 5 metres as shown in Figure 4 is carrying a point load of 2kN at a distance 2 metres from A. Determine the beam reactions, by using the principle of the virtual work. (5 Marks)

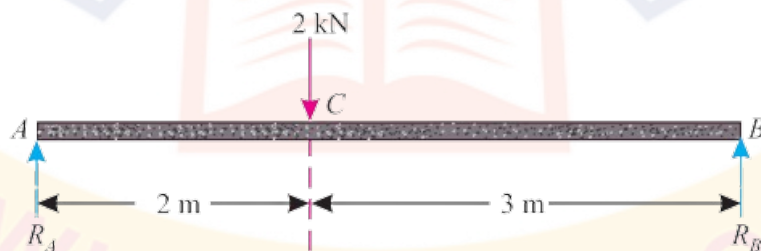


Figure 4

OR

14. (a) Find the support reactions for the beam loaded as shown in Figure 5. (7 Marks)

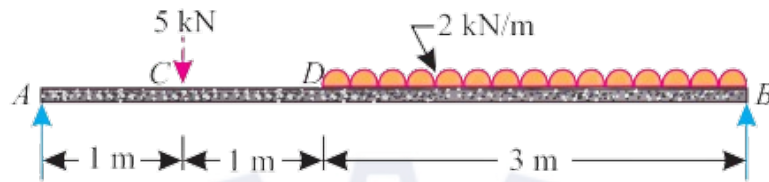


Figure 5

- (b) A beam AB 10m long is hinged at A and supported on rollers over a smooth surface inclined at 30° to the horizontal at B. The beam is loaded as shown in Figure 6. Determine the reactions at A and B. (7 Marks)

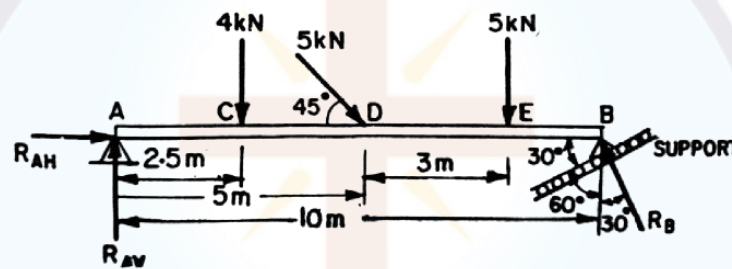


Figure 6

MODULE 3

15. A pole AO as shown in Figure 7 is supported by a ball and socket joint at its base and by cables AB and AC. Also it is subjected to forces 300N towards the negative X direction and 600N towards the positive Z direction and the forces act in a plane parallel to XZ plane. Compute the forces in the cables. (14 Marks)

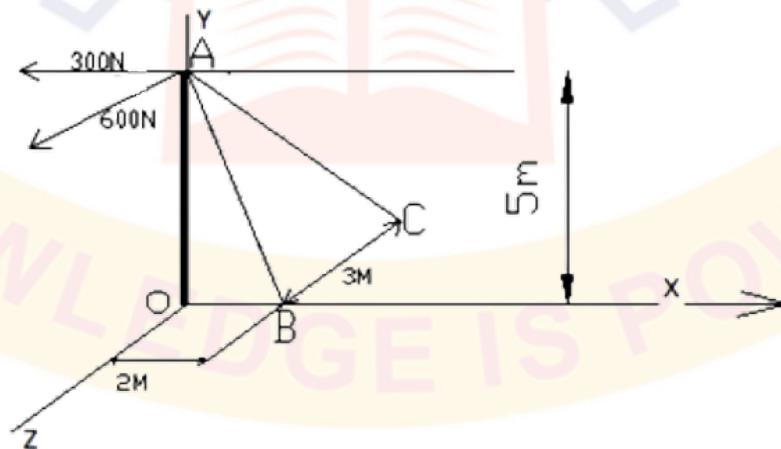


Figure 7

OR

16. (a) A rough inclined plane, rises 1 cm for every 5 cm along the inclined length. Calculate the effort required to drag a body weighing 100 N up the plane, when the effort is applied parallel to the plane (coefficient of friction is 0.25). (5 marks)
- (b) A uniform ladder of 4 m length rests against a vertical wall with which it makes an angle of 45° . The coefficient of friction between the ladder and the wall is 0.4 and that between ladder and the floor is 0.5. At what position along the ladder from the bottom end does the ladder slip, if a man, whose weight is one-half of that of the ladder, ascends it. (9 marks)

MODULE 4

17. (a) Locate the centroid of the plane area shown in Figure 8. (10 marks)

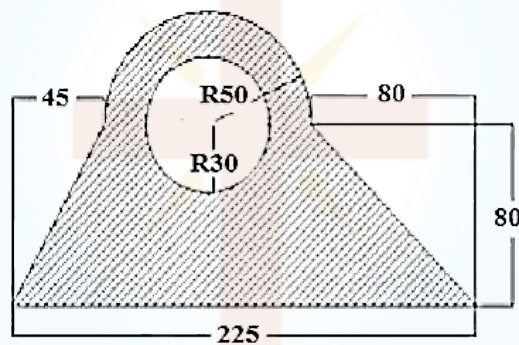


Figure 8

- (b) A regular hexagon of side length "a" as shown in Figure 9 is rotated about one of the sides. Apply suitable theorem to find the volume of the solid of revolution. (4 marks)

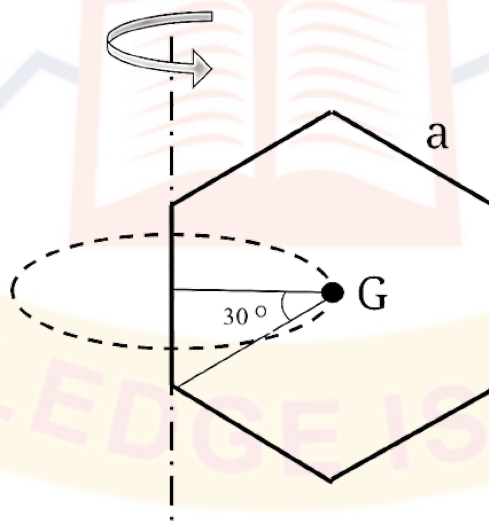


Figure 9

OR

18. Determine the moment of inertia and radius of gyration of the given area shown in Figure 10 about the horizontal centroidal axis. (14 marks)

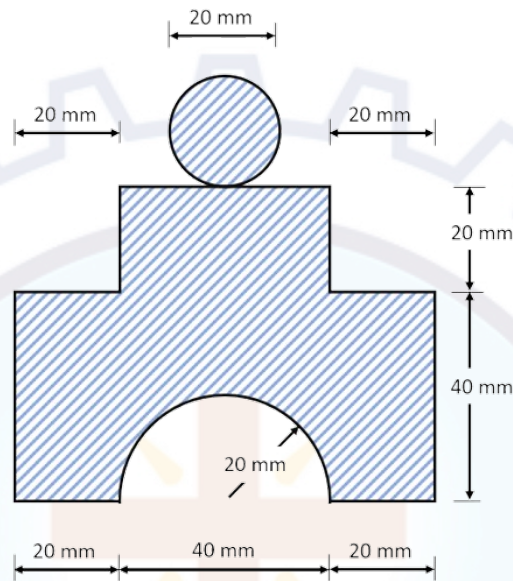


Figure 10

MODULE 5

19. (a) A car starts from rest on a curved road of 250m radius and accelerates at a constant tangential acceleration of 0.6 m/s^2 . Determine the distance and the time for which that car will travel before the magnitude of the total acceleration attained by it becomes 0.75 m/s^2 . (7 marks)
- (b) A block of mass 80 kg rests on a horizontal plane as shown in Figure 12. Find the magnitude of force P required to give the block an acceleration of $a = 4 \text{ m/s}^2$ to the right. The coefficient of friction between the block and the plane is 0.30. (7 marks)

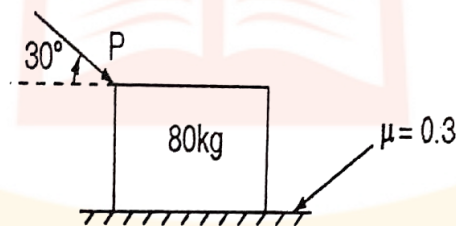


Figure 11

OR

20. (a) A mass of 60kg lies on a smooth horizontal table. It is connected to a fine string passing over a smooth guide pulley over the edge of table to a mass of 50kg. Find the tension in the string and acceleration of the system. (8 marks)

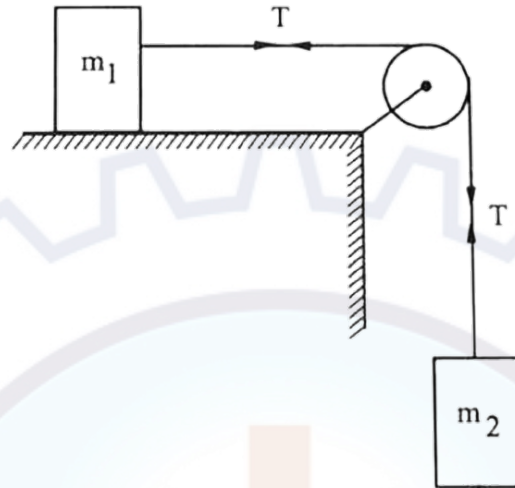


Figure 12

- (b) A tray of mass 'm' is mounted on three identical springs, as shown in Figure 14. The period of vibration of the empty tray is 0.5 sec. After placing a mass of 1.5 kg on the tray, the period was observed to be 0.6 sec. Find the mass of the tray and stiffness of each spring. (6 marks)

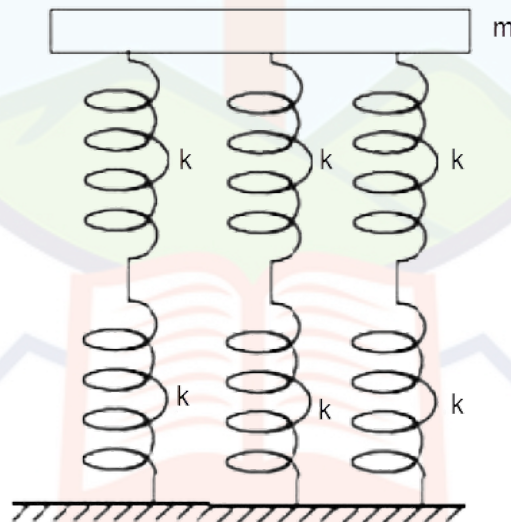


Figure 13

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24ES1T03C	GRAPHICS FOR CIVIL ENGINEERS	2	1	1	5	4	2024

Preamble

The course outlines the fundamental principles, objectives, and technical considerations for drafting comprehensive drawings in the field of Civil Engineering. This course establishes the foundation for effectively performing technical communication through graphical representation in accordance with global standards.

Prerequisites: Nil.

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Understand the concepts of engineering drawings and draw the projection of points and lines. (Cognitive knowledge level: Apply)
CO 2	Develop representation and understanding skills in the appropriate drawing levels by preparing orthographic projection of solids. (Cognitive knowledge level: Apply)
CO 3	Draw sectional views and develop surfaces of a given object (Cognitive knowledge level: Apply)
CO 4	Apply the principles of isometric projections to visualize different objects as well as the types of bonds in bricks. (Cognitive knowledge level: Apply)
CO 5	Prepare pictorial drawings using the principle of perspective projections and convert pictorial views into orthographic views (Cognitive knowledge level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	0	1	0	0	0	0	1	2	0	2
CO 2	3	0	1	0	0	0	0	1	2	0	2
CO 3	3	0	1	0	0	0	0	1	2	0	2
CO 4	3	2	1	0	0	0	0	1	2	0	2
CO 5	3	2	1	0	0	0	0	0	2	0	2

Assessment Pattern

GRAPHICS FOR CIVIL ENGINEERS			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	30	30	30
Understand	70	70	70
Apply	-	-	-
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course Project	: 10 marks
Self Study	: 5 marks

End Semester Examination Pattern

ESE will be of 3-hour duration on A4 size answer booklet and will be for 100 marks. The question paper shall contain two questions from each module. Student has to answer any one question from each module. Each question carries 20 marks and can have maximum 2 sub-divisions.

SYLLABUS

MODULE 1 (11 hours)

Introduction: Relevance of technical drawing in engineering field - Types of lines – Dimensioning - BIS code of practice for technical drawing - Lettering - Scales.

Orthographic projection of Points and Lines: Projection of points in different quadrants - Projection of straight lines inclined to one and inclined to both planes in different quadrants.

MODULE 2 (10 hours)

Orthographic projection : Projection of solids such as Square, Pentagon and Hexagonal Prisms, Pyramids, Cone and Cylinder - Projection of solids with axis inclined to one of the reference planes, inclined to both the reference planes.

MODULE 3 (11 hours)

Sections of Solids: Sections of Prisms, Pyramids, Cone, Cylinder with axis in vertical position and cut by different section planes - True shape of the sections.

Development of Surfaces: Development of surfaces of Prisms, Pyramids, Cone, Cylinder and solids cut by different section planes - Find the shortest distance between two points on the surface.

MODULE 4 (8 hours)

Isometric Projection: Isometric View and Projections of Prisms, Pyramids, Cone, Cylinder, Sphere, Frustum of Cone and their combinations.

Bonds in bricks: 1,1/2 brick thick English bond, 1,1/2 brick thick Flemish bond (application level).

MODULE 5 (8 hours)

Perspective Projection: Perspective projection of Prisms and Pyramids with axis perpendicular to the ground plane, axis perpendicular to picture plane.

Freehand sketching: Freehand sketching of real objects.

Conversion of Pictorial Views: Conversion of pictorial views into orthographic views.

Text Books:

1. Bhatt, N.D., Engineering Drawing, Charotar Publishing House Pvt. Ltd.
2. John, K.C. Engineering Graphics, Prentice Hall India Publishers.
3. P.I. Varghese, and K C John, Machine Drawing, V I P Publishers

Reference Books:

1. Anilkumar, K.N., Engineering Graphics, Adhyuth narayan Publishers
2. Francis D.K. Ching, "Building construction Illustrated, 4th edition, John Wily & Sons, 2008
3. Agrawal, B. And Agrawal, C.M., Engineering Darwing, Tata McGraw Hill Publishers.
4. Duff, J.M. and Ross, W.A., Engineering Design and Visualisation, Cengage Learning.
5. Kulkarni, D.M., Rastogi, A.P. and Sarkar, A.K., Engineering Graphics with Auto-CAD, PHI.
6. Luzaddff, W.J. and Duff, J.M., Fundamentals of Engineering Drawing, PHI.
7. Varghese, P.I., Engineering Graphics, V I P Publishers
8. Venugopal, K., Engineering Drawing and Graphics, New Age International Publishers.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	11 hours
1.1	Introduction: Relevance of technical drawing in engineering field - Types of lines - Dimensioning.	1 hour
1.2	BIS code of practice for technical drawing – Lettering - Scales.	2 hour
1.3	Orthographic projection of Points and Lines: Concept of principle planes of projection, different quadrants, locating points on different quadrants.	2 hour
1.4	Projection of straight lines inclined to one plane.	2 hour
1.5	Projection of straight lines inclined to both planes.	4 hour
2	Module 2	10 hours
2.1	Introduction of different solids - Orthographic projection of solids.	1 hour
2.2	Projection of solids such as Square, Pentagon and Hexagonal Prisms, Pyramids, Cone and Cylinder.	2 hour
2.3	Projection of solids with axis inclined to one of the reference planes.	2 hour
2.4	Practice problems on solids inclined to both reference planes.	5 hour
3	Module 3	11 hours
3.1	Introduction to section planes - Principle of locating cutting points and finding true shape.	2 hour
3.2	Problems on Sections of Cone and Cylinder with axis in vertical position and cut by different section planes.	2 hour
3.3	Problems on Sections of Prisms and pyramids with axis in vertical position and cut by different section planes.	2 hour
3.4	Principle of development of solids, sectioned solids.	2 hour

3.5	Problems on development of solids.	2 hour
3.6	Find the shortest distance between two points on the surface (application level).	1 hour
4	Module 4	8 hours
4.1	Principle of Isometric View and Projection, Isometric Scale, Problems on simple solids.	1 hour
4.2	Projections of Prisms, Pyramids, Cone, Cylinder, Sphere.	2 hour
4.3	Isometric problems on sphere and Frustum of cone.	1 hour
4.4	Problems on combination of different solids	2 hour
4.5	Bonds in bricks: 1,1/2 brick thick English bond.	1 hour
4.6	Bonds in bricks: 1,1/2 brick thick Flemish bond.	1 hour
5	Module 5	8 hours
5.1	Introduction to perspective projection, different planes, station point etc. - Perspective problems on prisms: axis perpendicular to the ground plane, axis perpendicular to picture plane.	2 hour
5.2	Perspective problems on pyramids: axis perpendicular to the ground plane, axis perpendicular to picture plane.	2 hour
5.3	Freehand sketching of real objects.	1 hour
5.4	Conversion of pictorial views into orthographic views.	3 hour
Total		48 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Locate points in different quadrants as per given conditions.
2. Problems on lines inclined to both planes.
3. Find True length, Inclinations and Traces of lines.

Course Outcome 2 (CO 2):

1. Draw orthographic views of solids and combination solids.
2. Draw views of solids inclined to any one reference plane.
3. Draw views of solids inclined to both reference planes.

Course Outcome 3 (CO 3):

1. Draw views of solids sectioned by a cutting plane.
2. Find the true shape of the section.
3. Draw development of lateral surface of solids and also its sectioned views.

Course Outcome 4 (CO 4):

1. Draw Isometric views/projections of solids.
2. Draw Isometric views/projections of frustum of cone.
3. Draw the bonds in brick masonry.

Course Outcome 5 (CO 5):

1. Draw Perspective views of Solids with axis perpendicular to the ground plane.
2. Draw Perspective views of Solids with axis perpendicular to picture plane.
3. Draw Orthographic views of solids from given three dimensional view

MODEL QUESTION PAPER

QP CODE:

Pages: 2

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

FIRST SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24ES1T03C

GRAPHICS FOR CIVIL ENGINEERS

Max. Marks: 100

Duration: 3 hours

Instructions:

Retain necessary Construction lines

Show necessary dimensions

Answer any ONE question from each module

Each question carries 20 marks

MODULE I

1. One end point of a line AB is 12mm above HP and 15 mm in front of VP. The other end of the line is 50mm above HP and 42 mm in front of VP. Draw the projections of the line AB if its elevation measures 70mm. Find the true length and true inclinations of the line with the principal planes.
2. One end point P of a line 75mm long, is 10mm above HP and 20mm in front of VP. The line is inclined 45° to HP and its plan is inclined 35° to x-y line. Draw the projections of the line PQ and find out true inclination of the line with respect to VP.

MODULE II

3. A pentagonal pyramid of base edge 30 mm and axis length 60 mm is resting on VP on one of its base edges. The axis of the pyramid is inclined at 35° to VP and the resting base edge is inclined at 45° to HP. Draw the projection of the pyramid.
4. A cone of base diameter 50 mm and axis length 60 mm is resting on VP on one of its generators with the front view of the axis inclined at 40° to HP. Draw its projections.

MODULE III

5. A cylinder with a 60 mm base diameter and 70 mm axis is resting on its base in the HP. It is cut by an auxiliary inclined plane which makes an angle of 60° with the HP and perpendicular to VP and passes through the top end of the axis. Draw its front view, sectional top view and true shape of the section.
6. A pentagonal pyramid, side of base 50 mm and height 80 mm rests on its base on the ground with one of its base sides parallel to VP. A section plane perpendicular to VP and inclined at 30° to HP cuts the pyramid, bisecting its axis. Draw the development of the truncated pyramid.

MODULE IV

7. Draw the isometric view of a pentagonal pyramid, side of base 20mm and height 50mm which rests centrally with base on a cylinder of diameter 60mm and height 40mm.
8. Brickwork bonding is important to ensure the stability of the structure and to produce a pleasing appearance. Draw neat sketches of 'English bond' and 'Flemish bond'.

MODULE V

9. A hexagonal prism 25mm side and 50mm long is lying on one of its rectangular face on the ground plane. The station point is 80mm in front of the picture plane, 65mm above the ground plane and lies in a central plane which is 70mm to the right of the axis of the prism. Draw the perspective view of the prism if one of the hexagonal faces of the prism is on the picture plane.
10. Draw the top view, front view and any one side view of the figure shown below. The front view direction is marked with a long arrow. Any missing dimension may be suitably assumed.

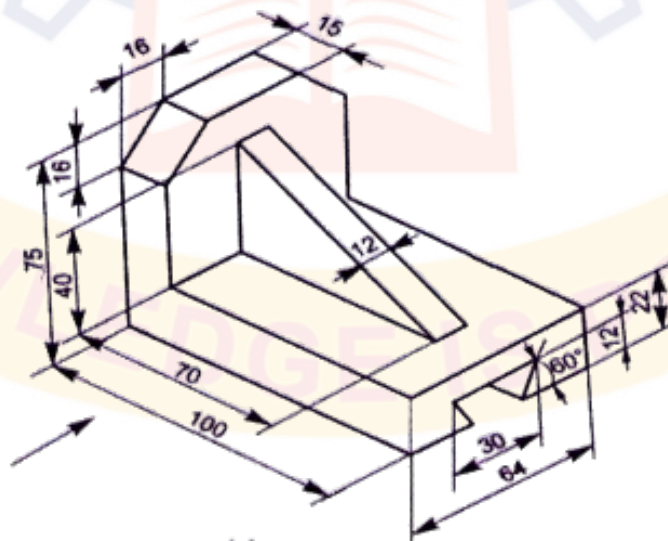


Figure 1

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24ES1L01B	PROGRAMMING LAB (B)	0	0	3	2	2	2024

Preamble

This course introduces students to problem-solving using Python programming, offering hands-on experience with core concepts such as data types, control structures, functions, file handling, and data analysis. By engaging in practical exercises, students will develop the skills necessary to analyse complex engineering problems and implement effective solutions using Python. Upon completing this course, students will be equipped to apply Python to real-world engineering challenges, enhancing their computational thinking and technical proficiency.

Prerequisites: Nil.

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Use fundamental Python constructs to solve basic computational problems (Cognitive Knowledge Level: Apply)
CO 2	Solve problems using data structures, logical conditions, and control loops enhancing their problem-solving skills (Cognitive Knowledge Level: Apply)
CO 3	Create functions and use inbuilt Python libraries to perform calculations and solve practical problems (Cognitive Knowledge Level: Apply)
CO 4	Manage and manipulate files and directories in Python (Cognitive Knowledge Level: Apply)
CO 5	Manipulate data using fundamental Python packages/libraries to perform mathematical operations and statistical analysis (Cognitive Knowledge Level: Analyse)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	3	3	0	0	0	0	0	0	0	1
CO 2	3	3	3	0	0	0	0	0	0	0	1
CO 3	3	3	3	0	0	0	0	0	0	0	1
CO 4	3	3	3	0	0	0	0	0	0	0	1
CO 5	3	3	3	3	0	0	0	0	0	0	1

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	10 marks
Continuous Assessment	10 marks
Viva-Voce (Self Study)	10 marks
Test	15 marks
Lab Record	5 marks

End Semester Examination (ESE) Pattern:

The following guidelines should be followed regarding the award of marks

Algorithm	20 marks
Program	30 marks
Viva-Voce	30 marks
Output	20 marks

SYLLABUS

LIST OF EXPERIMENTS

18 experiments from the following list of experiments are mandatory. At least 3 questions should be given from each set. The study and discussion of the remaining are also required.

	SET 1
1	Write a Python program to swap the values of two variables without using a third variable.
2	Write a Python program that accepts a single numeric parameter representing an angle in radians to convert into degree.
3	Implement a Python program that calculates simple interest based on user input for the principal amount, rate of interest, and time.
4	Create a Python program that takes a single character input and determines whether it is a vowel or consonant.
5	Write a Python programme to solve a quadratic equation. The inputs shall be taken from the user.
	SET 2
6	Write a Python program to find the first n prime numbers.
7	Write a Python program to check if a given year is a leap year
8	Write a Python program to read a string (word), store it in an array and check whether it is a palindrome.
9	Create a program that takes a tuple of numbers, converts it to a list, adds a new element, and then converts it back to a tuple.
10	Write a program to create a dictionary with student names as keys and their scores as values. Implement a search feature to find a student's score by name.
	SET 3
11	Write a function that returns the n^{th} Fibonacci number. Test the function with various values of n.
12	Write a program that simulates rolling a six-sided die 10 times and prints the result of each roll using the random module.

13	Create a custom module named <code>math_utils.py</code> with a function <code>factorial(n)</code> that returns the factorial of a number <code>n</code> . Import this module in a script and use the <code>factorial()</code> function.
14	A person needs to file his Income Tax Returns. He doesn't know if new regime or the old regime is beneficial. Please help him out by writing a Python program asking him the gross salary and possible deductions. You may use functions and Python libraries.
15	Write a Python function that takes two parameters: a list of numbers and a second parameter that can have one of three values: "asc", "desc", or "none". If the second parameter is "asc", the function should return the list of numbers in ascending order. If it is "desc", the function should return the list of numbers in descending order. If the second parameter is "none", the function should return the unaltered list.
	SET 4
16	Write a program that finds and prints the longest line in the file 'lines.txt'. The file will be kept in a prescribed directory.
17	Write a program that writes a list of dictionaries to a CSV file 'output.csv' and text file 'output.txt' both in a folder named 'data'.
18	Write a Python program that lists all the files in the current directory.
19	Write a Python program that searches for a specific word in a file and replaces it with another word. The program should save the changes to the same file. Also count the number of words replaced.
20	Reads the first 5 lines from an existing text file using the <code>readline()</code> method. If the file doesn't exist, handles the error using <code>try</code> and <code>except</code> , and creates a new file with the same name. Writes user input line by line into the file until the user decides to stop, ensuring the file is properly saved.
	SET 5
21	Create a NumPy array with random integers between 0 and 100 of size 5x5. Compute and print the mean, median, standard deviation, and sum of all elements. Find the row wise and column wise sum of the elements of the matrix. Perform matrix multiplication and display the result along with the multiplied ones. Find the element wise product, sum and difference find the sum of squares of all the elements row wise and display the result.

22	Read a csv file where the details of students and their marks obtained in various subjects are given. Remove the students from the list who is absent for any one of the exams where it displays 'abs' against the subject. Find the percentage of marks for each student and add it as the last column and save the updated file in a new name. Also display the names of students that scored more than 80% marks.
23	Load a CSV file containing sales data with columns for product name, quantity sold, and price. Calculate the total sales revenue for each product and identify the product with the highest revenue.
24	Generate a 10x10 matrix of random integers, extract all even numbers, and replace them with their negative values and all odd numbers to double their values. Find the minimum and maximum elements in the matrix.
25	Generate a line plot of the sine and cosine functions from 0 to 2π using Matplotlib. Give a title, label the axes and add a legend. Save the plot. Try the same for a scatter plot.

Reference Books

1. Eric Matthes, "Python Crash Course", No Starch Press
2. Cay S Horstmann, Rance D Necaise, "Python For Everyone", Wiley
3. Guttag John V, "Introduction to Computation and Programming using Python", PHI
4. Kenneth A Lambert, "Fundamentals of Python: First Programs", Cengage

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE1L01	CIVIL ENGINEERING LAB	0	0	3	2	2	2024

Preamble

The Civil Workshop aims to equip students with practical skills in measurement and construction. The course covers diverse measuring techniques essential for Civil Engineering projects. Additionally, the course offers insights into plumbing layouts and various masonry techniques.

Prerequisites: Nil.

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Undertake area measurements for various construction activities (Cognitive Knowledge Level: Apply)
CO 2	Apply surveying skills to assess and establish level differences in construction projects. (Cognitive Knowledge Level: Apply)
CO 3	Execute setting out for a given plan (Cognitive Knowledge Level: Apply)
CO 4	Understand and implement plumbing lines for water supply and sewage system (Cognitive Knowledge Level: Apply)
CO 5	Execute brick masonry works in English and Flemish bonds (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	3	0	0	2	1	0	3	1	0	3
CO 2	3	3	1	0	2	1	0	3	1	0	3
CO 3	3	3	0	0	2	1	0	3	1	0	3
CO 4	3	1	2	0	2	1	0	3	1	0	3
CO 5	2	2	1	0	2	1	0	3	1	0	3

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	10 marks
Continuous Assessment	10 marks
Viva-Voce (Self Study)	10 marks
Test	15 marks
Lab Record	5 marks

SYLLABUS

Course Content and Practical Schedule

LIST OF EXPERIMENTS

1	Calculate the area of a built-up space using digital distance measuring device and standard measuring tape.
2	Calculate the Carpet area and Plinth area of a building.
3	Calculate the area of a polygon by Compass traversing.

4	Calculate the area of a polygon by intersection method using a Compass.
5	Find the level difference between the given points using levelling.
6	Setting out of a building: Set out a building as per the given building plan using tape and cross staff.
7	Introduce the students to plumbing tools, different types of pipes, type of connections, traps, valves, fixtures and sanitary fittings and to establish a plumbing network for a given layout.
8	Construct a brick wall (one and one-and-half thick) in English bond.
9	Construct a brick wall (one and one-and-half thick) in Flemish bond.
10	Conduct a market study of various construction materials like brick, cement, steel and aggregates to understand the types, rates, specifications etc.

Reference Books

1. Khanna P.N, "Indian Practical Civil Engineering Handbook", Engineers Publishers.
2. Bhavikatti. S, "Surveying and Levelling (Volume 1)", I.K. International Publishing House.
3. Arora S.P and Bindra S.P, " Building Construction", Dhanpat Rai Publications .
4. S. C. Rangwala, "Engineering Materials," Charotar Publishing House. Plumbing Engineering Services Design Guide by J. Paul Guyer.
5. S. K. Duggal, "Building Materials", New Age International, 2009.
6. B. N. Dutta," Estimating and Costing in Civil Engineering", UBS Publishers.
7. J.L. Meriam and L.G. Kraige, "Engineering Mechanics: Statics".
8. S. Timoshenko and D.H. Young, "Engineering Mechanics".

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24MC1T01	LIFE SKILLS	1	0	1	2	P/F	2024

Preamble

This Course is aimed at equipping individuals with the essential competencies to navigate life's challenges with resilience and positivity. This course, embarks on a profound exploration of personal development, fostering self-awareness, meaningful connections, and the ability to navigate the complexities of both the abstract and the concrete aspects of life. It aims to enhance employability by providing practical insights and hands-on experiences that will empower one to apply these principles effectively in one's personal and professional endeavors.

Prerequisites: Nil.

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Empower individuals with the knowledge and practical skills needed to navigate life challenges and to cope with emotions and stress. (Cognitive Knowledge Level: Apply)
CO 2	Develop a profound understanding of themselves and others, leading a fulfilling professional life by embracing a holistic approach to well being. (Cognitive Knowledge Level: Analyzes)
CO 3	Provide a solid foundation in leadership principles and team dynamics. (Cognitive Knowledge Level: Apply)
CO 4	Basic understanding of financial concepts for financial well being. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	1	1	0	0	0	2	2	3	2	2	2
CO 2	1	1	0	0	0	2	3	3	2	2	2
CO 3	1	1	0	0	0	2	2	3	0	3	2
CO 4	2	1	2	0	0	2	0	0	0	3	0

Assessment Pattern

LIFE SKILLS		
Bloom's Category	Continuous Assessment Test (%)	End Semester Examination (%)
Remember	20	20
Understand	20	20
Apply	30	30
Analyse	30	30
Evaluate	-	-
Create	-	-

Mark Distribution

Total Marks	CIE Marks	ESE Marks
100	50	50

Continuous Internal Evaluation Pattern

Attendance	10 marks
Continuous Assessment Test (1 numbers)	25 marks
Self Study (Regular assessment)	15 marks

Regular Assessment

Group Discussion (Marks: 9)

Create groups of about 6 students each and engage them on a GD on a suitable topic for about 20 minutes. Parameters to be used for evaluation are as follows:

1. Communication Skills: 3 marks
2. Subject Clarity: 2 marks
3. Group Dynamics: 2 marks
4. Behaviors & Mannerisms: 2 marks

Presentation Skills (Marks: 6)

Identify a suitable topic and ask the students to prepare presentation (preferably a powerpoint presentation) for about 10 minutes. Parameters to be used for evaluation are as follows

1. Communication Skills: 2 marks
2. Platform Skills: 2 marks
3. Subject Clarity/Knowledge: 2 marks

End Semester Examination Pattern

Part A: Short answer question (20 marks)

There will be one question from each MODULE (four questions in total, five marks each). Each question should be written in about maximum of 400 words. Parameters to be used for evaluation are as follows:

1. Content Clarity/Subject Knowledge
2. Presentation style
3. Organization of content

Part B: Case Study (30 marks)

The students will be given a case study with questions at the end. The students have to analyze the case and answer the question at the end. Parameters to be used for evaluation are as follows:

1. Analyze the case situation
2. Key players/characters of the case

3. Identification of the problem (both major & minor if exists)
4. Bring out alternatives
5. Analyze each alternative against the problem
6. Choose the best alternative
7. Implement as solution
8. Conclusion
9. Answer the question at the end of the case

SYLLABUS

MODULE 1 (6 hours)

Overview of Life Skills:

Meaning and significance of life skills, Life skills identified by WHO: Self-awareness, Empathy, Critical thinking, Creative thinking, Decision making, problem solving, Effective communication, interpersonal relationship, coping with stress- Four A's of stress management, Gratitude Training, Coping with emotion- PATH method and relaxation techniques.

MODULE 2 (6 hours)

Life Skills for Professionals:

positive thinking, right attitude, Experience, attention to detail, having the big picture, learning skills, research skills, setting goals and achieving them, perseverance, motivation, self-motivation, and motivating others, IQ, EQ, and SQ , Collaboration, continuous learning, unlearning and relearning, cross cultural communication, social media etiquettes, Financial Literacy.

Time Management: Prioritizing tasks, setting realistic goals and managing time effectively, work life balance.

Holistic Thinking: imagination, intuition, lateral thinking, Multiple intelligence, spirituality, family bonding, living peacefully.

MODULE 3 (6 hours)

Leadership:

Leadership traits, Styles of Leadership, VUCA Leadership, Transactional vs Transformational Leaders, managing diverse stakeholders, crisis management, Effective Leaders.

Group and Team Dynamics: Group vs Team, Team Dynamics, Virtual teams, managing team performance and managing conflicts, Intrapreneurship

MODULE 4 (6 hours)

Financial Literacy:

Time value of money, power of compounding, Future value of a single cash flow, effective versus nominal rate, Future value of an annuity, present value of a single cash flow, Present value of an annuity.

Reference Books

1. Shiv Khera, You Can Win, Macmillan Books, New York, 2003.
2. Barun K. Mitra, "Personality Development & Soft Skills", Oxford Publishers, Third impression, 2017.
3. ICT Academy of Kerala, "Life Skills for Engineers", McGraw Hill Education (India) Private Ltd., 2016.
4. Caruso, D. R. and Salovey P, "The Emotionally Intelligent Manager: How to Develop and Use the Four Key Emotional Skills of Leadership", John Wiley & Sons, 2004.
5. Kalyana, "Soft Skill for Managers"; First Edition; Wiley Publishing Ltd, 2015.
6. Larry James, "The First Book of Life Skills"; First Edition, Embassy Books, 2016.
7. Shalini Verma, "Development of Life Skills and Professional Practice"; First Edition; Sultan Chand (G/L) & Company, 2014.
8. Daniel Goleman, "Emotional Intelligence"; Bantam, 2006.
9. Remesh S., Vishnu R.G., "Life Skills for Engineers", Ridhima Publications, First Edition, 2016.
10. Butterfield Jeff, "Soft Skills for Everyone", Cengage Learning India Pvt Ltd; 1 edition, 2011.
11. Training in Interpersonal Skills: Tips for Managing People at Work, Pearson Education, India; 6 editions, 2015.
12. The Ace of Soft Skills: Attitude, Communication and Etiquette for Success, Pearson Education; 1 edition, 2013
13. Prasanna Chandra, "Fundamentals of Financial Management", McGraw Hill Education (India) Private Ltd, 2020
14. Edward de Bono, "Lateral Thinking"
15. Howard Gardener, "Multiple Intelligences"

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
	Module 1	6
1.1	Overview of Life Skills: Meaning and significance of life skills, Life skills identified by WHO: Self-awareness, Empathy, Critical thinking, Creative thinking, Decision making	1
1.2	Problem solving, Effective communication, interpersonal relationship, coping with stress- Four A's of stress management.	1
1.3	Gratitude Training, Coping with emotion- PATH method and relaxation techniques	1
1.4	Activity- Presentation, Group discussion	3
	Module 2	6
2.1	Life skills for professionals: positive thinking, right attitude, Experience, attention to detail, having the big picture, learning skills, research skills, setting goals and achieving them, perseverance, motivation, self-motivation, and motivating others,	1
2.2	IQ, EQ, and SQ, Collaboration, continuous learning, unlearning and relearning, cross cultural communication, social media etiquettes, Financial Literacy.	1
2.3	Time management: Prioritizing tasks, setting realistic goals and managing time effectively, work life balance.	1
2.4	Holistic Thinking: imagination, intuition, lateral thinking, Multiple intelligence, spirituality, family bonding, living peacefully.	1
2.5	Activity- Presentation, Group discussion.	2

	Module 3:	6
3.1	Leadership: Leadership traits, Styles of Leadership, VUCA Leadership, Transactional vs Transformational Leaders, managing diverse stakeholders, crisis management, Effective Leaders.	1
3.2	Group and Team Dynamics: Group vs Team, Team Dynamics, Virtual teams, managing team performance and managing conflicts, Intrapreneurship	1
3.3	Activity- Presentation, Group discussion	4
	Module 4:	6
4.1	Financial Literacy: Time value of money, power of compounding, Future value of a single cash flow.	1
4.2	Effective versus nominal rate, Future value of an annuity.	1
4.3	Present value of a single cash flow, Present value of an annuity.	1
4.4	Activity- Presentation, Group discussion	3
Total		24 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. What are the life skills identified by WHO?
2. List the 4 A's of stress management.
3. Differentiate between Critical thinking and Creative thinking.

Course Outcome 2 (CO 2):

1. What are the life skills that a professional should have?
2. Explain how time management can help in work life balance.
3. What is the difference between intuition and lateral thinking?

Course Outcome 3 (CO 3):

1. How a person can grow as a leader in an organization?
2. Discuss the term "Crisis management".
3. What are the differences between a team and a group?

Course Outcome 4 (CO 4):

1. A finance company advertises that it will pay a lumpsum of Rs. 10000 at the end of 6 years to investors who deposit annually Rs. 1000. What interest rate is implicit in this offer?
2. How much should be deposited at the beginning of each year for 10 years in order to provide a sum of Rs. 50000 at the end of 10 years?
3. Suppose you deposit Rs. 10000 with an investment company which pays 8 percent interest with quarterly compounding. How much will this deposit grow in 5 years?

MODEL QUESTION PAPER

QP CODE:

Pages: 2

Reg.No.:

Name:

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

FIRST SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24MC1T01

LIFE SKILLS

Max. Marks: 50

Duration: 2 hours

PART A

Answer all questions. Each question carries 5 marks.

1. Stress is the emotional or physical tension the body creates when presented with events or thoughts that cause worry, frustration, anger or nervousness. When stress exceeds the ability to cope, balance in the mind and body need to be restored. Discuss how stress management can act as an effective tool to accomplish this.
2. "The only limit to our realization of tomorrow is our doubts of today." – Franklin D. Roosevelt. Critically assess how cultivating positive thinking and maintaining a right attitude can transform professional challenges into opportunities for growth.
3. Discuss leadership styles that are effective for successful management of multicultural groups and teams.
4. Mr. Vinay plans to send his son for higher studies abroad after 10 years. He expects the cost of these studies to be Rs. 100000. How much should he save annually to have a sum of Rs. 100000 at the end of 10 years if the interest rate is 12 percent?

PART B

Read carefully the following case and answer the questions given below.

Each question carries 6 marks.

1. Based on the case study given below, answer the following questions: It occurred on the night of 2–3 December 1984 at the Union Carbide India Limited (UCIL) pesticide plant in Bhopal, Madhya Pradesh. Over 500,000 people were exposed to Methyl Isocyanate (MIC) gas and other chemicals. A runaway reaction had occurred in a storage tank of Methyl Isocyanate (MIC), which was used to manufacture a pesticide. The valves of the tank had burst, and a cloud of poisonous gas had escaped. The winds carried it to nearby shanty towns and the populous city of Bhopal, where thousands of people either died in their sleep or woke and died while fleeing. Those who survived suffered from burning eyes and lungs. Local medical facilities were not equipped for the disaster, and over the next few weeks' thousands more died. The killer gas spread through the city, sending residents scurrying through the dark streets. No alarm ever sounded a warning, so that local people were not informed the situation, and no evacuation plan was prepared. When victims arrived at hospitals breathless and blind, doctors did not know how to treat them, as UCIL had not provided emergency information. Perhaps most importantly at the time of the tragedy, the staff did not realize the gravity of the situation and even took a break for tea after the leak had been noticed, thinking they would have plenty of time to fix it. The operator in the control room did not notify his supervisor when the temperature began to rise inside the tank and the entire situation remained unattended for at least an hour. The disaster raised some serious ethical issues. The pesticide factory was built in the midst of densely populated settlements. UCIL chose to store and produce MIC, one of the deadliest chemicals (permitted exposure levels in USA and Britain are 0.02 parts per million), in an area where nearly 120,000 people lived. The MIC plant was not designed to handle a runaway reaction. When the uncontrolled reaction started, MIC was flowing through the scrubber (meant to neutralize MIC emissions) at more than 200 times its designed capacity.
 - (a) Critique the communication strategy (or lack thereof) employed by UCIL during the disaster. How did the absence of timely warnings and information affect the outcome?
 - (b) Assess the ethical implications of UCIL's decision to build a pesticide plant in a densely populated area. How should corporate responsibility have been exercised in this context?
 - (c) As an engineer, comment on the drawback of the design which may have the reason for the tragedy.
 - (d) Evaluate the leadership displayed by UCIL's management during the Bhopal disaster. How did their response, or lack thereof, impact the outcome of the crisis?
 - (e) Reflect on the lessons learned from the Bhopal disaster. What key takeaways should industries and governments derive from this incident to enhance safety and prevent future catastrophes?

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24MC1T02	DESIGN THINKING	1	1	0	2	P/F	2024

Preamble

This course gives students a comprehensive understanding of the iterative design process and its real-world applications. It covers the fundamentals of design thinking, including concept development, brainstorming, and creativity enhancement. Emphasizing customer needs identification and human-centered design principles, it explores product conceptualization and evaluation, along with prototyping techniques. Additionally, the course addresses ethical considerations and challenges within the design thinking process through diverse case studies. By the end of the course, students will gain practical insights into design thinking methodologies, preparing them to effectively tackle complex design challenges.

Prerequisites: Nil.

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Exhibit/show a thorough understanding of the fundamental principles of the design thinking methodology. (Cognitive Knowledge Level: Understand)
CO 2	Utilize diverse techniques effectively to generate creative concepts, adopting innovation and ideation. (Cognitive Knowledge Level: Apply)
CO 3	Demonstrate expertise in ideating prototypes, models, and proof-of-concept iterations. (Cognitive Knowledge Level: Analyse)
CO 4	Analyze real-world challenges and develop a practical design thinking framework suitable for their professional endeavors. (Cognitive Knowledge Level: Create)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	2	1	3	1	1	1	1	2	1	1	1
CO 2	2	2	3	1	1	1	1	2	1	1	1
CO 3	2	2	3	1	1	1	1	2	1	1	1
CO 4	2	2	3	1	1	1	1	2	1	1	1

Assessment Pattern

DESIGN THINKING			
Bloom's Category	Continuous Assessment		End Semester Examination (%)
	Test 1 (%)	Case Study Presentation Mark (%)	
Remember	25	-	20
Understand	25	-	20
Apply	25	-	20
Analyse	25	-	20
Evaluate	-	-	-
Create	-	100	20

Mark Distribution

Total Marks	CIE Marks	ESE Marks
100	50	50

Continuous Internal Evaluation Pattern

Attendance	10 marks
Continuous Assessment Test	25 marks
Self Study (Case Study Presentation)	15 marks

End Semester Examination Pattern : There will be two parts; Part A and Part B. Part A contain 4 questions carrying 5 marks each. Part B contains 2 questions from each module out of which 1 to be answered and can have maximum 2 sub- divisions. Questions from Module 1&2 carries 8 marks each and Module 3&4 carries 7 marks.

SYLLABUS

MODULE 1 (5 hours)

Design Thinking Approach:

Introduction to Design Thinking; Iterative Design Thinking Process Stages: Empathize, Define, Ideate, Prototype and Test; The double-diamond Model of design by British Design Council.

Developing concepts:

Steps to develop concepts from functions; Brainstorming: Mechanism of brainstorming, Ideation; Creativity: How to increase level of creativity.

MODULE 2 (6 hours)

Design Process: Requirements: Identifying customer needs and requirements, market analysis, defining goals; Product concepts: establishing functions, task specifications.

Solution Concept: conceptualization, evaluating alternatives; embodiment design; Analysis and optimization; experiment; marketing. Human-centred design process.

MODULE 3 (6 hours)

Concepts Evaluation:: Evaluating conceptual alternatives: Pugh's Evaluation matrix, decision matrix with examples, QFD and house of quality.

Prototyping: Prototypes, Models and Proofs of concepts; What is Prototype? Why Prototype? Building models and prototypes, Rapid Prototyping; Lean startup method for prototype development; Testing prototypes and models and proving concepts.

MODULE 4 (7 hours)

Ethics in Design: Understanding obligations, code of ethics, familiarity with several code of ethics such as ASCE, ASME, IEEE, VDI etc. code of ethics and moral frameworks.

Challenges in Design Thinking: Design thinking case studies detailing the various aspects detailed above are to be discussed. The case studies are suggested to be from the below listed areas but not to be limited to: Consumer package goods; Education; Financial Services; Health care; Journalism; Non-Profit organizations; Retail; Technology; Transportation sector; Self-improvement.

Text Books

1. Yousef Haik & Tamer M Shahin, “Engineering design process”, Course Technology, 2010.
2. Clive L Dym, Patrick Little & Elizabeth J Orwin, “Engineering Design-A Project based Introduction”, Wiley, 2014.
3. Don Norman, “The Design of Everyday Things”, Basic Books; 2nd edition, 2013.
4. Christian Mueller-Roterberg, “Handbook of Design Thinking: Tips and Tools for how to design thinking”, 2018.

Reference Books

1. Daniel Kahneman, “Thinking Fast and Slow”, Farrar, Straus & Giroux, 201.
2. Rod Judkins, “The art of Creative Thinking”, Penguin Publishing Group, 2016.
3. Donella H Meadows, “Thinking in Systems”, Chelsea Green Publishing, 2008.
4. Tim Brown, “Change by Design”, HarperCollins, 2019.
5. V.N.Mittle & Arvind Mittal, ”Basic Electrical Engineering ” 2nd Edition, McGraw Hill, 2006.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Topic	No of Lecture /Tutorial Hours
	Module 1	5
1.1	Design Thinking Approach: Introduction to Design Thinking; Iterative Design Thinking Process Stages: Empathize, Define, Ideate, Prototype and Test	1
1.2	The double-diamond Model of design by British Design Council	1
1.3	Developing concepts: Steps to develop concepts from functions	1
1.4	Brainstorming: Mechanism of brainstorming, Ideation	1
1.5	Creativity: How to increase level of creativity	1
	Module 2	6
2.1	Design Process: Requirements: Identifying customer needs and requirements, market analysis, defining goals	1
2.2	Product concepts: establishing functions, task specifications	2
2.3	Solution Concept: conceptualization, evaluating alternatives	1
2.4	Embodiment design; Analysis and optimization; experiment; marketing	1
2.6	Human centred design process	1
	Module 3:	6
3.1	Concepts Evaluation: Evaluating conceptual alternatives: Pugh's Evaluation matrix, decision matrix with examples.	2
3.2	Prototypes, Models and Proofs of concepts	1

3.3	What is Prototype? Why Prototype? Building models and prototypes, Rapid Prototyping	1
3.4	Lean startup method for prototype development; Testing prototypes and models and proving concepts	2
	Module 4:	7
4.1	Ethics in Design: Understanding obligations, code of ethics, familiarity with several code of ethics such as ASCE, IEEE, VDI etc. code of ethics and moral frameworks	1
4.2	Challenges in Design thinking	1
4.3	Design thinking case studies detailing the various aspects	5
Total		24 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Describe design thinking and list the different stages in a design thinking process.
2. Illustrate the double-diamond Model of design.
3. Describe how to develop concepts from functions and Mechanism of brainstorming.
4. How to increase the level of creativity and the process of forming ideas from conception to implementation?

Course Outcome 2 (CO 2):

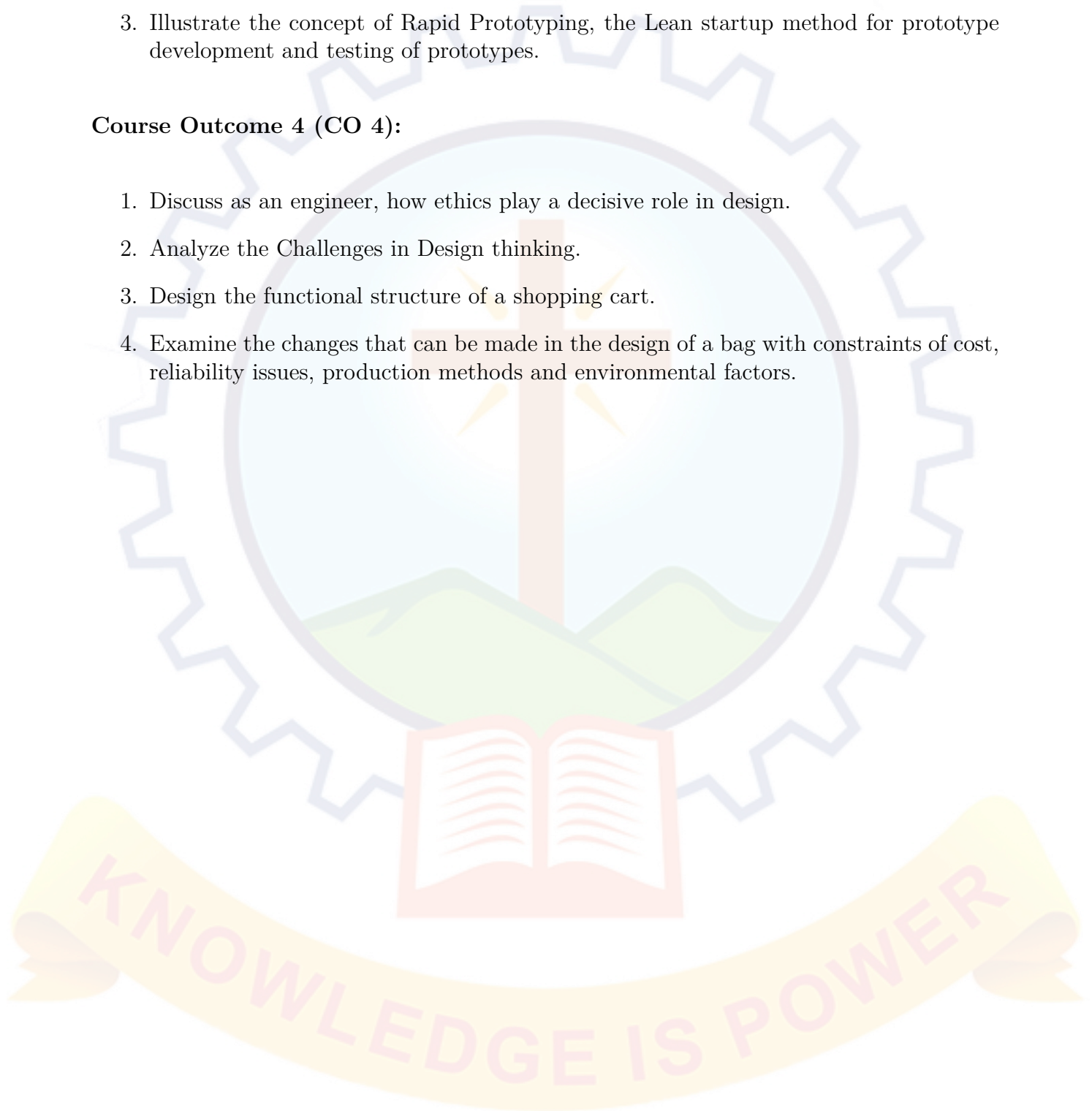
1. How to narrow down to the best design considering the customer needs and requirements, market analysis and defining goals?
2. Illustrate the process of product concepts, forming ideas and embodiment design.
3. Explain the Human-centred design process.

Course Outcome 3 (CO 3):

1. Describe the concept evaluation using Pugh's Evaluation matrix, and decision matrix with examples.
2. Explain the ideation of prototypes, models, and proofs of concepts.
3. Illustrate the concept of Rapid Prototyping, the Lean startup method for prototype development and testing of prototypes.

Course Outcome 4 (CO 4):

1. Discuss as an engineer, how ethics play a decisive role in design.
2. Analyze the Challenges in Design thinking.
3. Design the functional structure of a shopping cart.
4. Examine the changes that can be made in the design of a bag with constraints of cost, reliability issues, production methods and environmental factors.



MODEL QUESTION PAPER

QP CODE:

Pages: 2

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

FIRST SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24MC1T02

DESIGN THINKING

Max. Marks: 50

Duration: 2 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Demonstrate the basic concept of brainstorming and the rules developed for brainstorming session.
2. Briefly explain what is product and solution concepts in design process.
3. Distinguish between prototypes and models.
4. Explain the importance of ethics in design.

PART B

Answer any one question from each module.

5. What do you mean by design thinking and why it is needed. How does the design thinking approach help engineers. 8

OR

6. Summarize different stages of design thinking process using appropriate examples.. 8
7. Illustrate different phases of extensive prescriptive model of design process. 8

OR

8. Identify the customer requirements with the help of refrigerator as example, 8

9. How concepts evaluation can be done using Pugh's evaluation matrix. Compare Pugh's evaluation matrix with the decision matrix. 7

OR

10. List the different methods in which the prototype of a product can be generated and tested. 7
11. Design a device/machine that will crush aluminum cans. The device must be fully automatic. The device should switch on automatically, crush the can automatically, eject the crushed can automatically and switch off automatically. 7

OR

12. Design a new shopping cart that can be used primarily in grocery stores. The shopping cart should solve the common problems in the available carts. There is a tendency to conserve parking space by not designating a return cart area. Leaving cart in the parking lots may lead to serious accidents and car damage. Many customers do not fill their carts when shopping; however, they do not like to carry baskets. Other customers like to sort products as they shop. 7

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24MC1L01	YOGA AND SPORTS	0	1	1	1	P/F	2024

Preamble

This course enables the learners to understand how to attain physical fitness, mental well-being, and holistic growth through the combined benefits of yoga and sports. The topics covered in this course are Yoga & Lifestyle Physical fitness, wellness and exercise programmes, First aid and Postures & nutrition. This course helps the students to develop appreciation of physical activity as a lifetime pursuit and a means to better health.

Prerequisites: Nil.

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Demonstrate the need of physical activities and Yoga for the strength, flexibility, and relaxation of mind and body. (Cognitive Knowledge Level: Apply)
CO 2	Use scientific principles of exercise and training in daily routine. (Cognitive Knowledge Level: Apply)
CO 3	Apply first aid promptly and appropriately whenever and wherever the need arises.(Cognitive Knowledge Level: Apply)
CO 4	Understand the importance of postures and nutrition (Cognitive Knowledge Level: Understand)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	0	0	0	0	0	0	2	3	2	0	2
CO 2	0	0	0	0	0	0	3	3	2	0	2
CO 3	0	0	0	0	0	2	3	3	3	0	2
CO 4	0	0	0	0	0	0	3	3	2	0	2

Mark Distribution

Total Marks	CIE Marks
50	50

Continuous Internal Evaluation Pattern

Attendance	: 10 marks
Regular assessment	: 35 marks
Self Study	: 5 marks

Marks for the regular assessment can be based on the co questions given at the end.

SYLLABUS

MODULE 1 (6 hours)

Yoga & Lifestyle:

Meaning and importance of Yoga. Introduction-Asanas: Pranayama, Meditation and Yogic Kriyas. Yoga for concentration and related Asanas (Sukhasana; Tadasana; Padmasana and Shashankasana). Relaxation Techniques for improving concentration-Yog-nidra. Asanas as preventive measure. Hypertension: Tadasana, Vajrasana, Pawanuktasana, Ardha Chakrasana, Bhujangasana, Shavasana. Obesity: Procedure, Benefits and contraindications for Vajrasana, Hastasana, Trikonasana, Ardha Matsyendrasana. Back pain: Tadasana, Ardha Matsyendrasana, Vakrasana, Shalabhasana, Bhujangasana.

MODULE 2 (6 hours)

Physical fitness and exercise:

Meaning and importance of physical fitness and wellness. Components of physical fitness and health related fitness. Exercise for improving speed, strength, endurance, and flexibility and co ordinative abilities.Exercises to prevent back pain, tennis elbow, shoulder injury and knee pain, Neck pain.Fitness test battery for speed, strength, endurance, flexibility.Importance of weight training.Warming up and cooling down.How to deal with every day stress.

MODULE 3 (6 hours)

First aid:

First aid and principles of first aid.First aid measure for the following: Bleeding through Nose, Snakebite, Dog Bite, Electric Shock, Burns and Drowning.Common injuries and their management: Wounds, Cuts, Sprain, Fracture and Dislocation. Cardio Pulmonary Resuscitation (CPR).How to prevent muscle cramps and its management.How to carry an injured person.

MODULE 4 (6 hours)

Postures and nutrition:

Posture and its importance.Common Postural Deformities-Knock Knee, Flat Foot, Round Shoulders, Lordosis, Kyphosis, Bow Legs and Scoliosis.Corrective Measures for Postural Deformities. Balanced diet, malnutrition and Deficiency diseases. Hydration

Text Books

1. Modern Trends and Physical Education by Prof. Ajmer Singh.
2. Light on Yoga by B.K.S. Iyengar.
3. Health and Physical Education- NCERT (11th and 12th Classes)

Reference Books

1. Physiological aspects of sports training and performance by Jay Hoffman.
2. Periodization theory and methodology of training by Tudor O Bompa and G Grigery Haff.
3. Essential of strength training and conditioning by Thomas Baechle E R, Roger W Earle.
4. A practice guide to emergency first aid, safety injuries, illnesses by Montreal.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
	Module 1	6
1.1	Meaning and importance of Yoga. Introduction-Asanas, Pranayama, Meditation and Yogic Kriyas. Yoga for concentration and related Asanas (Sukhasana; Tadasana; Padmasana and Shashankasana) Relaxation Techniques for improving concentration-Yog-nidra. Asanas as preventive measures.	2
1.2	Hypertension: Tadasana, Vajrasana, Pawanuktasana, Ardha Chakrasana, Bhujangasana, Shavasana.	1
1.3	Obesity: Procedure, Benefits and contraindications for Vajrasana, Hastasana, Trikonasana, Ardha Matsyendrasana.	1
1.4	Back pain: Tadasana, Ardha Matsyendrasana, Vakrasana, Shalabhasana, Bhujangasana	2
	Module 2	6
2.1	Meaning and importance of physical fitness and wellness, Components of physical fitness and health related fitness	1
2.2	Exercise for improving speed, strength, endurance, and flexibility and coordinative abilities	1
2.3	Exercises to prevent back pain, shoulder injury and knee pain.	2
2.4	Fitness test battery for speed, strength, endurance, flexibility.	1
2.5	Importance of weight training, Warming up and cooling down.	1
	Module 3:	6
3.1	First aid and principles of first aid. First aid measure for the following: Bleeding through Nose, Snakebite, Dog Bite, Electric Shock, Burns and Drowning.	2
3.2	Common injuries and their management: Wounds, Cuts, Sprain, Fracture and Dislocation	2

3.3	Cardio pulmonary resuscitation (CPR).	1
3.4	How to prevent muscle cramps and its management. How to carry an injured person	1
	Module 4:	6
4.1	Posture and its importance. Common Postural Deformities- Knock Knee, Flat Foot, Round Shoulders.	2
4.2	Lordosis, Kyphosis, Bow Legs and Scoliosis. Corrective Measures for Postural Deformities.	2
4.3	Balanced diet, malnutrition and deficiency disease, Hydration.	2
Total		24 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Demonstrate yoga asanas for life style problems
2. Create a PPT presentation on various yoga asanas
3. Group Activity - Group discussion about the need and benefits of physical activities and Yoga for the strength, flexibility, and relaxation of mind and body.

Course Outcome 2 (CO 2):

1. Analyze the exercise activities of at least five famous personalities and give a PPT presentation about how each one of them uses physiological principles related to exercise and training in daily routine.
2. Conduct a survey on how the following categories of people follow physiological principles related to exercise and training in daily routine.
 - (a) Sports person
 - (b) Working woman
 - (c) Students
 - (d) Ladies in the age group of 25-35, 35-45, 45- 55, 55-65, above 65
 - (e) Gents in the age group of 25-35, 35-45, 45- 55, 55-65, above 65

Course Outcome 3 (CO 3):

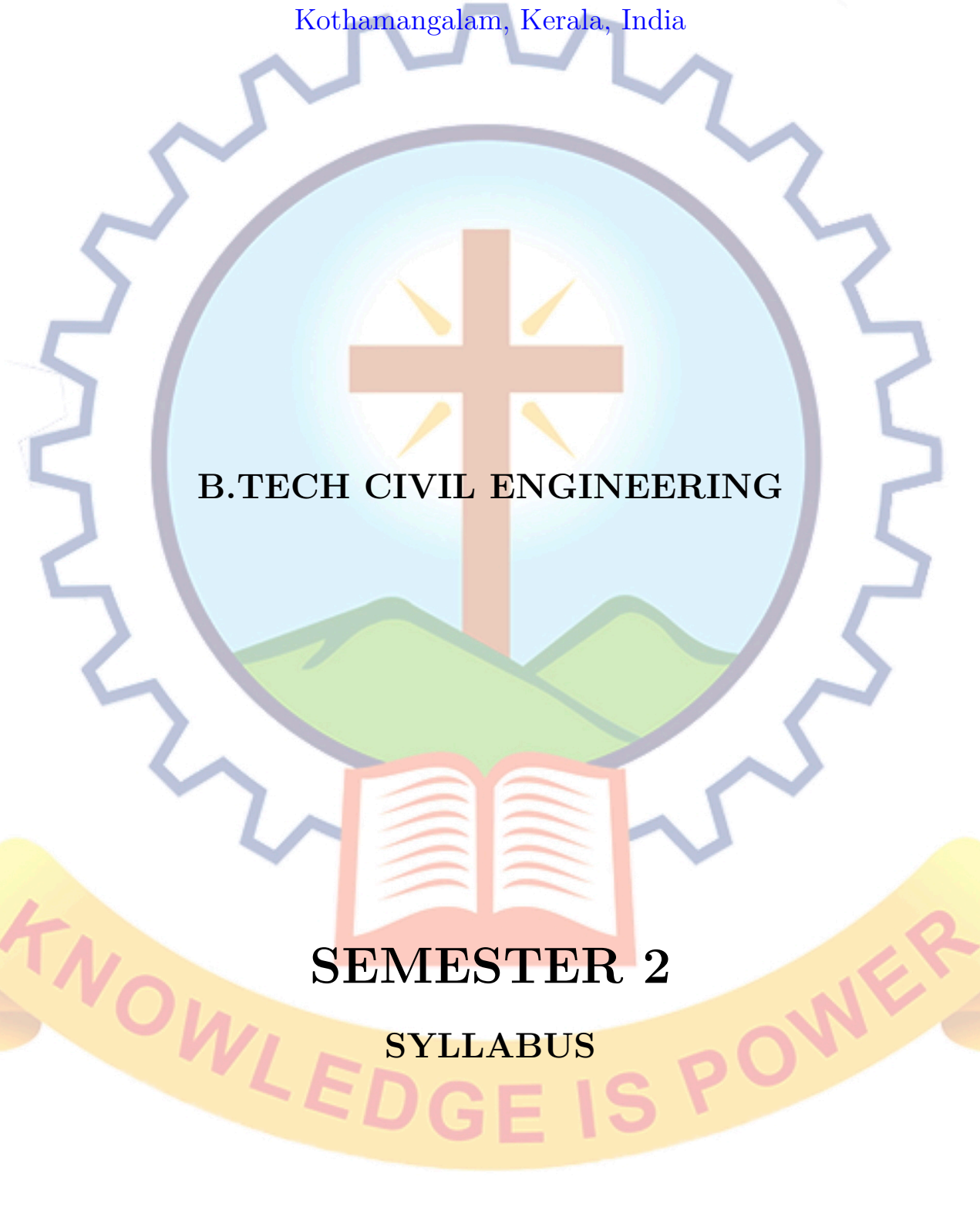
1. With a role play, illustrate various first aid activities that can be followed at various situation in life. In each illustration, try to give emphasis on dos and don'ts to be followed in each situation.

Course Outcome 4 (CO 4):

1. Observe at least 10 students in your class and identify common postural deformities each one of them have. Also identify good posters they follow. Have a discussion with each one of them to identify whether they have already recognized it or not. Prepare a report on this including your thoughts on the diet they take and its impact on their health.

MAR ATHANASIOUS COLLEGE OF ENGINEERING

Government Aided, Autonomous Institution
Kothamangalam, Kerala, India



B.TECH CIVIL ENGINEERING

SEMESTER 2

SYLLABUS

KNOWLEDGE IS POWER

SEMESTER 2

SLOT	COURSE NO.	COURSES	L-T-P-S	HOURS	CREDIT
A	B24MA1T02	ORDINARY DIFFERENTIAL EQUATIONS AND TRANSFORMS	3-1-0-5	4	4
B	B24PH1T01B	ENGINEERING PHYSICS (B)	2-1-0-4	3	3
C	B24CY1T01B	ENGINEERING CHEMISTRY (B)	2-1-0-4	3	3
D	B24ES1T04	BASIC ELECTRICAL AND MECHANICAL ENGINEERING	2-2-0-5	4	4
E	B24CE1T03	SURVEYING AND GEOMATICS	2-1-0-4	3	3
F	B24ES1L03	MECHANICAL AND ELECTRICAL WORKSHOP	0-0-2-1	2	1
G	B24CE1L02	ENGINEERING MECHANICS LAB	0-0-3-2	3	2
H	B24PC1L01B	PHYSICS (B) AND CHEMISTRY (B) LAB	0-0-2-2	2	1
I	B24MC1T03	PROFESSIONAL COMMUNICATION AND ETHICS	2-0-1-3	3	P/F
J	B24MC1L02	IDEA LAB	0-0-3-3	3	P/F
			TOTAL	30	21

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24MA1T02	ORDINARY DIFFERENTIAL EQUATIONS AND TRANSFORMS	3	1	0	5	4	2024

Preamble

This course introduces the concepts and applications of differential equations, sequence and series including power series and basic transforms such as Laplace and Fourier transforms. The objective of this course is to familiarize the prospective engineers with some advanced concepts and methods in Mathematics which include differential equations, sequence, series and transforms. The topics treated in this course have applications in all branches of engineering.

Prerequisites: Nil.

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Solve homogeneous and non-homogeneous linear differential equation with constant coefficients (Cognitive Knowledge Level: Apply)
CO 2	Perform various tests to determine whether a given series is convergent, absolutely convergent or conditionally convergent (Cognitive Knowledge Level: Apply)
CO 3	Determine the Taylor and Fourier series expansion of functions and learn their applications. (Cognitive Knowledge Level: Apply)
CO 4	Determine the Fourier transforms of functions and apply them to solve problems arising in engineering (Cognitive Knowledge Level: Apply)
CO 5	Compute Laplace transform and apply them to solve ordinary differential equations arising in engineering (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	1	1	0	0	0	0	0	0	0	0	0
CO 2	1	1	0	0	0	1	0	0	0	0	0
CO 3	1	1	0	0	0	0	0	0	0	0	0
CO 4	1	1	0	0	1	0	0	0	0	0	0
CO 5	1	1	0	1	1	1	1	0	0	0	1

Assessment Pattern

ORDINARY DIFFERENTIAL EQUATIONS AND TRANSFORMS			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	20	20	20
Understand	40	40	40
Apply	40	40	40
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course Project	: 10 marks
Self Study	: 5 marks

There will be two parts; Part A and Part B. Part A contain 10 questions carrying 3 marks each. Part B contains 2 questions from each module out of which 1 to be answered. Each question carries 14 marks and can have maximum 2 sub divisions.

SYLLABUS

MODULE 1 (Ordinary Differential Equations)

(Text 2: Relevant topics from sections 2.1, 2.2, 2.5,2.6, 2.7, 2.10, 3.1, 3.2, 3.3)

Homogenous linear differential equation of second order, superposition principle, general solution, homogenous linear ODEs with constant coefficients-general solution. Solution of Euler-Cauchy equations (second order only). Existence and uniqueness (without proof). Non homogenous linear ODEs-general solution, solution by the method of undetermined coefficients(for the right hand side of the form $x^n, e^{kx}, \sin ax, \cos ax$ and their linear combinations) , methods of variation of parameters. Solution of higher order equations-homogeneous and non-homogeneous with constant coefficients using method of undetermined coefficients.

MODULE 2 (Sequences and Series)

(Text 1: Relevant topics from sections 9.1, 9.3, 9.4, 9.5, 9.6)

Convergence of sequences and series, convergence of geometric series and p-series (without proof), tests of convergence (comparison, limit comparison, ratio and root tests without proof); Alternating series and Leibnitz test, absolute and conditional convergence.

MODULE 3 (Fourier Series)

(Text 1: Relevant topics from sections 9.8, 9.9. Text 2: Relevant topics from sections 11.1, 11.2, 11.6)

Taylor series (without proof, assuming the possibility of power series expansion in appropriate domains), Binomial series and series representation of exponential, trigonometric, logarithmic functions (without proofs of convergence); Fourier series, Euler formula, Convergence of Fourier series (without proof), half range sine and cosine series.

MODULE 4 (Fourier Transforms)

(Text 2: Relevant topics from sections 11.7, 11.8, 11.9)

Fourier integral representation, Fourier sine and cosine integrals. Fourier sine and cosine transforms, inverse sine and cosine transform. Fourier transform and inverse Fourier transform, basic properties. The Fourier transform of derivatives. Convolution theorem (without proof).

MODULE 5 (Laplace Transforms)

(Text 2: Relevant topics from sections 6.1, 6.2 ,6.3, 6.4, 6.5)

Laplace Transform and its inverse, Existence theorem (without proof), linearity, Laplace transform of basic functions, first shifting theorem, Laplace transform of derivatives and integrals, solution of differential equations using Laplace transform, Unit step function, Second shifting theorem. Dirac delta function and its Laplace transform, Solution of ordinary differential equation involving unit step function and Dirac delta functions. Convolution theorem (without proof) and its application to finding inverse Laplace transform of products of functions.

Text Books

1. H. Anton, I. Biven, S. Davis, “Calculus”, Wiley, 10th edition, 2015.
2. Erwin Kreyszig, “Advanced Engineering Mathematics”, 10th edition, John Wiley & Sons, 2016.

Reference Books

3. J. Stewart, “Essential Calculus”, Cengage, 2nd edition, 2017.
4. G.B. Thomas and R.L. Finney, “Calculus and Analytic geometry”, 9th Edition, Pearson, Reprint, 2002.
5. Peter O Neil, “Advanced Engineering Mathematics”, 7th Edition, Thomson, 2007.
6. Louis C Barret, C Ray Wylie, “Advanced Engineering Mathematics”, Tata McGraw Hill, 6th edition, 2003.
7. Veerarajan T, “Engineering Mathematics for first year”, Tata McGraw - Hill, 2008.
8. B.S. Grewal, “Higher Engineering Mathematics”, Khanna Publishers, 43 Edition, 2015.
9. Ronald N. Bracewell, “The Fourier Transform and its Applications”, McGraw – Hill International Editions, 2000.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1: Ordinary Differential Equations	9
1.1	Homogenous linear equation of second order, Superposition principle, general solution.	1
1.2	Homogenous linear ODEs of second order with constant coefficients.	2
1.3	Second order Euler-Cauchy equation.	1
1.4	Non homogenous linear differential equations of second order with constant coefficient-solution by undetermined coefficients, variation of parameters.	3
1.5	Higher order equations with constant coefficients.	2
2	Module 2: Sequences and Series	9
2.1	Convergence of sequences and series, geometric and p-series.	2
2.2	Test of convergence (comparison, ratio and root).	4
2.3	Alternating series and Leibnitz test, absolute and conditional convergence	3
3	Module 3: Fourier series	9
3.1	Taylor series, Binomial series and series representation of exponential, trigonometric, logarithmic functions.	3
3.2	Fourier series, Euler formulas, Convergence of Fourier series (Dirichlet's conditions)	3
3.3	Half range sine and cosine series.	3
4	Module 4: Fourier Transforms	9
4.1	Fourier integral representation.	1
4.2	Fourier Cosine and Sine integrals and transforms.	2

4.3	Complex Fourier integral representation, Fourier transform and its inverse transforms, basic properties.	3
4.4	Fourier transform of derivatives, Convolution theorem	3
5	Module 5: Laplace Transforms	9
5.1	Laplace Transform , inverse Transform, Linearity, First shifting theorem, transform of basic functions.	2
5.2	Transform of derivatives and integrals.	1
5.3	Solution of Differential equations, Initial value problems by Laplace transform method.	2
5.4	Unit step function - Second shifting theorem.	1
5.5	Dirac Delta function and solution of ODE involving Dirac delta function.	2
5.6	Convolution and related problems.	1
Total		45 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1): Solve homogeneous and nonhomogeneous linear equation with constant coefficients.

1. Find the general solution to $2x^2 \frac{d^2y}{dx^2} + x \frac{dy}{dx} - 3y = 0$ given that $y_1(x) = \frac{1}{x}$ is a solution.
2. Solve the initial value problem $x^2 y'' - 3xy' + 4y = 0$ given that $y(1) = \pi, y'(1) = 4\pi$
3. By the method of undetermined coefficients, solve $y'' - 2y' + y = e^x \cos 2x$

Course Outcome 2 (CO 2): Perform various tests to determine whether a given series is convergent, absolutely convergent or conditionally convergent.

1. Find the sum of the series $\sum_{n=1}^{\infty} \frac{1}{9n^2+3n-2}$, if it is convergent.
2. Examine the convergence of $\sum_{n=1}^{\infty} \left(\frac{n}{n+1} \right)^{n^2}$
3. Determine whether the series $\sum_{n=1}^{\infty} \frac{(-1)^n n^4}{4^n}$ is absolutely convergent.

Course Outcome 3 (CO 3): Determine the power series expansion of a given function.

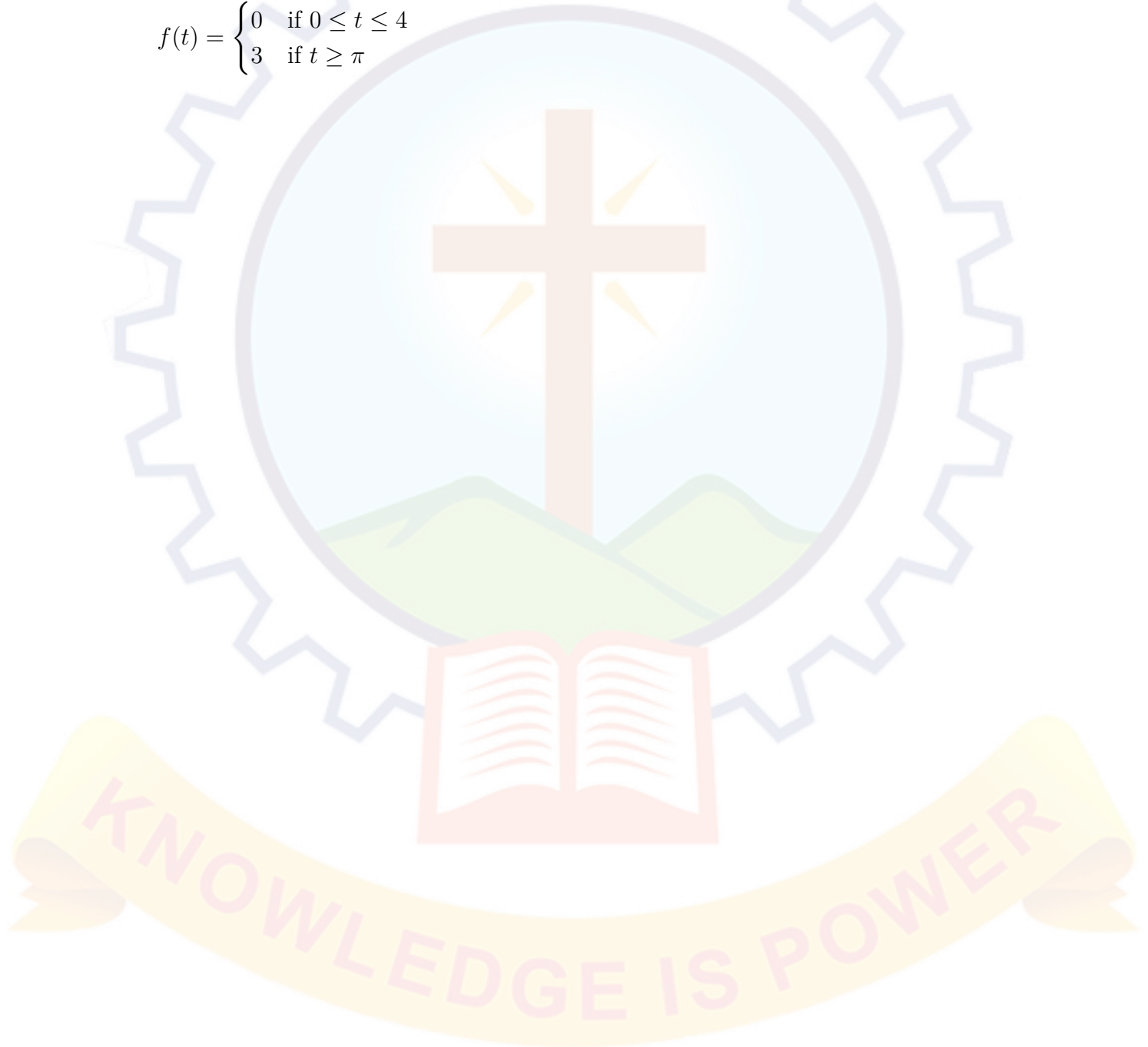
1. Find the Taylor's series representation of $f(x) = \sin \pi x$ about $x = 1$
2. Determine the binomial series representation of $\frac{1}{\sqrt{(2+x)^3}}$
3. Find the Fourier series of the periodic function $f(x)$ of period 2, where $f(x) = \begin{cases} -1 & -1 \leq x \leq 0 \\ 2x & 0 \leq x \leq 1 \end{cases}$ and deduce that $1 + \frac{1}{3^2} + \frac{1}{5^2} + \dots = \frac{\pi^2}{8}$.

Course Outcome 4 (CO 4): Determine the Fourier transforms of functions and apply them to solve problems arising in engineering .

1. Find the Fourier integral representation of function defined by $f(x) = e^{-x}$ for $x > 0$ and $f(x) = 0$ for $x < 0$.
2. What are the conditions for the existence of Fourier Transform of a function $f(x)$?
3. Find the Fourier Transform of $f(x) = x$ for $|x| \leq 1$ and $f(x) = 0$ otherwise.

Course Outcome 5 (CO 5): Compute Laplace transform and apply them to solve ODEs arising in engineering.

1. What is the inverse Laplace Transform of $\frac{3s+2}{(s-1)(s^2+2s+5)}$
2. Find Laplace Transform of (i) $e^{-t}\sin^2 t$ (ii) $\delta(t-a)$
3. Solve the differential equation $y'' + 4y = f(t)$, $y(0) = 1$, $y'(0) = 0$ where
$$f(t) = \begin{cases} 0 & \text{if } 0 \leq t \leq 4 \\ 3 & \text{if } t \geq \pi \end{cases}$$



MODEL QUESTION PAPER

QP CODE:

Pages: 2

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

SECOND SEMESTER B. TECH DEGREE EXAMINATION, YEAR

Course Code: B24MA1T02

ORDINARY DIFFERENTIAL EQUATIONS AND TRANSFORMS

Common to all branches

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Check whether $x, \ln x$ are linearly independent or not.
2. Solve $y''' + 9y' = 0$.
3. Find the rational number represented by the repeating decimal 5.373737...
4. Examine the convergence of $\sum_{k=1}^{\infty} \frac{1}{k!}$
5. Find the binomial series for $f(x) = (1+x)^{\frac{1}{3}}$ upto third degree term.
6. Obtain the half range sine series expansion of $f(x) = \pi x - x^2$ in $(0, \pi)$.
7. Find the cosine integral representation of the function $f(x) = \begin{cases} 1 & ; 0 < x < 1 \\ 0 & ; x > 1 \end{cases}$
8. Find the Fourier cosine transform of e^{-x} , $x > 0$.
9. Find the Laplace transform of $\sin^2 2t$.
10. Find $L^{-1} \left\{ \frac{1}{(s-1)(s-2)} \right\}$.

PART B

Answer any one question from each module. Each question carries 14 marks

11. (a) Solve the initial value problem $y'' + 9y = 0, y(0) = 0.2, y'(0) = -1.5$. 7
(b) By the method of variation of parameters solve $y'' + 4y = \tan 2x$. 7

OR

12. (a) By the method of undetermined coefficients solve $y'' + 2y' + 4y = 3e^{-x}$. 7
(b) Solve $x^2y'' + xy' + 9y = 0, y(1) = 0, y'(1) = 2.5$. 7
13. (a) Test the convergence of (i) $\sum_{k=1}^{\infty} \frac{3k^3 - 2k^2 + 4}{k^7 - k^3 + 2}$ (ii) $\sum_{k=1}^{\infty} \frac{k^k}{k!}$. 7
(b) Check the convergence of the series $1 + \frac{1.3}{3!} + \frac{1.3.5}{5!} + \frac{1.3.5.7}{7!} + \dots$ 7

OR

14. (a) Determine whether the series $\sum_{k=1}^{\infty} \frac{1}{\sqrt{k+1}}$ is absolutely convergent or conditionally convergent. 7
(b) Test the convergence of (i) $\sum_{k=1}^{\infty} \frac{k!}{3!(k-1)!3^k}$ (ii) $\sum_{k=1}^{\infty} \left(\frac{4k-5}{2k+1}\right)^k$ 7
15. (a) Expand into a Fourier series, $f(x) = e^{-x}, 0 < x < 2\pi$. 7
(b) Obtain the half range Fourier sine series of $f(x) = \begin{cases} x & , 0 < x < \frac{\pi}{2} \\ \pi - x & , \frac{\pi}{2} < x < \pi \end{cases}$ 7

OR

16. (a) Find the Fourier series expansion of $f(x) = x^2$ in the interval $-\pi < x < \pi$.
Hence show that $1 - \frac{1}{2^2} + \frac{1}{3^2} - \frac{1}{4^2} + \dots = \frac{\pi^2}{12}$. 7
(b) Find the half range cosine series for $f(x) = (x-1)^2$ in $0 \leq x \leq 1$. 7
17. (a) Find the Fourier transform of $f(x) = \begin{cases} 1 & \text{if } |x| < 1 \\ 0 & \text{otherwise} \end{cases}$ 7
(b) Find the Fourier sine integral of $f(x) = \begin{cases} \sin x & , 0 \leq x \leq \pi \\ 0 & , x > \pi \end{cases}$ 7

OR

18. (a) Using Fourier integral representation show that $\int_0^{\infty} \frac{\cos wx}{1+w^2} dw = \frac{\pi}{2} e^{-x}, x > 0$. 7
(b) Find the Fourier sine transform of $f(x) = \begin{cases} k & , 0 < x < a \\ 0 & , x > a \end{cases}$ 7
19. (a) Find the Laplace transform of (i) $t \sin 2t$ (ii) $e^{-t} \sin 3t \cos 2t$ 7
(b) Using convolution theorem find $L^{-1} \left\{ \frac{1}{s(s^2+4)} \right\}$ 7

OR

20. (a) Find $L^{-1} \left\{ \frac{4s+5}{(s+2)(s-1)^2} \right\}$ 7
(b) Use Laplace transform to solve $y'' + 2y' + 2y = 0, y(0) = y'(0) = 1$. 7

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24PH1T01B	ENGINEERING PHYSICS (B)	2	1	0	4	3	2024

Preamble

The aim of this course is to equip students with a solid foundation in physics principles and knowledge of their engineering applications. This will enhance the students' ability to analyze and solve complex engineering problems. Ultimately, the goal is to produce graduates who are well prepared to tackle real world engineering challenges with a deep understanding of the underlying physical principles.

Prerequisites: Nil.

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Analyze the phenomenon of oscillations and quantify the distinction between undamped, damped and forced oscillations. (Cognitive Knowledge Level: Apply)
CO 2	Apply laws of Physics in the design and analysis of different types of sensors. (Cognitive Knowledge level: Apply)
CO 3	Understand the different types of chemical bonds, the concept of dislocations in materials and their influence on the mechanical properties of materials. (Cognitive Knowledge level: Apply)
CO 4	Quantify architectural and acoustic characteristics of buildings, gain familiarity with the principles and applications of ultrasonic testing for flaw detection and the design of ultrasonic transducers and systems. (Cognitive Knowledge level: Apply)
CO 5	Understand the principle and structure of lasers and the working of optical fibers. (Cognitive Knowledge level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	2	1	0	0	0	0	0	0	1	0	0
CO 2	2	1	1	1	1	0	0	0	1	0	0
CO 3	2	0	0	0	0	0	0	0	1	0	0
CO 4	2	0	1	1	1	1	0	0	1	0	0
CO 5	2	0	0	1	1	1	0	0	1	0	1

Assessment Pattern

ENGINEERING PHYSICS (B)			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	30	30	30
Understand	50	50	50
Apply	20	20	20
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course Project	: 10 marks
Self Study	: 5 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contains 10 questions carrying 3 marks each. Part B contains 2 questions from each module out of which 1 to be answered. Each question carries 14 marks and can have maximum 2 sub divisions.

SYLLABUS

MODULE 1 (7 hours)

Oscillations: Simple Harmonic Oscillator - differential equation, solution - torsion pendulum Damped harmonic oscillator - differential equation and solution (underdamped case), comparison with undamped harmonic oscillator, logarithmic decrement, relaxation time, Q factor, Forced Harmonic Oscillator - differential equation and its solution, Analysis of the solution - amplitude resonance

MODULE 2 (8 hours)

Sensors: Introduction and classification, Sensor characteristics (definition only): Static characteristics - transfer function - sensitivity, calibration - calibration error, hysteresis, resolution, output impedance; Dynamic characteristics - zero order, first order and second order sensors (qualitative ideas only).

Sensor elements (principle of working and operation): Resistive elements - Potentiometric measurement of linear and angular displacement, resistive strain gauge; Capacitive elements - capacitive sensor architectures, capacitive displacement and liquid level sensors; Inductive elements - LVDT; Hall effect sensors

MODULE 3 (8 hours)

Bonding in Materials: Ionic, Covalent, Metallic and Van der Waals bonding; Bonding Energy. Crystalline State - crystal planes and directions - Miller indices, Defects in Crystals - zero, one and two dimensional defects, Grain Boundaries. Movement of atoms - Slip Along Atomic Planes - Dislocation Movement - edge and screw dislocations, Burger vector, Solid state Diffusion - Fick's Laws

MODULE 4 (7 hours)

Acoustics & Ultrasonics: Acoustics - Characteristics of Sound waves - Pitch, Loudness - Decibel, Absorption coefficient, Reverberation - Reverberation time - Significance, Sabine's formula and applications.

Ultrasonics-Production- Magnetostriction effect and Piezoelectric effect, Magnetostriction oscillator and Piezoelectric oscillator – Working, Applications - SONAR, NDT

MODULE 5 (6 hours)

Laser & Fibre Optics:

Optical processes - Absorption, Spontaneous emission and stimulated emission, - Einstein's relations. Principle of laser - conditions for sustained lasing - components of laser - Population inversion - energy source - Pumping, Metastable states - active medium, optical resonator. Construction and working of Ruby laser.

Optic fiber-Principle of propagation of light, Numerical aperture – Derivation Applications of fibers - Intensity modulated sensors.

Text Books

1. Aruldas G., "Engineering Physics", PHI Pvt. Ltd., 2015
2. M.N. Avadhanulu, P.G. Kshirsagar, TVS Arun Murthy, "A Textbook of Engineering Physics", S.Chand & Co., Revised Edition, 2019.
3. James F. Shackelford, "Introduction to Material Science for Engineers", Pearson, Eighth Edition, 2015.
4. Jacob Fraden, "Handbook of Modern Sensors - Physics, Designs, and Applications", Springer, Fourth Edition, 2010.
5. John P. Bentley, "Principles of Measurement Systems", Pearson Education Limited, Fourth Edition, 2005.

Reference Books

1. Arthur Beiser, "Concepts of Modern Physics ", Tata McGraw Hill Publications, 6th Edition 2003
2. D.K. Bhattacharya, Poonam Tandon, "Engineering Physics", Oxford University Press, 2015
3. Md.N.Khan & S.Panigrahi "Principles of Engineering Physics 1&2", Cambridge University Press, 2016
4. Ajoy Ghatak, "Optics", McGraw Hill Education, Sixth Edition, 2017

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
	Module 1: Oscillations	7
1.1	Simple Harmonic Oscillator - differential equation, solution - torsion pendulum	3
1.2	Damped harmonic oscillator - differential equation and solution (underdamped case), comparison with undamped harmonic oscillator, logarithmic decrement, relaxation time, Q factor	2
1.3	Forced Harmonic Oscillator - differential equation and its solution, Analysis of the solution - amplitude resonance	2
	Module 2: Sensors	8
2.1	Sensors - Introduction and classification, Sensor characteristics (definition only): Static characteristics - transfer function - sensitivity, calibration - calibration error, hysteresis, resolution, output impedance; Dynamic characteristics - zero order, first order and second order sensors (qualitative ideas only)	2
2.2	Sensor elements (principle of working and operation): Resistive elements - Potentiometric measurement of linear and angular displacement, resistive strain gauge; Capacitive elements - capacitive sensor architectures, capacitive displacement and liquid level sensors; Inductive elements - LVDT; Hall effect sensors	6
	Module 3: Bonding in Materials	8
3.1	Bonding in materials - Ionic, Covalent, Metallic and Van der Waals bonding; Bonding Energy	2
3.2	Crystalline State - crystal planes and directions - Miller indices, Defects in Crystals - zero, one and two dimensional defects, Grain Boundaries	3
3.3	Movement of atoms - Slip Along Atomic Planes - Dislocation Movement - edge and screw dislocations, Burger vector, Solid state Diffusion - Fick's Laws	3

	Module 4: Acoustics & Ultrasonics	7
4.1	Acoustics - Characteristics of Sound waves - Pitch, Loudness - Decibel, Absorption coefficient, Reverberation - Reverberation time - Significance, Sabine's formula and applications	3
4.2	Ultrasonics-Production- Magnetostriction effect and Piezoelectric effect, Magnetostriction oscillator and Piezoelectric oscillator – Working, Applications - SONAR, NDT	4
	Module 5: Laser & Fibre Optics	6
5.1	Optical processes - Absorption, Spontaneous emission and stimulated emission - Einstein's relations	1
5.2	Principle of laser - conditions for sustained lasing - components of laser - Population inversion - energy source - Pumping, Metastable states - active medium, optical resonator	2
5.3	Construction and working of Ruby laser	1
5.4	Optic fibre-Principle of propagation of light, Numerical aperture – Derivation	1
5.5	Applications of fibres - Intensity modulated sensors	1
Total		36 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Define SHM.
2. Define Q factor of a DHO.
3. Explain amplitude resonance.

Course Outcome 2 (CO 2):

1. List the dynamic characteristics of a sensor.
2. Explain the working of a Hall Effect sensor.
3. What is an LVDT?

Course Outcome 3 (CO 3):

1. Differentiate between covalent, metallic and Van der Waal bonding.
2. State Fick's Laws governing solid state diffusion.
3. Describe Edge dislocation.

Course Outcome 4 (CO 4):

1. Write Sabine's formula.
2. What is the change in dB level when the intensity of a source of sound is doubled?
3. Explain two methods of ultrasonic NDT.

Course Outcome 5 (CO 5):

1. Describe the principle of LASER.
2. Why are metastable levels needed in a LASER?
3. Write a note on intensity modulated sensors.

MODEL QUESTION PAPER

QP CODE:

Pages: 2

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

SECOND SEMESTER B. TECH DEGREE EXAMINATION, YEAR

Course Code: B24PH1T01B

ENGINEERING PHYSICS (B)

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Derive the differential equation of a DHO.
2. Define Q factor. What are the factors on which it depends?
3. Differentiate between first order and second order sensors.
4. Explain transfer function, sensitivity and calibration error of a sensor.
5. Explain edge and screw dislocations.
6. State Fick's Laws of solid state diffusion.
7. Differentiate between reverberation and echo.
8. Mention any three applications of ultrasonics.
9. Explain the term population inversion.
10. Describe the principle of operation of optic fibers.

PART B

Answer any one question from each module. Each question carries 14 marks

11. (a) Derive the differential equation of an FHO. Obtain the expression for the amplitude of forced oscillations. 10

- (b) The amplitude of an underdamped harmonic oscillation reduces to $\frac{1}{10}^{th}$ of its initial value after 100 oscillations. Its time period is 1.15s. Calculate its relaxation time. 4

OR

12. (a) Frame and solve the differential equation of a DHO and find the solution for the overdamped case. Show graphically the variation of its displacement with time. 10
(b) DHO of mass 2g has a force constant of 10Nm^{-1} and a damping constant of 2s^{-1} . Find the angular frequency with and without damping. 8
13. (a) Explain any six static characteristics of a sensor. 6
(b) With the help of a neat diagram, explain the working of a Hall Effect sensor. 8

OR

14. (a) Explain the dynamical characteristics of a sensor. 6
(b) Explain, with the help of a neat schematic diagram, the working of a resistive strain gauge. 8
15. (a) Explain the terms defects, slip and dislocation movements in crystals. 8
(b) Explain solid state diffusion. State Fick's Laws. 6

OR

16. (a) Explain the classification of materials based on the bonding. What are the bonding energies in each case? 10
(b) Calculate the Miller indices of a plane whose intercepts are a, b2 and con the crystallographic axes respectively in a simple cubic cell. 4
17. (a) Derive Sabine's formula and explain its applications. 10
(b) A hall has a volume of 1000m^3 and a total absorption equivalent to 100m^2 of OWU. What will be the effect on its reverberation time if the audience fills the hall thereby increasing the absorption by 150m^2 of OWU? 4

OR

18. (a) Explain piezoelectric effect and the working of a piezoelectric ultrasonic generator. 10
(b) A quartz crystal of thickness 1mm vibrates at resonance. Calculate its fundamental frequency if its Young's modulus is $7.96 \times 10^9 \text{Nm}^{-2}$ and density is 2670kgm^{-3} . 4
19. (a) Explain the construction and working of Ruby laser. 10
(b) Describe shortly the main components of a laser system. 4

OR

20. (a) Derive the expression for the Numerical Aperture of an optic fiber. 10
(b) Calculate the N.A. of an optic fiber having core index of 1.54 and cladding index of 1.5. 4

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CY1T01B	ENGINEERING CHEMISTRY (B)	2	1	0	4	3	2024

Preamble

To equip the students with an extensive understanding of the concepts of chemistry specifically adapted for engineering applications. Students will be introduced to application oriented topics including electrochemistry, corrosion control methods and water purification technologies. Additionally, students will acquire knowledge about topics like nanomaterials, spectroscopy, Scanning Electron Microscopy, polymers, ceramics etc. This will enable the students to develop the abilities and skills relevant for the study and practice of chemistry in their respective field of engineering.

Prerequisites: Nil.

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Develop a comprehensive understanding of nanoscale materials, including their synthesis, fundamental properties and diverse applications. (Cognitive Knowledge Level: Apply)
CO 2	Understand the principles and applications of various spectroscopic techniques and microscopic techniques such as SEM. (Cognitive Knowledge Level: Apply)
CO 3	Demonstrate an inclusive understanding of the principles of electrochemistry and corrosion. Also gain knowledge about various corrosion control methods. (Cognitive Knowledge Level: Apply)
CO 4	Understand various drinking water purification and water softening techniques. Also recognize the importance of ensuring access to safe and clean drinking water for public health. (Cognitive Knowledge Level: Apply)
CO 5	Acquire knowledge about various types of polymers and ceramics, and their potential applications in the field of engineering. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	2	1	1	1	1	1	0	0	1	0	1
CO 2	2	2	0	2	1	0	0	0	1	0	1
CO 3	2	1	0	0	1	0	0	0	1	0	1
CO 4	2	2	1	0	1	0	0	0	1	0	1
CO 5	2	1	1	1	1	1	0	0	1	0	1

Assessment Pattern

ENGINEERING CHEMISTRY (B)			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	30	30	30
Understand	50	50	50
Apply	20	20	20
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course Project	: 10 marks
Self Study	: 5 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contain 10 questions carrying 3 marks each. Part B contains 2 questions from each module out of which 1 to be answered. Each question carries 14 marks and can have maximum 2 sub divisions.

SYLLABUS

MODULE 1 (7 hours)

Fundamentals of Nanomaterials

Introduction - Classification - Based on dimension and structural composition - Nanoscale materials – Introduction - Properties and applications of Quantum dots, Graphene and Carbon nanotubes (CNT) – General Properties and applications of nanomaterials - Synthesis of nanomaterials – Top-Down and Bottom-Up approaches – Physical methods of synthesis - Mechanical milling, Laser ablation and Sputtering - Chemical methods of synthesis – Sol-Gel, co-precipitation and reduction.

MODULE 2 (8 hours)

Spectroscopic and Microscopic Techniques

Introduction - Types of spectrum - Electromagnetic spectrum - Molecular energy levels - Beer-Lambert's law – Numerical problems based on Beer-Lambert's law - Electronic spectroscopy (UV-vis) – Principle, instrumentation and applications - Types of electronic transitions - Vibrational spectroscopy (IR) – Principle and applications - Number of vibrational modes - Vibrational modes of CO_2 and H_2O – Force constant equation for diatomic molecules - Numerical problems based on force constant - Microscopic techniques - Scanning Electron Microscope (SEM) - Principle, instrumentation, working and applications.

MODULE 3 (7 hours)

Introduction to Electrochemistry and Corrosion Science

Introduction - Reference electrodes - Calomel electrode - Construction and working - Electrochemical series - Applications – Nernst equation for single electrode and cell (Derivation not required) – Applications – Effect of temperature on emf - Numerical problems based on Nernst equation - Corrosion – Introduction - Galvanic series - Types of corrosion – Galvanic and pitting corrosion - Corrosion control methods - Cathodic protection - Sacrificial anodic protection and impressed current cathodic protection – Electroplating of Copper - Electroless plating of Copper – Anodizing of Aluminium.

MODULE 4 (7 hours)

Water Quality and Treatment Techniques

Cells Hardness - Types of hardness – Temporary and permanent hardness - Units of hard-

ness - Degree of hardness – Numerical problems based of degree of hardness - Softening of water – Zeolite process and Ion exchange process - Principle, working and advantages - Drinking water purification technologies – Desalination - Reverse osmosis and Electrodialysis - Working, advantages and applications – Ultrafiltration - Advantages and disadvantages - UV irradiation - Advantages and disadvantages.

MODULE 5 (7 hours)

Introduction to Engineering Polymers and Ceramics

Polymers - Introduction – Thermoplastics and thermosetting plastics - Speciality polymers - Preparation, properties and applications of UPVC, Kevlar, SBR, PMMA and Epoxy resin - Self-healing polymers – Introduction, advantages, applications and examples - Biodegradable polymers – Introduction - Polylactic acid - Preparation, properties and applications - Cellulose – Structure, properties and applications - Composites – Introduction - Glass reinforced plastics - Introduction, Properties and applications – Ceramics – Introduction, properties and applications.

Text Books

1. Jain and Jain, “Engineering Chemistry”, Dhanpat Rai Publishing Company, 17th edition 2015.
2. Shashi Chawla, “A Text Book of Engineering Chemistry”, Dhanpat Rai and Co. (P) Limited, 2017.
3. Muhammed Arif, Annette Fernandez, Kavitha P. Nair, “Engineering Chemistry”, Owl Books, 2019.
4. Ahad J., “Engineering Chemistry”, Jai Publication, 2019.
5. Roy K. Varghese, “Engineering Chemistry”, Crown Plus Publishers, 2019.
6. Soney C. George, Rino Laly Jose, “Text Book of Engineering Chemistry”, S. Chand and Company Pvt. Ltd., 2019.
7. B. L. Tembe, Kamaluddin, M. S. Krishnan, “Engineering Chemistry (NPTEL Web Book)”, 2018.

Reference Books

1. T. Pradeep, “NANO: The Essentials: Understanding Nanoscience and Nanotechnology”, McGraw-Hill, 2008.
2. B. Rogers, J. Adams, S. Pennathur, “Nanotechnology: Understanding Small Systems”, CRC Press, 2014.
3. Donald L. Pavia, “Introduction to Spectroscopy”, Cengage Learning India Pvt. Ltd., 2015.
4. J. Goldstein, “Scanning Electron Microscopy and Microanalysis”, Springer, 2012.

5. H. H. Willard, L. L. Merritt, "Instrumental Methods of Analysis", CBS Publishers, 7th Edition, 2005.
6. Samuel Glasstone, "An Introduction to Electrochemistry", East-West Press Pvt. Ltd., 2006.
7. Pietro Pedferri, "Corrosion Science and Engineering", Springer Link, 2018.
8. Chittaranjan Ray and Ravi Jain, "Drinking Water Treatment: Focusing on Appropriate Technology and Sustainability", Springer, 2011.
9. James K. Edzwald, "Water Quality and Treatment: A Handbook on Drinking Water", McGraw-Hill, 2010.
10. Jane Kucera, "Desalination: Water from Water", Wiley, 2019.
11. Raymond B. Seymour, Charles E. Carraher, "Polymer Chemistry: An Introduction", Marcel Dekker Inc; 4th Revised Edition, 1996.
12. Fed W. Billmeyer, "Text Book of Polymer Science", John Wiley and Sons, 1984.
13. C. Barry Carter, M. Grant Norton, "Ceramic Materials: Science and Engineering", Springer, 2013.
14. Robert B. Heimann, "Classic and Advanced Ceramics: From Fundamentals to Applications", Wiley, 2010.
15. P. W. Atkins, "Physical Chemistry", Oxford University Press, 10th edn., 2014.
16. B. R. Puri, L. R. Sharma, M. S. Pathania, "Principles of Physical Chemistry", Vishal Publishing Co., 47th Edition, 2017.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
	Module 1 (Fundamentals of Nanomaterials)	7
1.1	Introduction - Classification - Based on dimension and structural composition.	1
1.2	Nanoscale materials – Introduction - Properties and applications of Quantum dots, Graphene and Carbon nanotubes (CNT) – General properties and applications of nanomaterials.	3
1.3	Synthesis of nanomaterials – Top-Down and Bottom-Up approaches – Physical methods of synthesis - Mechanical milling, Laser ablation and Sputtering - Chemical methods of synthesis – Sol-Gel, co-precipitation and reduction.	3
	Module 2 (Spectroscopic and Microscopic Techniques)	8
2.1	Introduction - Types of spectrum - Electromagnetic spectrum - Molecular energy levels - Beer-Lambert's law – Numerical problems based on Beer-Lambert's law.	3
2.2	Electronic spectroscopy (UV-vis) – Principle, instrumentation and applications - Types of electronic transitions - Vibrational spectroscopy (IR) – Principle and applications - Number of vibrational modes - Vibrational modes of CO_2 and H_2O – Force constant equation for diatomic molecules - Numerical problems based on force constant.	4
2.3	Microscopic techniques - Scanning Electron Microscope (SEM) - Principle, instrumentation, working and applications.	1

	Module 3 (Introduction to Electrochemistry and Corrosion Science)	7
3.1	Introduction - Reference electrodes - Calomel electrode - Construction and working - Electrochemical series - Applications – Nernst equation for single electrode and cell (Derivation not required) – Applications – Effect of temperature on emf - Numerical problems based on Nernst equation.	3
3.2	Corrosion – Introduction - Galvanic series - Types of corrosion – Galvanic and pitting corrosion - Corrosion control methods - Cathodic protection - Sacrificial anodic protection and impressed current cathodic protection.	2
3.3	Electroplating of Copper - Electroless plating of Copper – Anodizing of Aluminium	2
	Module 4 (Water Quality and Treatment Techniques)	7
4.1	Hardness - Types of hardness – Temporary and permanent hardness - Units of hardness - Degree of hardness – Numerical problems based of degree of hardness.	2
4.2	Softening of water – Zeolite process and Ion exchange process - Principle, working and advantages.	2
4.3	Drinking water purification technologies – Desalination - Reverse osmosis and Electrodialysis - Working, advantages and applications – Ultrafiltration - Advantages and disadvantages - UV irradiation - Advantages and disadvantages.	3
	Module 5 (Introduction to Engineering Polymers and Ceramics)	7
5.1	Polymers - Introduction – Thermoplastics and thermosetting plastics - Speciality polymers - Preparation, properties and applications of UPVC, Kevlar, SBR, PMMA and Epoxy resin.	3
5.2	Self-healing polymers – Introduction, advantages, applications and examples - Biodegradable polymers – Introduction - Polylactic acid - Preparation, properties and applications - Cellulose – Structure, properties and applications.	2
5.3	Composites – Introduction - Glass reinforced plastics - Introduction, Properties and applications – Ceramics – Introduction, properties and applications.	2
Total		36 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. What are nanomaterials? Give two properties.
2. Comment on the structure of graphene.
3. How nanomaterials are synthesized by reduction?

Course Outcome 2 (CO 2):

1. How spectroscopy is classified based on the nature of interacting species?
2. What are the limitations of Beer-Lambert's law?
3. Why electromagnetic lenses are used in SEM?

Course Outcome 3 (CO 3):

1. How equilibrium constant is determined using electrochemical series?
2. Give any two differences between electrochemical series and galvanic series.
3. Write the representation and reduction reaction of calomel electrode.

Course Outcome 4 (CO 4):

1. Define two units of hardness?
2. Explain the regeneration of ion exchange resins.
3. How water is sterilized using UV irradiation? Give two advantages.

Course Outcome 5 (CO 5):

1. Give the structure and two properties of Kevlar.
2. Comment on the advantages of self-healing polymers.
3. What are ceramics? Give two properties.

MODEL QUESTION PAPER

QP CODE:

Pages: 2

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

SECOND SEMESTER B. TECH DEGREE EXAMINATION, YEAR

Course Code: B24CY1T01B

ENGINEERING CHEMISTRY (B)

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Give any three applications of nanomaterials.
2. Differentiate SWNT and MWNT.
3. State Beer-Lambert's law. Give the mathematical expression.
4. Explain how vibrational spectroscopy is used to distinguish inter and intra molecular H-bonding?
5. What are reference electrodes? Give two examples.
6. How corrosion is prevented by sacrificial anodic protection?
7. Discuss the chemistry behind the removal of temporary hardness by boiling.
8. Define degree of hardness.
9. Comment on the behaviour of thermoplastics and thermosetting plastics on heating.
10. Draw the structure of cellulose.

PART B

Answer any one question from each module. Each question carries 14 marks

11. (a) How nanomaterials are classified based on dimension and structural composition?
Give examples. 8

- (b) What are quantum dots? Give its properties and applications. 6

OR

12. (a) Describe laser ablation and sol-gel methods for the synthesis of nanomaterials. 8
(b) What is graphene? Give its properties and applications. 6
13. (a) Explain the various electronic transitions with examples. 8
(b) Illustrate the vibrational modes of CO_2 and H_2O . 6

OR

14. (a) Explain the instrumentation and working of SEM. 8
(b) A solution of thickness 2 cm transmits 40% of the incident light. Calculate the concentration of the solution, if $\epsilon = 6000 \text{ Lmol}^{-1} \text{ cm}^{-1}$. 6
15. (a) Give the principle of electroless plating. How electroless plating of copper is carried out? 8
(b) Define electrochemical series. Explain any four applications. 6

OR

16. (a) Explain the construction and working of calomel electrode with a neat sketch. 8
(b) What is corrosion? Explain how iron undergoes pitting corrosion? 6
17. (a) What are ion exchange resins? Explain ion exchange process for the removal of hardness of water. How exhausted resins are regenerated? 10
(b) What is Reverse osmosis? How desalination of sea water is achieved through reverse osmosis? 4

OR

18. (a) Explain the working, advantages and applications of Electrodialysis. 8
(b) Calculate the temporary, permanent and total hardness of water sample which contains $\text{CaSO}_4 = 30 \text{ mg/L}$, $\text{MgSO}_4 = 35 \text{ mg/L}$, $\text{Ca}(\text{HCO}_3)_2 = 50 \text{ mg/L}$ and $\text{Mg}(\text{HCO}_3)_2 = 40 \text{ mg/L}$. 6
19. (a) Explain the synthesis, properties and applications of Kevlar and PMMA. 10
(b) What are self-healing polymers? Give examples. 4

OR

20. (a) Explain the synthesis, properties and applications of UPVC and SBR. 10
(b) List any two properties and applications of ceramics. 4

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24ES1T04	BASIC ELECTRICAL AND MECHANICAL ENGINEERING	2	2	0	5	4	2024

Preamble

The objective of this course is to provide an insight and inculcate the essentials of Electrical and Mechanical Engineering discipline to the students of Civil Engineering. This course aims to provide comprehensive knowledge about the fundamental principles and concepts of electrical and mechanical systems. It also enables Civil Engineers to understand the electrical and mechanical systems within various Civil Engineering applications and during construction. Completing the course, students gain the necessary knowledge for more advanced courses and practical applications.

Prerequisites: Nil.

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Understand the essential circuit components and the fundamental circuit laws governing electrical circuits. (Cognitive Knowledge Level: Understand)
CO 2	Recall the basics of electromagnetism and the fundamentals of electrical machines and three-phase systems. (Cognitive Knowledge Level: Remember)
CO 3	Apply the basic knowledge of household wiring components and analyze electrical wiring layout for small residential buildings. (Cognitive Knowledge Level: Apply)
CO 4	Illustrate the working of IC engines and hydraulic machines. (Cognitive Knowledge Level: Apply)
CO 5	Explain the basic principle of power transmission elements and material handling devices. (Cognitive Knowledge Level: Analyse)
CO 6	Describe the fundamentals of power plants engineering and air conditioning systems. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	3	2	1	0	1	1	1	1	1	1
CO 2	3	3	2	1	0	1	1	1	1	1	1
CO 3	3	2	2	1	0	1	1	1	1	1	1
CO 4	3	1	1	0	0	1	0	0	1	0	1
CO 5	3	1	2	0	0	1	0	0	1	0	1
CO 6	2	1	1	0	0	1	0	0	1	0	1

Assessment Pattern

BASIC ELECTRICAL AND MECHANICAL ENGINEERING			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	20	20	20
Understand	30	30	30
Apply	50	50	50
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course Project	: 10 marks
Self Study	: 5 marks

End Semester Examination Pattern

There will be two parts: Part I – Basic Electrical Engineering and Part II – Basic Mechanical Engineering. Part I and PART II carry 50 marks each. For the end semester examination, part I contains 2 parts - Part A and Part B. Part A contains 5 questions carrying 4 marks each (not exceeding 2 questions from each module). Part B contains 2 questions from each module, out of which one needs to be answered. Each question carries 10 marks and can have a maximum of 2 subdivisions. The pattern for the end-semester examination for part II is the same as that of part I. However, students should answer parts I and 2 in separate answer booklets.

SYLLABUS

MODULE 1 (7 hours)

DC Electric Circuits: Passive components - R, L, and C, Sources - current and voltage sources, Resistances in series and parallel, current and voltage division rule, Ohm's Law, Kirchoff's Laws (Numerical problems).

Alternating Current Fundamentals: Generation of single-phase voltage - frequency, time period, average value, RMS value (sine wave concept only), Form and peak factors- Phasor representation of R,L,C, RL, RC, and RLC circuits - concept of impedance, power - active, reactive, and apparent, power factor (Numerical problems).

MODULE 2 (8 hours)

DC Machines and Transformers: Faraday's laws, Lenz's law, statically and dynamically induced EMF. DC Generator- construction and working principle, types, applications. DC motor - working principle, types of DC motors, applications. Transformer (single-phase only) - Construction, types-Working principle. Construction, types.

Three-Phase AC Systems: Generation of three-phase voltages - phase sequence, Y- Δ connection (balanced only), relation between line and phase quantities, three-phase power, Single line diagram of a power system from generation to distribution.

MODULE 3 (8 hours)

Electrical wiring design: Electrical wiring system in domestic building - types of wiring, cables, Conduits, Switches and Outlets, switch boards, and distribution boards. Common power ratings of domestic gadgets, Codes and standards- Salient features of NEC, NBC and IE rule, NEC Symbols used in electrical wiring layout. Electrical lay out (single line diagram) for low- class domestic installation. Electrical load calculation- connected load method (Numerical problems).

Electrical Installation in Buildings: Protection devices - MCB, MCCB, ELCB/RCCB

and RCBO- Principle of operation-Rating and Specification, fuses-working and types. Electrical hazards and safety precautions-Earthing & need of earthing, types.

MODULE 4 (8 hours) Internal Combustion Engines: Introduction, Terminologies,

IC engine parts, Working of SI and CI engine, Two stroke and Four stroke engine, Air, Fuel, Cooling and Lubrication systems, CRDI and MPFI engines. Concept of hybrid engines.

Hydraulic Machines: Classification of hydraulic turbines, Working of Pelton, Francis, Kaplan turbines (Descriptions with figures only). Pumps: Classification, Working of Centrifugal and Reciprocating pumps.

MODULE 5 (8 hours)

Power Transmission Elements: Classification and applications of mechanical drives, Velocity ratio of belt drive, Length of belt, Slip in belt, Power transmitted, simple problems. Gear drive: Types, Gear Ratio, Simple, compound and epicyclic gear trains (simple descriptions only)

Material Handling: Objective, principle and selection of material handling equipment, Types of conveyors, parts and working of belt conveyors, screw conveyors and pneumatic conveyor- Hoisting machine, Elevators, Winches and Cranes – Types – Concrete Pumps -Types, Working (Descriptions only)

MODULE 6 (8 hours)

Power Plant Engineering: Hydel power plants: Layout, classifications and study of various components. Steam power plant: Layout, steam generators, study of various components. Gas turbine power plant and combined power plants, Layout. New generation power producing systems.

Air Conditioning: Units of Refrigeration, Refrigeration effect, Psychrometric properties, Psychrometric chart, Comfort conditions, window, split and centralized air condition system, Summer and Winter air-conditioning, Inverter Technology in Air conditioners, Solar Air conditioners.

Text Books

1. D. P. Kothari and I. J. Nagrath, “Basic Electrical Engineering,” 3rd Edition, Tata McGraw Hill.
2. J. B. Gupta, “Theory and Performance of Electrical Machines” 15th Edition, S. K. Katarina & Sons.
3. M.K. Giridharan, Electrical System Design.
4. J. Benjamin, “Basic Mechanical Engineering”, Pentex Books, 9th Edition, 2018

5. P. Balachandran, Basic Mechanical Engineering, Owl Books

Reference Books

1. C. L. Wadhwa, "Basic Electrical Engineering," 4th Edition, New Age International Publisher
2. V. N. Mittle, "Basic Electrical Engineering," Tata McGraw Hill.
3. V. K. Mehta & Rohit Mehta, "Principles of Electrical Engineering," 6th Edition, S. Chand & Co. PVT. LTD
4. S. K. Bhattacharya, "Basic Electrical and Electronics Engineering," 2nd Edition, Pearson Education.
5. D C Kulshreshtha, "Basic Electrical Engineering," 2nd Edition Tata McGraw Hill.
6. Del Toro V, "Electrical Engineering Fundamentals," 2nd Edition, New Delhi Prentice Hall of India.
7. Hughes, "Electrical and Electronic Technology", 10th Edition, Pearson Education.
8. R. K. Rajput, "Basic Electrical Engineering," 2nd Edition, Laxmi Publications PVT. LTD
9. M. Clifford, K. Simmons, "An Introduction to Mechanical Engineering Part I", CRC Press
10. Roy and Choudhary, "Elements of Mechanical Engineering", Media Promoters & Publishers Pvt. Ltd., Mumbai.
11. G. S. Sawhney, "Fundamentals of Mechanical Engineering", PHI
12. M.S. Shanmugam, Palanichamy, "Basic Civil and Mechanical Engineering", McGraw Hill Education; First edition, 2018

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
	Module 1	7 hours.
1.1	DC Electric Circuits: Passive Components - R, L, and C, sources - current and voltage sources.	1 hour
1.2	Resistances in series and parallel, current and voltage division rule (Numerical problems).	1 hour.
1.3	Ohm's Law, Kirchoff's Laws (Numerical problems).	2 hours.
1.4	Alternating Current Fundamentals: Representation of sinusoidal waveforms - frequency, time period, average value, RMS value.	1 hour.
1.5	Phasor representation of R, RL, RC, RLC circuits - concept of impedance, power - active, reactive and apparent, power factor (Numerical problems).	2 hours.
	Module 2	8 hours.
2.1	Electromagnetic Induction: Faraday's laws, Lenz's law, statically and dynamically induced EMF	1 hour
2.2	DC Machines: Construction and working principle - DC Generator – Types-applications	2 hours
2.3	DC motor Construction and working principle- Types-applications	1 hour
2.4	Transformers (single phase only): Working principle	1 hour
2.5	Three-Phase AC Systems: Generation of three-phase voltages - phase sequence.	1 hour
2.6	Y-Δ connection (balanced only), relation between line and phase quantities, three phase power.	2 hours

	Module 3	8 hours
3.1	Electrical wiring design: Electrical wiring system in domestic building - types of wiring, cables, Conduits, Switches and Outlets, switch boards, and distribution boards.	1 hour
3.2	Common power ratings of domestic gadgets, Codes and standards- Salient features of NEC, NBC and IE rule, NEC Symbols used in electrical wiring layout.	1 hour
3.3	Electrical lay out (single line diagram) for low- class domestic installation. Electrical load calculation- connected load method (Numerical problems).	2 hours
3.4	Electrical Installation in Buildings: Protection devices - MCB, MCCB, ELCB/RCCB and RCBO- Principle of operation, fuses-working and types	2 hours
3.5	Electrical hazards and safety precautions-Earthing & need of earthing, types, Electrical Safety & Precautions.	2 hours
	Module 4	8 hours
4.1	Introduction, Terminologies, IC engine parts	1 hour
4.2	Working of four stroke SI and CI engine, Working of two stroke SI and CI engine	2 hours
4.3	Air, Fuel, Cooling and Lubrication systems, CRDI and MPFI engines. Concept of hybrid engines.	2 hours
4.4	Hydraulic Machines: Classification of hydraulic turbines, Working of Pelton, Francis, Kaplan turbines (Descriptions with figures only).	2 hours
4.5	Pumps: Classification, Working of Centrifugal and Reciprocating pumps	1 hours
	Module 5	8 hours
5.1	Power Transmission Elements: Classification and applications of mechanical drives, Velocity ratio of belt drive, Length of belt, Slip in belt, Power transmitted, simple problems.	2 hours
5.2	Gear drive: Types, Gear Ratio, Simple, compound and epicyclic gear trains (simple descriptions only)	2 hours

5.3	Material Handling: Objective, principle and selection of material handling equipment, Types of conveyors, parts and working of belt conveyors, screw conveyors and pneumatic conveyer-	2 hours
5.4	Hoisting machine, Elevators, Winches and Cranes – Types – Concrete Pumps -Types, Working (Descriptions only)	2 hours
	Module 6	8 hours
6.1	Power Plant Engineering: Hydel power plants: Layout, classifications and study of various components. Steam power plant: Layout, steam generators, study of various components.	2 hours
6.2	Gas turbine power plant and combined power plants, Layout. New generation power producing systems.	2 hours
6.3	Air Conditioning: Units of Refrigeration, Refrigeration effect, Psychrometric properties, Psychrometric chart, Comfort conditions, window, split and centralized air condition system	2 hours
6.4	Summer and Winter air-conditioning, Inverter Technology in Air conditioners, Solar Air conditioners	2 hours
Total		47 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Solve problems based on series and parallel circuits.
2. Solve problems based on current and voltage division rules.
3. Solve problems using Kirchhoff's laws.
4. Phasor representation of R, RL, RC and RLC circuits.
5. Problems on rms and average values of periodic waveforms.
6. Problems related to power and power factor.

Course Outcome 2 (CO 2):

1. Construction and working of DC generator and DC motor.
2. Different types and applications of DC generator and DC motor.
3. Working principle of single-phase transformer.
4. Problems on three-phase line & phase quantities for a balanced load.

Course Outcome 3 (CO 3):

1. Electrical wiring system in domestic building.
2. Codes and standards.
3. Electrical lay out (single line diagram).
4. Electrical load calculation- connected load method (Numerical problems).
5. Protection devices and its principle of operation.
6. Electrical hazards and safety precautions-Earthing & need of earthing, types, Electrical Safety & Precautions.

Course Outcome 4 (CO 4):

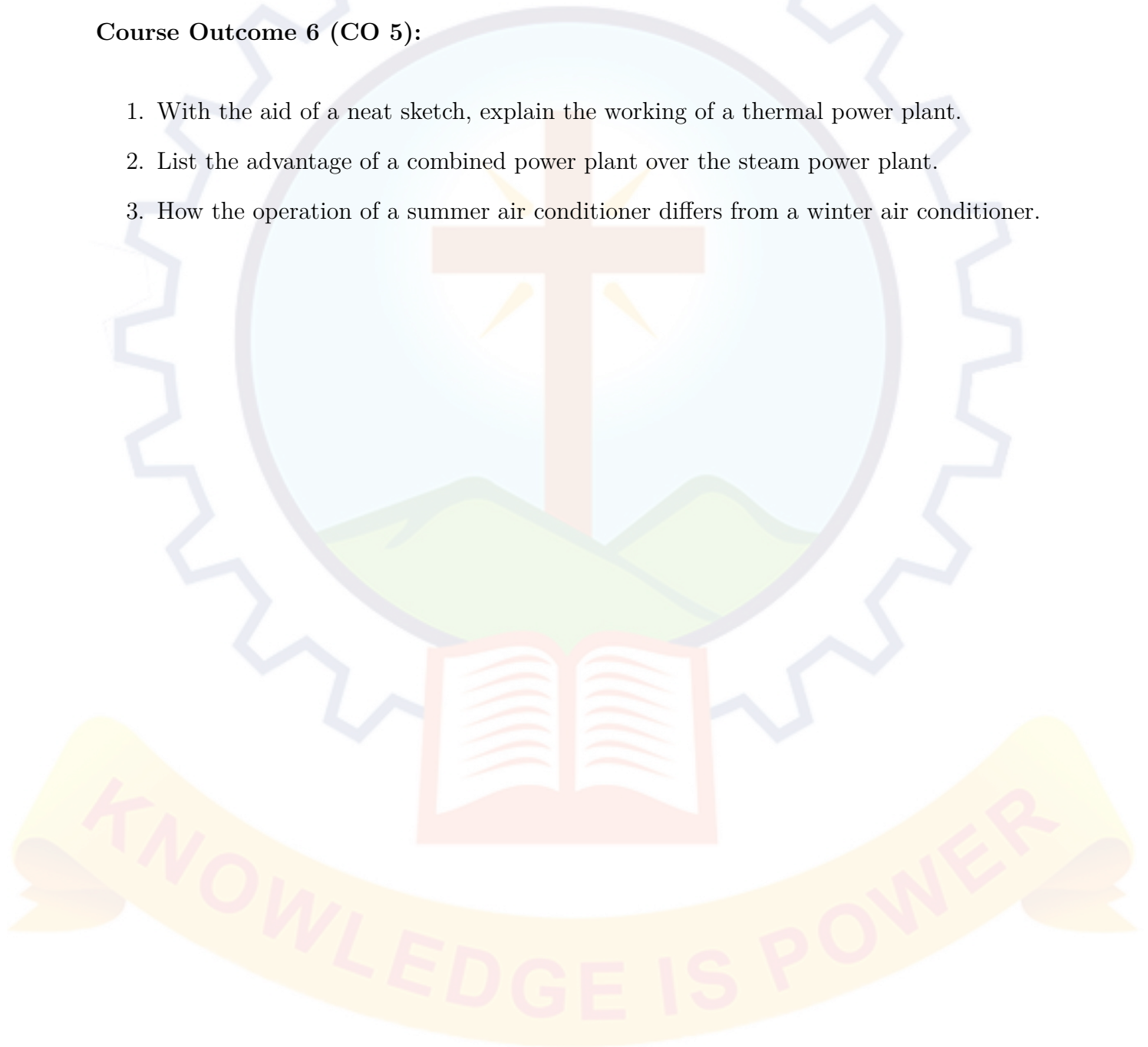
1. Describe the working of a four-stroke diesel engine?
2. Why two stroke engines are less efficient than our stroke engine.
3. How hydraulic turbines are classified?

Course Outcome 5 (CO 5):

1. Derive an expression to determine the length of an open belt drive
2. Solve problem based on velocity ratio of a gear drive
3. What are the important components of a conveyer belt drive? Explain with figure.

Course Outcome 6 (CO 5):

1. With the aid of a neat sketch, explain the working of a thermal power plant.
2. List the advantage of a combined power plant over the steam power plant.
3. How the operation of a summer air conditioner differs from a winter air conditioner.



MODEL QUESTION PAPER

QP CODE:

Pages: 3

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

SECOND SEMESTER B. TECH DEGREE EXAMINATION, YEAR

Course Code: B24ES1T04

BASIC ELECTRICAL AND MECHANICAL ENGINEERING

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 4 marks.

1. State and explain Kirchhoff's laws with examples.
2. Differentiate between statically and dynamically induced emf.
3. Derive the relation between line and phase current in a 3-phase delta-connected system.
4. Distinguish between MCB and MCCB.
5. What is the need for earthing? Describe the different types of earthing.
6. With the neat block diagram, explain the fuel system of a CI engine.
7. Illustrate the working of an epicyclic gear train.
8. Explain the principles of material handling.
9. Explain cooling and dehumidification processes.
10. Define: Specific humidity, relative humidity and dew point temperature.

PART B

Answer any one question from each module. Each question carries 10 marks.

11. For the circuit shown above, determine the current flows through all the resistors using Kirchhoff's law.

10

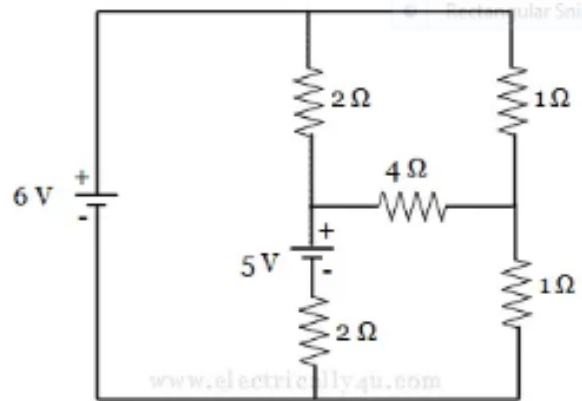


Figure 1

OR

12. A resistance of 10Ω and inductance of $0.3H$ and a capacitance of 100 F are connected in series across $230V$, $50Hz$ single-phase supply. Calculate the 10

- (a) Impedance of the circuits
- (b) Current through the circuits
- (c) Voltage across R , L , and C
- (d) Power consumed by the circuit.

13. A 3-phase, $400V$, 4 wire system has a balanced star connected load with impedance $Z=15+j10\Omega$ each. Find the line currents and the total power consumed by the load. 10

OR

14. (a) State Faraday's laws of electromagnetic induction. 4
(b) Explain the construction and working principle of DC motor. 6

15. What is the role of NEC and NBC in building design? 10

OR

16. (a) Explain the different types of wiring. 5
(b) What are the different NEC symbols used in electrical wiring layout? 5

17. Explain the working of a 4-stroke CI engine with the help of a neat diagram. 10

OR

18. With the aid of a neat sketch, describe the working of a Francis turbine. 10
19. (a) Discuss the factors to be considered while selecting a material handling equipment. 4
- (b) What are the different types of belt conveyors? Explain its important parts of a flat belt conveyor system. 6

OR

20. Two flat belt pulleys having a centre-to-centre distance of 137 cm have drive diameter of 72 cm and 36cm. (a) Determine the length of the belt if both pulleys will rotate in same direction. (b) Determine the angle of contact on the small and big pulley. (c) Calculate the belt length if the belt will be cross-connected to make the pulleys rotate in opposite directions. (e) Determine the angle of contact for opposite direction. 10
21. Explain the general layout of a hydroelectric power plant. 10

OR

22. (a) How summer air conditioners differ from winter air conditioners. 5
- (b) Explain the working of the summer air conditioner with the aid of a neat sketch. 5

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE1T03	SURVEYING AND GEOMATICS	2	1	0	4	3	2024

Preamble

The course delves into the fundamental significance of surveying, examining diverse techniques for measuring angles and distances. It offers insight into field surveying methodologies and contemporary surveying technologies, providing a comprehensive understanding of the subject's intricacies.

Prerequisites: Introduction to Civil Engineering

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Comprehend the importance of surveying. Apply the concepts of leveling and contouring in various civil engineering applications (Cognitive Knowledge Level:Apply)
CO 2	Apply various engineering techniques for distance and angular measurement in surveying. (Cognitive Knowledge Level:Apply)
CO 3	Develop the concept of area and volume computation in surveying. Recognize the basic principles of traverse surveying and curves. (Cognitive Knowledge Level:Apply)
CO 4	Grasp basic knowledge regarding remote sensing, GIS and Terrain modelling.(Cognitive Knowledge Level:Apply)
CO 5	Recognize various advanced surveying techniques (Cognitive Knowledge Level:Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	3	1	1	1	2	0	0	2	1	0
CO 2	3	3	1	1	3	2	0	0	2	1	0
CO 3	3	3	1	1	0	2	0	0	2	1	0
CO 4	3	3	1	1	3	2	1	0	2	1	0
CO 5	3	3	1	1	3	2	1	0	2	1	0

Assessment Pattern

SURVEYING AND GEOMATICS			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	30	30	30
Understand	30	30	30
Apply	40	40	40
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course Project	: 10 marks
Self Study	: 5 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contain 10 questions carrying 3 marks each. Part B contains 2 questions from each module out of which 1 to be answered. Each question carries 14 marks and can have maximum 2 sub divisions.

SYLLABUS

MODULE 1 (8 hours)

Surveying: Definition - principles – objectives and classification of surveying - primary divisions of surveying - plane surveying , geodetic surveying .

Levelling: Definition of terms - levelling instruments - temporary and permanent adjustments - methods of levelling - simple levelling, differential levelling (numerical examples), fly levelling, profile levelling, cross sectional levelling, reciprocal levelling - reduction of levels - errors in levelling.

Contours: Definition - contour Interval - horizontal equivalent - characteristics of contour - contouring - direct and indirect methods - comparison between direct and indirect method - development of contours (numerical examples) - contour gradient - location of contour gradient on a map, location of contour gradient on the ground - uses of contours - storage capacity of a reservoir(numerical examples).

MODULE 2 (6 hours)

Theodolite Survey: Definitions of terms - temporary and permanent adjustments of theodolite - methods of measurement of horizontal and vertical angle - errors in measurements.

Combined Distance and Angular Measurement: Tacheometry - principles of stadia and tangential tacheometry (basic concepts only) - Total station – features – functions - applications.

MODULE 3 (8 hours)

Computation of Area and volume in Surveying: Computation of area - mid ordinate rule, average ordinate rule, trapezoidal rule, Simpson's rule (numerical examples) - computation of volume - trapezoidal and prismoidal formula (numerical examples)

Traverse Survey: Methods of traversing - traverse computations - balancing the traverse - Bowditch's rule, transit rule(numerical examples) - omitted measurements (a line and an angle only).

Curves: Elements of a simple curve - setting out of curves (angular methods) (numerical examples) - compound curve - reverse curve - transition curve - vertical curve (introduction only).

MODULE 4 (7 hours)

Remote sensing: Introduction - principles of remote sensing - remote sensing system and observation platforms - sensor characteristics - applications.

Geographic Information System(GIS): Components - map projections - coordinate systems - geographic and projected coordinate systems – toposheets - data types - spatial and attribute data - raster and vector data representation – applications

Terrain modeling: DEM – DTM - TIN

MODULE 5 (7 hours)

Global Positioning Systems(GPS): GNSS - components and principles of GPS – trilateration - applications of GPS -surveying with GPS - differential global positioning system – principle - concepts and function

Ground Penetrating Radar Survey: Introduction – principles of GPR - components of GPR - operating procedure of GPR – applications

Photogrammetric Survey: Terrestrial photogrammetry - aerial photogrammetry (basic concepts only) - Drone survey - introduction - features and benefits of drone survey - applications of drone survey

Hands on training on GIS software

Course Project

1. Watershed/river basin boundary delineation
2. LULC Classification using satellite images
3. LST using satellite images
4. Generate contour map from DEM

Text Books

1. S. K. Roy , “Fundamentals of Surveying”, PHI Learning Private Limited.
2. Satheesh Gopi, “Advanced Surveying: Total Station, GIS and Remote Sensing”, Pearson Education.
3. S. K. Duggal, “Surveying Vol. I”, Tata McGraw Hill Education.
4. S. K. Duggal, “Surveying Vol. II”, Tata McGraw Hill Education
5. B.C.Punmia, Ashok K. Jain, Arun K. Jain, “Surveying Vol I”,Laxmi Publications.
6. B.C.Punmia, Ashok K. Jain, Arun K. Jain, “Surveying Vol II”,Laxmi Publications.
7. K. R. Arora, “Surveying Vol. I”, Standard Book House.
8. K. R. Arora, “Surveying Vol. II”, Standard Book House.

9. Thomas Lillesand, Ralph W. Kiefer, Jonathan Chipman, "Remote Sensing and Image Interpretation", Wiley Publications
10. George Joseph, "Fundamentals of Remote Sensing", University Press, 2003
11. Kang-tsung Chang "Introduction to Geographic Information Systems", Mc Graw Hill Education
12. Dr.E.V.Raghava Rao, Dr.S.A. Rahim, "Advanced Methods and Techniques in Drone Surveying", Prashas Research Consulting Pvt.Ltd.

Reference Books

1. T.P.Kanatkar, V.S.Kulkarni, "Surveying and Levelling- Part I", Pune Vidyarthi Griha Prakashan.
2. T.P.Kanatkar, V.S.Kulkarni, "Surveying and Levelling- Part II", Pune Vidyarthi Griha Prakashan
3. C. Venkatramaiah, "Textbook of Surveying", Universities Press (India) Private Limited 2011.
4. James M Andersen, Edward M Mikhail, "Surveying Theory and Practice", McGraw Hill Education.
5. BurroughP, "Principles of Geographical Information systems", Oxford University Press, 1998.
6. C. J. Iliffe, "Datums and Map Projections for Remote Sensing, GIS and Surveying", Whittles Publishing, 2006.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
	Module 1	8 hours.
1.1	Surveying: Definition - principles – objectives and classification of surveying - primary divisions of surveying - plane surveying , geodetic surveying .	1 hour
1.2	Levelling: Definition of terms - levelling instruments - temporary and permanent adjustments - methods of levelling - simple levelling , differential levelling (numerical examples) , fly levelling , profile levelling , cross sectional levelling , reciprocal levelling - reduction of levels - errors in levelling.	4 hours.
1.3	Contours: Definition - contour Interval - horizontal equivalent - characteristics of contour - contouring - direct and indirect methods - comparison between direct and indirect method - development of contours (numerical examples) - contour gradient - location of contour gradient on a map , location of contour gradient on the ground - uses of contours - storage capacity of a reservoir(numerical examples).	3 hours.
	Module 2	6 hours.
2.1	Theodolite Survey: Definitions of terms - temporary and permanent adjustments of theodolite - methods of measurement of horizontal and vertical angle - errors in measurements.	2 hours
2.2	Combined Distance and Angular Measurement: Tacheometry - principles of stadia and tangential tacheometry (basic concepts only) - Total station – features – functions - applications.	4 hours
	Module 3	8 hours
3.1	Computation of Area and volume in Surveying: Computation of area - mid ordinate rule , average ordinate rule, trapezoidal rule , simpson's rule (numerical examples) - computation of volume - trapezoidal and prismoidal formula (numerical examples)	3 hours

3.2	Traverse Survey: Methods of traversing - traverse computations - balancing the traverse - bowditch's rule, transit rule (numerical examples) - omitted measurements (a line and an angle only).	3 hours
3.3	Curves: Elements of a simple curve - setting out of curves (angular methods)(numerical examples) - compound curve - reverse curve - transition curve - vertical curve (introduction only).	2 hours
	Module 4	7 hours
4.1	Remote sensing: Introduction - principles of remote sensing - remote sensing system and observation platforms - sensor characteristics - applications.	2 hours
4.2	Geographic Information System(GIS): Components - map projections - coordinate systems - geographic and projected coordinate systems – toposheets - data types - spatial and attribute data - raster and vector data representation – applications	4 hours
4.3	Terrain modeling: DEM – DTM - TIN	1 hour
	Module 5	7 hours
5.1	Global Positioning Systems(GPS): GNSS - components and principles of GPS – trilateration - applications of GPS -surveying with GPS - differential global positioning system – principle - concepts and function	3 hours
5.2	Ground Penetrating Radar Survey : Introduction – principles of GPR - components of GPR - operating procedure of GPR – applications	1 hour
5.3	Photogrammetric Survey: Terrestrial photogrammetry - aerial photogrammetry (basic concepts only) - Drone survey - introduction - features and benefits of drone survey - applications of drone survey	1 hour
5.4	Hands on training on GIS software	2 hours
Total		36 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Outline the objectives and principles of surveying
2. Solve problems on determination of reduced levels in surveying.
3. Solve problems on storage capacity of reservoirs

Course Outcome 2 (CO 2):

1. Discuss various features and applications of Total station
2. Outline the importance of Theodolite surveying
3. Enumerate the importance of Tacheometric surveying.

Course Outcome 3 (CO 3):

1. Problems on area and volume computation.
2. Outline the importance of Traverse surveying.
3. Discuss the importance of setting out of curves in civil engineering.

Course Outcome 4 (CO 4):

1. Outline the principles of remote sensing.
2. Enumerate the significance of GIS in surveying.

Course Outcome 5 (CO 5):

1. Enumerate the components and principles of GPS surveying
2. Discuss the importance of GPR survey and Drone survey

MODEL QUESTION PAPER

QP CODE:

Pages: 2

Reg.No.:

Name:

**MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM**

SECOND SEMESTER B. TECH DEGREE EXAMINATION, YEAR

**Course Code: B24CE1T03
SURVEYING AND GEOMATICS**

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Discuss the basic principles of surveying.
2. Define back sight, foresight and intermediate sight.
3. List temporary adjustments in theodolite
4. Compare the different systems of tacheometric surveying
5. Elaborate on traverse surveying.
6. List the elements of a compound curve.
7. Discuss the relevance of remote sensing in executing civil engineering projects.
8. Discuss the applications of GIS in surveying
9. Enumerate the principles of GPR survey
10. Discuss applications of drone survey.

PART B

Answer any one question from each module. Each question carries 14 marks

11. (a) The following consecutive readings were taken with an auto level and a 4m levelling staff on a continuously sloping ground on a straight line at a common interval of 30 m. 0.855 (on A), 1.545, 2.335, 3.115, 3.825, 0.455, 1.380, 2.055, 2.855, 3.455, 0.585, 1.015, 1.850, 2.755, 3.845 (on B). The RL of A was 380.500m. Make a level field book and calculate the reduced levels of points using Height of Instrument method and apply usual checks. (10)
- (b) Explain errors in levelling. (4)

OR

12. (a) Discuss the characteristics of contours, give suitable sketches. (9)
- (b) Briefly explain the terms “Contour Interval” and “Horizontal Equivalent of Contour”? (5)
13. (a) Discuss in detail the two methods of measuring horizontal angles using a theodolite (10)
- (b) Discuss sources of errors in theodolite surveying. (4)

OR

14. (a) Discuss how to determine the tachometric constants (5)
- (b) Describe with sketch how to measure angles and distances by total station. (9)
15. (a) A series of offsets were taken at 3m intervals in the following order from a chain line to a curved boundary 2.16, 1.53, 1.80, 1.98, 1.80, 1.59, 1.80, 2.52, 2.43, 2.40, 2.58, 2.70, 2.91, and 3.06 meters. Find the area between the chain line, curved boundary and the end offsets by Simpson’s rule and trapezoidal rule. (8)
- (b) Elaborate on methods of computation of volume by
- i. Trapezoidal formula
 - ii. Prismoidal formula
- (6)

OR

16. (a) Elaborate on balancing the traverse with emphasis on Bowditch’s rule. (7)
- (b) Discuss transition curve and its functions. Compare methods to find out the length of transition curve. (7)
17. (a) Explain principles of remote sensing. Discuss remote sensing system and observation platform (10)
- (b) Enumerate various applications of GIS in civil engineering (4)

OR

18. (a) Describe the key components of GIS (7)
- (b) Explain the advantages and limitations of remote sensing. (7)
19. (a) Explain principles and components of ground penetrating radar survey (7)
- (b) Elaborate the features and benefits of Drone Survey. (7)

OR

20. (a) Briefly explain the concepts of aerial photogrammetry (7)
- (b) Describe components and principles of GPS (7)

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24ES1L03	MECHANICAL AND ELECTRICAL WORKSHOP	0	0	2	1	1	2024

Preamble

The aim of this course is to train the students to identify and manage tools, materials and methods required for various engineering projects. The students will also gain practical knowledge to develop and analyze basic electrical circuits and understand the various safety measures and troubleshooting in electrical wiring. The course will expose students to a collaborative learning atmosphere where they will acquire the essential abilities for organizing, arranging, and carrying out an engineering project. The course also enables the student to familiarize various tools, measuring devices, practices and different methods of manufacturing processes employed in industry for fabricating components.

Prerequisites: Higher secondary level Physics and Mathematics.

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Identify electrical symbols, measuring instruments, accessories, and tools used for electrical wiring.
CO 2	Understand the substation, distribution system, and safety measures against electrical shocks and select the fuse unit for a given electrical circuit.
CO 3	Estimate and develop the electric circuits for wiring domestic and industrial buildings.
CO 4	Identify and use various tools in carpentry & sheet metal work and perform multiple operations for the preparation of joints using wood and fabrication using sheet metal
CO 5	Identify and use various tools in smithy, foundry, fitting and welding and to practice forging, moulding, casting, chipping, filing, cutting, drilling, etc., and prepare multiple joints and welds

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	2	3	1	0	3	1	3	3	2	3
CO 2	3	2	3	1	0	3	1	3	3	2	3
CO 3	3	3	3	3	0	3	1	3	3	3	3
CO 4	1	1	0	0	0	0	0	1	1	0	1
CO 5	1	1	0	0	0	0	0	1	1	0	1

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	70	30	1 hours

Continuous Internal Evaluation Pattern

Attendance	: 20 marks
Class Work/ Assessment	: 40 marks
Viva-Voce (Self Study)	: 10 marks
End semester examination (Internally by college)	: 30 marks

End Semester Examination Pattern

The college will internally conduct the end semester examination. Separate ESE's will be held for Electrical workshop and Mechanical workshop, each in the form of a one hour written objective exam. The total marks for this course will be equally divided between the Electrical and Mechanical workshops.

SYLLABUS

LIST OF EXPERIMENTS

Sl.No.	Topic
1	Familiarization with electrical symbols, measuring instruments, lighting and wiring accessories, tools, and various wiring systems. Study the electric shock phenomenon, precautions, safety procedures, and earthing in electrical installations.
2	Realization of domestic wiring. Wiring of one lamp controlled by one switch and a 3-pin plug socket controlled independently. Wiring of one lamp controlled by two switches (Staircase wiring).
3	Realization of Industrial wiring - Wiring of three lamps controlled by three switches (Godown wiring). Study of fuse, MCB, ELCB, and selection of fuse rating for circuits with medium and high power.
4	Wiring of the distribution board, including the power plug, an isolator, MCB, and ELCB for 1000 W power.
5	Measurement of low-medium-high resistance using the Megger and voltmeter-ammeter method.
6	Visit the on-campus substation and familiarize with the supply system, transformer, HT Panel, and distribution system.
7	Carpentry: Study of Carpentry tools, Types of Carpentry joints: T-Lap joint, Cross lap joint / Cross halving joint, Dove tail halving joint, Mortice & Tenon Joint.
8	Sheetmetal: - Study of sheet metal tools, Forming and joint practices: Cylindrical shape, Conical shape, Rectangular Tray.
9	Smithy: - Study of different tools & forged models in Smithy shop, Forging Practices: Square prism, Hexagonal headed bolt, octagonal prism.
10	Foundry: - Study of Foundry tools, Molding practices: Bench molding, Floor molding, Core making, Casting.
11	Fitting: - Study of fitting tools in a workshop, Type of Fitting shop joints: Square Joint, V-Joint, Male and Female fitting

12	Welding: - Study of welding tools, equipment's and methods, Welding practices: Arc Welding, MIG Welding, Oxy-Acetylene Gas Welding
13	Conventional Machines: Study and demonstration of conventional machines like Shaping and Slotting machine, Lathe, Milling machine, Grinding machines & Radial drilling machine
14	Advanced Manufacturing Methods: Study and demonstration of CNC machines and 3D printing

Reference Books

1. H Cotton, Advanced Electrical Technology, Reem Publications, 2011.
2. Suresh Kumar K.S, Electrical Circuit and Networks, Pearson Education, New Delhi, 2009.
3. EW. Golding, Electrical Measurements and Measuring Instruments, 5th ed. Reem Publications, 2011.
4. Chapman, W. A. J, 2007, Workshop Technology - Parts 1 & 2, 4th ed., New Delhi, India, CBS Publishers & Distributors Pvt. Ltd.
5. O'Brien, A. (Editor), 2001, Welding Handbook . 9th ed., Miami, American Welding Society.
6. Anderson, J., 2002, Shop Theory, New Delhi, India, Tata McGraw Hill.
7. Douglass, J. H., 1995, Wood Working with Machines, Illinois, McKnight & McKnight Pub. Co.
8. Tuplin, W. A., 1996, Modern Engineering Workshop Practice, Odhams Press.
9. Jain, P. L., 2009, Principles of Foundry Technology, 5th ed., New Delhi, India, Tata McGraw Hill
10. S.K. Hajra Choudhury, Workshop Technology Vol II, Media Promoters & Publishers.

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE1L02	ENGINEERING MECHANICS LAB	0	0	3	2	2	2024

Preamble

This course provides students with hands-on experience and a clear understanding of fundamental principles in engineering mechanics. Emphasizing the effects of applied force systems and the geometric properties of rigid bodies, both at rest and in motion, the laboratory sessions aim to reinforce theoretical concepts. By the end of the course, students will be equipped to recognize and solve similar problems encountered in real-world engineering situations.

Prerequisites: Engineering mechanics, Engineering Physics

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Identify and analyze different force systems by applying fundamental principles of mechanics (Cognitive Knowledge Level: Apply)
CO 2	Understand and compute the mechanics of static friction forces.(Cognitive Knowledge Level: Apply)
CO 3	Identify and analyze internal forces within statically determinate beams.(Cognitive Knowledge Level: Apply)
CO 4	Construct free-body diagrams and calculate the forces acting on rigid bodies in static equilibrium. (Cognitive Knowledge Level: Apply)
CO 5	Understand and evaluate the center of gravity and the mass moment of inertia. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	2	0	0	0	0	1	2	2	0	2
CO 2	3	2	0	0	0	0	1	2	2	0	2
CO 3	2	2	0	0	0	0	1	2	2	0	2
CO 4	2	2	0	0	0	0	1	2	2	0	2
CO 5	2	2	0	0	0	0	1	2	2	0	2

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	10 marks
Continuous Assessment	10 marks
Viva-Voce (Self Study)	10 marks
Test	15 marks
Lab Record	5 marks

SYLLABUS

LIST OF EXPERIMENTS

Sl.No.	Topic
1	Verification of triangle law & parallelogram law of forces
2	Verification of the equilibrium condition of a force system using the force table apparatus
3	To find out forces in Jib and Tie

4	WDetermination of the coefficient of static friction between two given material surfaces in an inclined plane.
5	Verification of the support reactions of a simply supported beam.
6	The study of the systems of pulleys and free body diagram
7	To calculate the force in the member of a truss.
8	Determination of moment of inertia of a disc
9	Determination of moment of inertia of a given fly wheel

Text Books

1. Francesco Costanzo, Gary Gray, and Michael E. Plesha - Engineering Mechanics: Statics & Dynamics
2. Shames, I. H., Engineering Mechanics - Statics and Dynamics, Prentice Hall of India.
3. R. C. Hibbeler and Ashok Gupta, Engineering Mechanics, Vol. I Statics, Vol II Dynamics, Pearson Education.

References

1. Merriam J. L and Kraige L. G., Engineering Mechanics - Vols. 1 and 2, John Wiley.
2. Tayal A K, Engineering Mechanics – Statics and Dynamics, Umesh Publications
3. . Bhavikkatti, S.S., Engineering Mechanics, New Age International Publishers
4. F.P.Beer abd E.R.Johnston (2011), Vector Mechanics for Engineers, Vol.I-Statics, Vol.II-Dynamics,9th Ed, Tata McGraw Hill
5. Rajasekaran S and Sankarasubramanian G, Engineering Mechanics - Statics and Dynamics, Vikas Publishing House Pvt Ltd.

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24PC1L01B	PHYSICS (B) AND CHEMISTRY (B) LAB	0	0	2	2	1	2024

Preamble

This integrated Physics-Chemistry laboratory course is designed to provide engineering students with essential hands-on experience and foundational experimental skills. Through a series of structured experiments, students will develop proficiency in precise measurement and accurate data recording. The course bridges the gap between theoretical concepts and practical applications by enabling learners to operate scientific instruments, perform fundamental chemical techniques and critically compare experimental results with theoretical predictions. This experiential learning course equips students to critically analyse and interpret data effectively and apply the physical and chemical principles to address complex engineering challenges.

Prerequisites: Nil.

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Develop analytical / experimental skills and impart prerequisite hands-on experience for engineering laboratories. (Cognitive Knowledge Level: Apply)
CO 2	Understand the need for precise measurement practices for data recording. (Cognitive Knowledge Level: Apply)
CO 3	Understand the principle, concept, working and applications of relevant technologies and compare results with theoretical calculations. (Cognitive Knowledge Level: Apply)
CO 4	Understand and practice fundamental techniques in chemistry to generate experimental skills. (Cognitive Knowledge Level: Apply)
CO 5	Learn to design and carry out scientific experiments as well as accurately record and analyze the results of such experiments. (Cognitive Knowledge Level: Apply)
CO 6	Acquire the ability to understand different methods of chemical synthesis and instrumental techniques to solve various engineering problems. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	2	0	0	1	1	0	0	0	0	0	0
CO 2	1	0	0	1	1	0	0	0	0	0	0
CO 3	2	1	0	0	0	0	0	0	0	0	0
CO 4	1	1	0	1	1	0	0	0	0	0	0
CO 5	1	1	0	3	1	0	0	0	0	0	0
CO 6	2	1	0	1	0	0	0	0	0	0	0

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	70	30	1 hour

Continuous Internal Evaluation Pattern

Attendance	: 20 marks
Class Work/ Assessment Viva-Voce	: 50 marks
End semester examination (Internally by college)	: 30 marks

End Semester Examination Pattern

The college will internally conduct the end semester examination. Separate ESE's will be conducted for Engineering Physics Lab and Engineering Chemistry Lab, each in the form of a 30 minutes written objective examination. The total marks for this course will be equally divided between the Engineering Physics Lab and Engineering Chemistry Lab.

SYLLABUS

LIST OF EXPERIMENTS

PART I ENGINEERING PHYSICS LAB (B)

Sl.No.	Experiment
1	DSO - Measurement of Frequency and Amplitude.
2	LCR Circuit – Calculation of Q Factor.
3	Measurement of strain using strain gauge and wheatstone bridge.
4	Ultrasonic Diffractometer - measurement of wavelength.
5	Optic Fiber - Measurement of Numerical Aperture.
6	Melde's String - Measurement of Linear Density.
7	Deflection magnetometer-Moment of a magnet- $\tan A$ position.
8	Optic Fiber - Measurement of Bending Loss.

PART II ENGINEERING CHEMISTRY LAB (B) (MINIMUM FOUR EXPERIMENTS ARE MANDATORY)

Sl.No.	Experiment
1	Calibration of pH meter and determination of pH of a solution.
2	Estimation of sodium ions by flame photometry.
3	Estimation of chloride ion in a water sample by Mohr's method.
4	Synthesis of Urea-formaldehyde resin.
5	Estimation of hardness by EDTA.
6	Anodization of Aluminium.

7	Determination of wavelength of absorption maximum and colorimetric estimation of Fe^{3+} ions in the solution.
8	Synthesis of iron oxide nanoparticles.

Reference Books

1. S.L. Gupta and Dr. V. Kumar, "Practical Physics with viva voice", Pragati Prakashan Publishers, Revised Edition, 2009.
2. M.N. Avadhanulu, A.A. Dani and Pokely P.M, "Experiments in Engineering Physics", S.Chand & Co, 2008.
3. S. K. Gupta, "Engineering physics practicals", Krishna Prakashan Pvt. Ltd., 2014 .
4. P. R. Sasikumar, "Practical Physics", PHI Ltd., 2011.
5. D.R Mehta, "Laboratory Manual Physics", D.K Publishing House.
6. G. Svehla, B. Sivasankar, "Vogel's Qualitative Inorganic Analysis", Pearson, 2012.
7. R. K. Mohapatra, "Engineering Chemistry with Laboratory Experiments", PHI Learning, 2017.
8. Muhammed Arif, "Engineering Chemistry Lab Manual", Owl publishers, 2019.
9. Roy K. Varghese, "Engineering Chemistry Laboratory Manual", Crown plus Publishers, 2019.
10. Soney C. George, Rino Laly Jose, "Lab Manual of Engineering Chemistry", S. Chand & Company Pvt Ltd., New Delhi, 2019.
11. S. M. Ashraf, "A Laboratory Manual of Polymers" I. K. International Publishing House Pvt. Ltd., 2008
12. Anu Tresa Sunny, Prajitha Velayudhan, Sabu Thomas, "Colloidal metal Oxide Nanoparticles: Synthesis, Characterization and Applications", Elsevier Science, 2019.
13. V. F. Henley, "Anodic Oxidation of Aluminium and its Alloys", Elsevier Science, 2013.

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24MC1T03	PROFESSIONAL COMMUNICATION AND ETHICS	2	0	1	3	P/F	2024

Preamble

This course aims to provide the students with the vital skills needed to excel in listening, reading, writing, and speaking. Whether conveying technical ideas or non-technical information, mastering these communication elements is crucial for aspiring professionals. The goal is to equip students with the ability to comprehend and successfully articulate ideas while also honing their persuasive communication skills. The course also aims to create in students awareness on ethics and human values.

Prerequisites: Nil.

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Expand vocabulary and linguistic proficiency pertinent to the field of engineering (Cognitive Knowledge Level: Apply)
CO 2	Examine, comprehend, and succinctly describe a range of textual material. (Cognitive Knowledge Level: Apply)
CO 3	Produce clear, technically sound documents and presentations that follow all required conventions. (Cognitive Knowledge Level: Apply)
CO 4	Manifest acute ethical awareness and effectively apply ethical principles in practical engineering scenarios. (Cognitive Knowledge Level: Apply)
CO 5	Analyze and address global ethical issues, showcasing an understanding of their roles as ethical leaders and contributors to technological development. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	0	0	0	0	0	0	0	3	3	1	2
CO 2	0	0	0	0	0	0	0	3	3	1	2
CO 3	2	2	2	0	0	3	3	2	2	2	2
CO 4	2	2	2	0	0	3	3	3	3	1	2
CO 5	2	2	2	0	0	3	3	3	3	1	3

Assessment Pattern

PROFESSIONAL COMMUNICATION AND ETHICS		
Bloom's Category	Continuous Assessment Tests (%)	End Semester Examination (%)
Remember	30	30
Understand	40	40
Apply	30	30
Analyse	-	-
Evaluate	-	-
Create	-	-

Mark Distribution

Total Marks	CIE Marks	ESE Marks
100	50	50

Continuous Internal Evaluation Pattern

Attendance	10 marks
Self Study (Regular assessment)	15 marks
Series test (one test, conducted for 50 marks and reduced to 25)	25 marks

Regular assessment

Project report presentation and technical presentation through PPT	4 marks
Listening Test	2 marks
Group discussion/mock job interview	4 marks
Resume submission	2 marks
Assignment/Case study	3 marks

End Semester Examination Pattern

Total Marks: 50, Time: 2 hours. There will be two parts; Part A and Part B. Part A contain 4 questions carrying 5 marks each. Part B contains one question from each module in two sets of which students should answer one from each set. Each question can have a maximum of 2 sub-divisions and carry 15 marks each.

SYLLABUS

MODULE 1 (9 hours)

Communication Process

Modes, Verbal and Non-Verbal Communication, Verbal Aptitude- Misspelled Words, synonyms, paraphrasing, sentence completion using appropriate words, subject-verb agreement, Reading-Strategies for Effective Reading, types, Listening-Active and Passive Listening, Barriers, Taking notes while listening Activity- Worksheets, Exercises, Synthesizing and deriving conclusions from technical articles videos, and podcasts

MODULE 2 (9 hours)

Professional discipline

Public Speaking- Technical Talks- Formal and Informal Letters- Emails- Resume Preparation, Video Profile- GD Vs Debate-Dynamics of Professional Presentation (Individual and Group)- Format of Report, Proposal and Minutes.

Activity- Public Speaking, Podcast preparation, Resume preparation, Video profile creation, Company profiling, Group discussion, Technical Proposal, Structured Flow Analysis using AI.

MODULE 3 (9 hours)

Fundamentals of Ethical Engineering

Introduction to Human Values - Morals, Ethics, and Integrity - Academic and Work Ethics - Service Learning and Civic Virtue - Respect, Peaceful Living, Caring, and Sharing - Values of Honesty, Courage, Cooperation, Commitment, Empathy, and Self-Confidence - Senses of Engineering Ethics - Moral Autonomy and Ethical Theories - Moral Issues and Dilemmas in Engineering.

MODULE 4 (9 hours)

Professional Responsibility in a Global Context

Engineering as Social Experimentation - Responsible Experimentation and Codes of Ethics - Customs, Religion, and their Role in Engineering Ethics - Collegiality, Loyalty, and Conflict Management - Confidentiality, Conflicts of Interest, and Occupational Crime - Rights and Responsibilities in Engineering - Global Ethical Issues: Multinational Corporations, Environmental Ethics, Business Ethics, and Computer Ethics - Engineers as Leaders, Expert Witnesses, and Contributors to Technological Development.

Text Books

1. Ashraf Rizvi, "Effective Technical Communication", 2nd Edition, McGraw Hill Education, 2017.
2. Meenakshi Raman and Sangeetha Sharma, "Technical Communication: Principles and Practice", 2nd Edition, Oxford University Press, 2011
3. M Govindarajan, S Natarajan and V S Senthil Kumar, Engineering Ethics, PHI Learning Private Ltd, New Delhi, 2012.
4. R S Naagarazan, A text book on professional ethics and human values, New age international (P) limited, New Delhi, 2006.

Reference Books

5. English for Engineers and Technologists (Combined edition, Vol. 1 and 2), Orient Blackswan 2010.
6. Training in Interpersonal Skills: Tips for Managing People at Work, Pearson Education, India, 6th edition, 2015.
7. Mike W Martin and Roland Schinzinger, Ethics in Engineering, 4th edition, Tata McGraw Hill Publishing Company Pvt Ltd, New Delhi, 2014.
8. Charles D Fleddermann, Engineering Ethics, Pearson Education/ Prentice Hall of India, New Jersey, 2004.
9. Charles E Harris, Michael S Protchard and Michael J Rabins, Engineering Ethics- Concepts and cases, Wadsworth Thompson Learning, United states, 2005.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
	Module 1 (Communication Process)	9
1.1	Modes, Verbal and Non-Verbal Communication,	1
1.2	Verbal Aptitude- Misspelled Words, synonyms, paraphrasing,	1
1.3	Sentence completion using appropriate words, subject verb agreement,	1
1.4	Reading-Strategies for Effective Reading, types .	1
1.5	Listening-Active and Passive Listening, Barriers, Taking notes while listening.	1
1.6	Activity- Public Speaking, Podcast preparation, Resume preparation, Video profile creation, Company profiling, Group discussion, Technical Proposal.	4
	Module 2 (Professional discipline)	9
2.1	Public Speaking- Technical Talks- Formal and Informal Letters	1
2.2	Emails- Resume Preparation, Video Profile, GD Vs Debate	1
2.3	Dynamics of Professional Presentation (Individual and Group).	1
2.4	Format of Report, Proposal and Minutes.	1
2.3	Activity- Public Speaking, Podcast preparation, Resume preparation, Video profile creation, Company profiling, Group discussion, Technical Proposal.	5
	Module 3 (Fundamentals of Ethical Engineering)	9
3.1	Introduction to Human Values - Morals, Ethics, and Integrity	1
3.2	Academic and Work Ethics - Service Learning and Civic Virtue - Respect, Peaceful Living, Caring, and Sharing.	2

3.3	Values of Honesty, Courage, Cooperation, Commitment, Empathy, and Self-Confidence.	2
3.4	Senses of Engineering Ethics - Moral Autonomy and Ethical Theories.	2
3.5	Moral Issues and Dilemmas in Engineering.	2
	Module 4 (Professional Responsibility in a Global Context)	9
4.1	Engineering as Social Experimentation - Responsible Experimentation and Codes of Ethics.	1
4.2	HCustoms, Religion, and their Role in Engineering Ethics - Collegiality, Loyalty, and Conflict Management	2
4.3	Confidentiality, Conflicts of Interest, and Occupational Crime.	1
4.4	Rights and Responsibilities in Engineering - Global Ethical Issues.	1
4.5	Multinational Corporations, Environmental Ethics, Business Ethics, and Computer Ethics.	2
4.6	Multinational Corporations, Environmental Engineers as Leaders, Expert Witnesses, and Contributors to Technological Development.	2
Total		36 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Analyze how different modes of communication impact the overall message.
2. Identify and use appropriate verbal communication skills in various contexts..
3. Identify different types of reading and apply suitable strategies accordingly
4. Recognize and overcome barriers to effective listening.

Course Outcome 2 (CO 2):

1. Demonstrate confidence and competence in public speaking.
2. Compose well-structured written communications.
3. Participate effectively in group discussions and debates, showcasing critical thinking and communication skills.

Course Outcome 3 (CO 3):

1. Understand the format and structure of professional reports and proposals.
2. Summarize and organize information effectively in meeting minutes.
3. Adapt presentation style based on the context and audience.

Course Outcome 4 (CO 4):

1. Explain the role of professional ethics in technological development
2. Explain the need for environmental ethics in engineering projects
3. How civic virtue and integrity contribute to application of ethical principles

Course Outcome 5 (CO 5):

1. Explain how ethical issues in the workplace affect the development of a company.
2. Show how occupational crimes are resolved by keeping the rights of employees
3. Explain the necessity of code of conduct for digital ethics

MODEL QUESTION PAPER

QP CODE:

Pages: 2

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

SECOND SEMESTER B. TECH DEGREE EXAMINATION, YEAR

Course Code: B24MC1T03

PROFESSIONAL COMMUNICATION AND ETHICS

Max. Marks: 50

Duration: 2 hours

PART A

Answer all questions. Each question carries 5 marks.

1. Find out which pair of words 'can be filled-up in the blanks in the sentence in the same sequence to make the sentence grammatically correct and meaningfully complete.
 - (a) He was not to done the exercise himself.
a) expected, be b) required, being c) needed, get d) supposed, have
 - (b) A committee has been.....to.....the transformation of the city into an international finance center.
a) Constituted, convert b) appointed, oversee c) inducted, change d) converged, evaluate
2. Highlight the differences between a group discussion (GD) and a debate.
3. Briefly explain morals, values, and ethics.
4. Provide an explanation on conflicts of interest with an example.

PART B

Answer any one question from each set. Each question carries 15 marks.

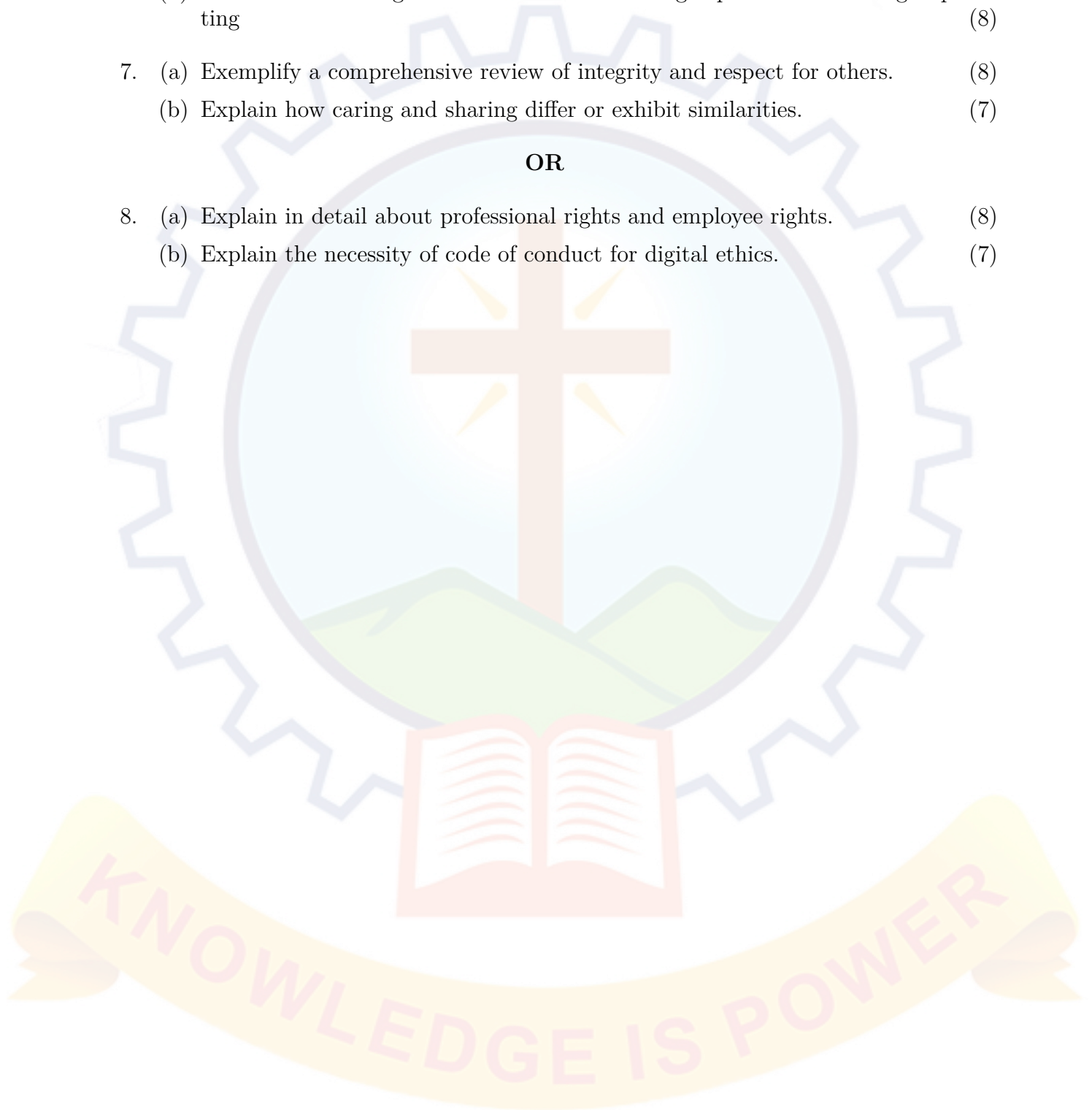
5. (a) "In today's world, being a good listener is more important than being a good Speaker." Enumerate (7)
(b) Help your friend by suggesting and explaining methods to improve his/her reading skills.. (8)

OR

6. (a) Compare and contrast the formats of a proposal and a report (7)
(b) Discuss the challenges and benefits of delivering a presentation in a group setting (8)
7. (a) Exemplify a comprehensive review of integrity and respect for others. (8)
(b) Explain how caring and sharing differ or exhibit similarities. (7)

OR

8. (a) Explain in detail about professional rights and employee rights. (8)
(b) Explain the necessity of code of conduct for digital ethics. (7)



CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24MC1L02	IDEA LAB	0	0	3	3	P/F	2024

Preamble

This course enables the students to understand the concepts of design, development and documentation tools under various domains in engineering. The various topics covered in this course are concepts of 2D and 3D design, cutting, routing, engraving, milling, slicing, printing and fabrication. Students will be exposed to PCB design and populating. They will learn Microcontroller programming, embedded system design and technical documentation. This course helps students to analyse real-life problems and find solutions using multidisciplinary engineering.

Prerequisites: Nil.

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Create 2D and 3D models using appropriate tools. (Cognitive Knowledge Level : Analyse)
CO 2	Design and fabricate circuits using PCB Design and fabrication mechanisms.(Cognitive Knowledge Level : Analyse)
CO 3	Develop project using appropriate Micro controller Programming.(Cognitive Knowledge Level : Apply)
CO 4	Build a product for some applications using design and fabrication technologies.(Cognitive Knowledge Level : Create)
CO 5	Create electronic documentation for the system/project using appropriate tools .(Cognitive Knowledge Level : Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	2	1	3	0	2	0	0	1	1	0	0
CO 2	1	0	1	0	1	0	0	0	0	1	1
CO 3	2	2	2	2	2	1	1	2	2	2	2
CO 4	1	2	3	2	3	3	3	3	3	3	3
CO 5	0	0	0	0	0	1	0	0	3	0	0

Mark Distribution

Total Marks	CIE Marks	ESE Marks (Internal) Micro Project
100	50	50

Continuous Internal Evaluation Pattern

Attendance	10 marks
Class Work	20 marks
Viva-Voce (Self Study)	10 marks
Test	10 marks

End Semester Evaluation Pattern:

Micro project Demonstration	20 marks
Micro Project Presentation	20 marks
Micro Project Report	10 marks

Note: The microproject has to be completed by the students as a group of a maximum of four students.

SYLLABUS

LIST OF EXPERIMENTS

Complete at least six experiments and one micro project from the given list.

Sl.No.	Topic
1	Prepare a 2D and 3D model using any standard tool.
2	Use the 2D model to engrave and cut the acrylic sheet using laser cutter. Assemble the laser-cut parts to fabricate the final model.
3	Use the 2D model for the fabrication of a model by using CNC milling.
4	Use a 3D model to engrave the pattern using CNC milling on the acrylic/wood/plastic block.
5	Use the 3D design for the fabrication of a model by using a 3D printer. Use a slicing software and generate the corresponding G-codes.
6	Write a program to read the input port pins of a micro controller and write the same to the output pins. Use a development board.
7	Write a program to read a sensor (temperature) and display it.
8	Write a program in Arduino IDE for Arduino development board to design a temperature controller. Control the speed of a fan based on the room temperature. Display the temperature on an LCD display.
9	Design a system to display the data send from the embedded system on a GUI in another Embedded system or PC (Wired – UART, I2C, SPI. Wireless – Bluetooth, Wifi)
10	Complete a Microproject. Prepare a technical report using latex for the temperature controller system in the standard template of the university.

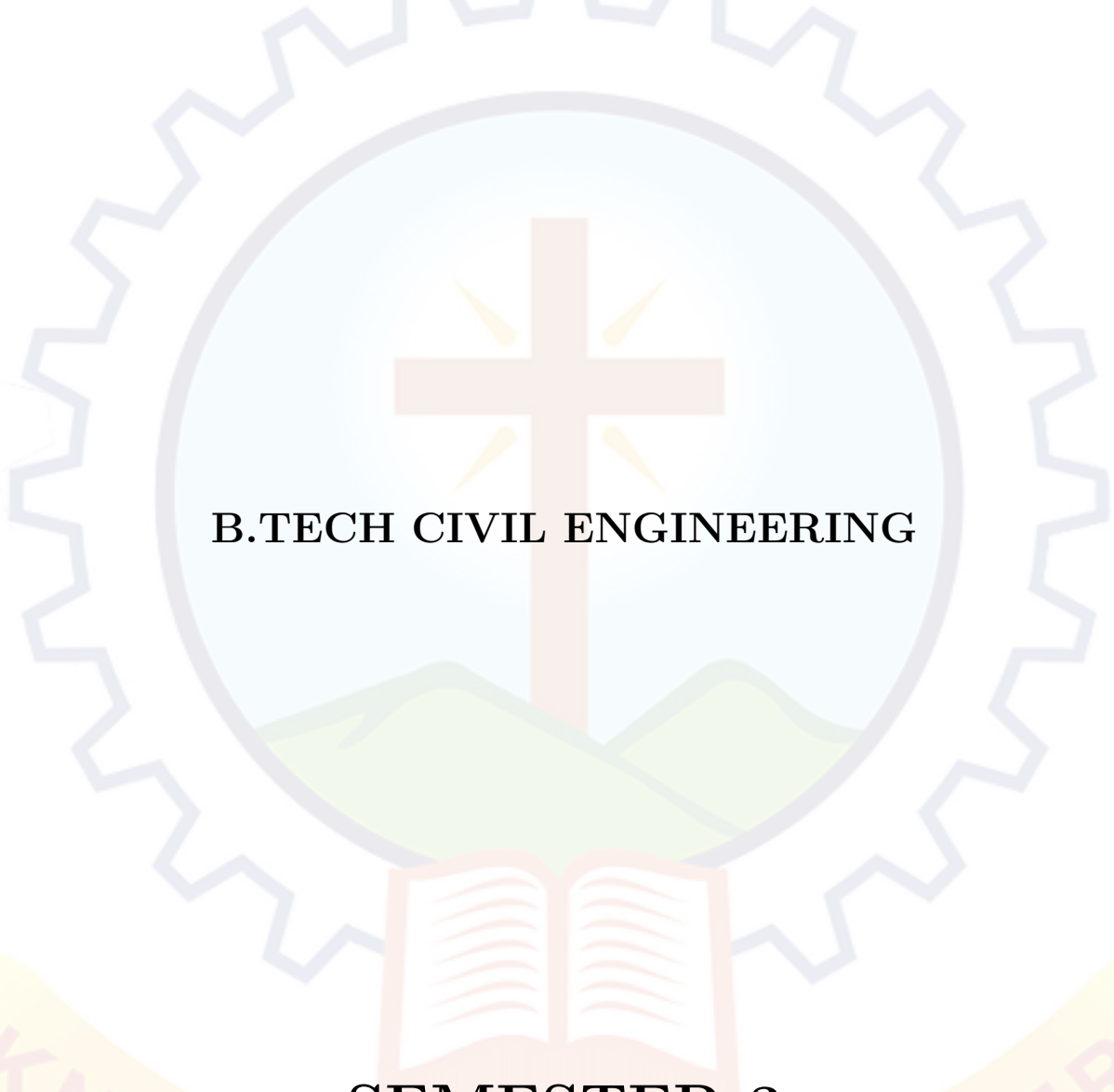
Reference Books

1. AICTE's Prescribed Textbook: Workshop / Manufacturing Practices (with Lab Manual), Khanna Book Publishing.
2. 3D Printing and Design, Dr. SabrieSoloman, ISBN: 978-9386173768, Khanna Book Publishing Company, New Delhi.

3. The Big Book of Maker Skills: Tools and Techniques for Building Great Tech Projects. Chris Hackett. Weldon Owen; 2018. ISBN-13: 978-1681884325.
4. The Total Inventors Manual (Popular Science): Transform Your Idea into a Top Selling Product. Sean Michael Ragan(Author).Weldon Owen;2017.ISBN-13:978-1681881584.
5. Make: Tools: How They Work and How to Use Them. Platt, Charles. Shroff/Maker Media. 2018. ISBN-13: 978- 352137374 .
6. The Art of Electronics. 3rd edition. Paul Horowitz and Winfield Hill. Cambridge University Press. ISBN: 9780521809269 .
7. Practical Electronics for Inventors. 4th edition. Paul Sherz and Simon Monk. McGraw Hill. ISBN-13: 978-1259587542 .
8. Encyclopedia of Electronic Components (Volume 1, 2 and 3). Charles Platt. Shroff Publishers. ISBN-13: 978-9352131945, 978-9352131952, 9789352133703.
9. Building Scientific Apparatus. 4th edition. John H. Moore, Christopher C. Davis, Michael A. Coplan and Sandra C. Greer. Cambridge University Press. ISBN-13: 978-0521878586.
10. Programming Arduino: Getting Started with Sketches. 2nd edition. Simon Monk. McGraw Hill. ISBN-13: 978-1259641633 .
11. Make Your Own PCBs with EAGLE: From Schematic Designs to Finished Boards. Simon Monk and Duncan Amos. McGraw Hill Education. ISBN-13: 978-1260019193.
12. Pro GIT. 2nd edition. Scott Chacon and Ben Straub. A press. ISBN-13: 9781484200773.
13. Venuvinod, PK., MA. W., Rapid Prototyping – Laser Based and Other Technologies, Kluwer.
14. Ian Gibson, David W Rosen, Brent Stucker., “Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing”, Springer,2010 .
15. Chapman W.A.J, “Workshop Technology”, Volume I, II, III, CBS Publishers and Distributors, 5th Edition, 2002.

MAR ATHANASIOUS COLLEGE OF ENGINEERING

Government Aided, Autonomous Institution
Kothamangalam, Kerala, India



B.TECH CIVIL ENGINEERING

SEMESTER 3

SYLLABUS

KNOWLEDGE IS POWER

SEMESTER 3

SLOT	COURSE NO.	COURSES	L-T-P-S	HOURS	CREDIT
A	B24MA2T03A	COMPLEX VARIABLES AND APPLICATIONS OF PDE	3-1-0-5	4	4
B	B24CE2T01	MECHANICS OF SOLIDS	3-1-0-5	4	4
C	B24CE2T02	FLUID MECHANICS & HYDRAULICS	3-1-0-5	4	4
D	B24CE2T03	FUNCTIONAL PLANNING OF BUILDINGS	2-1-0-4	3	3
E	B24HU2T02	ENTREPRENEURSHIP AND MANAGEMENT SKILLS FOR ENGINEERS	2-1-0-4	3	3
G	B24CE2L03	SURVEYING LABORATORY	0-0-3-2	3	2
H	B24CE2L04	HYDRAULICS LABORATORY	0-0-3-2	3	2
I	B24MC2T04	UNIVERSAL HUMAN VALUE AND CONSTITUTIONAL RIGHTS	2-0-0-2	2	P/F
J	B24MC2T05	ENERGY CONSERVATION AND ENVIRONMENTAL SUSTAINABILITY	2-0-0-2	2	P/F
M	B24CEM3x	MINOR	3-1-0-5	4	4
TOTAL				32	22

MINOR COURSES

COURSE NO.	COURSES
B24CEM32	WATER AND AIR QUALITY
B24CEM33	TRAFFIC SAFETY

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24MA2T03A	COMPLEX VARIABLES AND APPLICATIONS OF PDE	3	1	0	5	4	2024

Preamble

This course introduces basic ideas of partial differential equations which are widely used in the modelling and analysis of a wide range of physical phenomena and has got application across all branches of engineering. It is also possible to understand the basic theory of functions of complex variable and also its integration and conformal transformation.

Prerequisites: A basic course in partial differentiation and complex numbers.

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Solve Non linear and linear partial differential equations (Cognitive Knowledge Level : Apply)
CO 2	Solve one dimensional wave equation and heat equation using partial differential equations (Cognitive Knowledge Level : Apply)
CO 3	Make use of Cauchy-Riemann equations to understand complex functions, its continuity differentiability (Cognitive Knowledge Level : Apply)
CO 4	Evaluate complex integrals using Cauchys integral theorem and Cauchys integral formula (Cognitive Knowledge Level : Apply)
CO 5	Develop power series expansion of an analytic function (Cognitive Knowledge Level : Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	2	1	0	0	1	0	0	0	0	0	0
CO 2	2	1	0	0	0	1	0	0	0	0	0
CO 3	2	2	0	0	0	1	0	0	0	0	1
CO 4	2	1	0	0	0	0	0	0	0	0	0
CO 5	2	2	0	1	1	1	1	0	0	0	1

Assessment Pattern

Complex Variables and Applications of PDE			
Blooms Category	Continuous Assessment Tests		End Semester Examination (% Marks)
	Test 1 (% Marks)	Test 2 (% Marks)	
Remember	20	20	20
Understand	40	40	40
Apply	40	40	40
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course Project	: 10 marks
Self Study	: 5 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contain 10 questions carrying 3 marks each. Part B contains 2 questions from each module out of which 1 to be answered. Each question carries 14 marks and can have maximum 2 sub divisions.

SYLLABUS

MODULE 1: Partial Differential Equations (9 hours)

Partial differential equations, Formation of partial differential equations elimination of arbitrary constants-elimination of arbitrary functions, Solutions of a partial differential equations - Equations solvable by direct integration, Linear equations of the first order- Lagranges linear equation, Non-linear equations of the first order - Charpits method, Solution of equation by method of separation of variables.

MODULE 2: Applications of Partial Differential Equations (9 hours)

One dimensional wave equation - vibrations of a stretched string, solution of the wave equation using method of separation of variables, DAlemberts solution of the wave equation, One dimensional heat equation, solution of the heat equation.

MODULE 3: Complex Variable Differentiation (9 hours)

Complex function, limit, continuity, derivative, analytic functions, Cauchy-Riemann equations, harmonic functions, finding harmonic conjugate, Conformal mappings - mappings $w = z^2$, $w = e^z$, linear fractional transformation $w = \frac{1}{z}$, fixed points.

MODULE 4: Complex Variable Integration (9 hours)

Complex integration, Line integrals in the complex plane, Basic properties, First evaluation method-indefinite integration and substitution of limit, second evaluation method-use of a representation of a path, Contour integrals, Cauchy integral theorem on simply connected domain, Cauchy Integral formula.

MODULE 5: Complex Variable Series representation (9 hours)

Taylor's and Maclaurin series. Laurents series (without proof), zeros of analytic functions, singularities, poles, removable singularities, essential singularities, Residues.

Text Books:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th edition, 2018.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons, 2016.

Reference Books:

1. Peter V. O'Neil, Advanced Engineering Mathematics, Cengage, 7th Edition, 2012

COURSE CONTENTS AND LECTURE SCHEDULE

No	Topic	No. of Lecture/ Tutorial Hours
1	Module 1 (Partial Differential Equations)	9 hours
1.1	Partial differential equations, Formation of partial differential equations elimination of arbitrary constants-elimination of arbitrary functions, Solutions of a partial differential equation, Equations solvable by direct integration	3
1.2	Linear equations of the first order - Lagranges linear equation Non-linear equations of the first order - Charpits method	4
1.3	Boundary value problems, Method of separation of variables	2
2	Module 2 (Applications of Partial Differential Equations)	9 hours
2.1	One dimensional wave equation - vibration of a stretched string	1
2.2	Solution of wave equation using method of separation of variables, Fourier series solution of boundary value problems involving wave equation, DAlemberts solution of the wave equation	4
2.3	One dimensional heat equation	1
2.4	Solution of the heat equation, using method of separation of variables, Fourier series solutions of boundary value problems involving heat equation	4
3	Module 3 (Complex Variable Differentiation)	9 hours
3.1	Complex function, limit, continuity, derivative, analytic functions, Cauchy-Riemann equations.	4
3.2	Harmonic functions, finding harmonic conjugate	2
3.3	Conformal mappings - mappings of $w = z^2$, $w = e^z$, $w = 1/z$.	3

4	Module 4 (Complex Variable Integration)	9 hours
4.1	Complex integration, Line integrals in the complex plane, Basic properties, First evaluation method, second evaluation method, use of representation of a path	4
4.2	Contour integrals, Cauchy integral theorem (without proof) on simply connected domain .Cauchy Integral formula (without proof)	2
4.3	Cauchy Integral formula	2
4.4	Cauchy Integral formula for derivatives of an analytic function	1
5	Module 5 (Complex Variable Series representation)	9 hours
5.1	Taylor series and Maclaurin series	2
5.2	Laurents series(without proof)	3
5.3	Zeros of analytic functions, singularities, poles, removable singularities, essential singularities	2
5.4	Residues	2
Total Hours		45 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO1): Understand the concept and the solution of partial differential equation.

1. Form the partial differential equation given $z = f(x + it) + g(x - it)$.
2. Solve $\frac{\partial^2 z}{\partial y^2} = \sin(xy)$.
3. Solve $(y - z)p + (x - y)q = z - x$.
4. Solve $2zx - px^2 - 2qxy + pq = 0$.
5. Solve $\frac{\partial u}{\partial x} = 4\frac{\partial u}{\partial y}$ where $u(0, y) = 8e^{-3y}$ by the method of separation of variables.

Course Outcome 2 (CO2): Analyse and solve one dimensional wave equation and heat equation.

1. Write all possible solutions of one dimensional wave equation.
2. Find the steady state temperature distribution in a rod of length 10 cm with ends are kept at 20°C and 80°C .
3. Obtain a general solution for the one dimensional heat equation.
4. A string is stretched between the fixed points $(0, 0)$ and $(l, 0)$ and released at rest from the initial deflection given by $f(x) = \begin{cases} \frac{2k}{l}x, & \text{when } 0 < x < \frac{l}{2} \\ \frac{2k}{l}(l-x), & \text{when } \frac{l}{2} < x < l \end{cases}$
5. A rod of length l with insulated sides is initially at a uniform temperature u_0 .Its ends are suddenly cooled to 0°C and are kept at that temperature. Find the temperature function $u(x, t)$.

Course Outcome 3 (CO3): Understand complex functions, its continuity differentiability with the use of Cauchy-Riemann equations.

1. Find the real and imaginary parts of the function $5z^2 - 12z + 3 + 2i$.
2. Check whether the function $\frac{x+iy}{x^2+y^2}$ is analytic.
3. Determine the analytic function whose real part is $e^{2x}(x \cos 2y - y \sin 2y)$.
4. Find the fixed points of $(a + ib)z^2$.
5. Find the image of $1 \leq |z| \leq 2, \frac{\pi}{6} \leq \theta \leq \frac{\pi}{3}$ under the mapping $w = z^2$.

Course Outcome 4 (CO4): Evaluate complex integrals using Cauchy's integral theorem and Cauchy's integral formula.

1. Evaluate $\int_0^{1+i} (x - iy) dz$ along the straight line path from 0 to $1 + i$.
2. Find the value of $\int_C \frac{z^2+1}{z^2-1} dz$ where C is $|z - 4 - 2i| = 6.5$.
3. Evaluate $\oint_C \frac{\sin z}{z+4iz} dz$ where C is $|z| = 1$ in counter clockwise direction.
4. Integrate $\oint_C \frac{\sinh 2z}{(z-\frac{1}{2})^4} dz$ in counterclockwise direction around the unit circle.
5. Evaluate $\oint_C \frac{\cos(\pi z^2) + \sin(\pi z^2)}{(z-1)(z-2)} dz$ where C is $|z| = 3$ using Cauchy's integral formula.

Course Outcome 5 (CO5): Understand the series expansion of complex function about a singularity and apply residue theorem to compute several kinds of real integrals.

1. Find the Maclaurin series expansion of $\frac{z+2}{1-z^2}$.
2. Find all singular points and residue of the function $\csc z$.

3. Find the Laurent series of $\frac{-2z+3}{z^2-3z+2}$ valid in (i) $1 < |z| < 2$ (ii) $|z| > 2$.
4. Find the poles and residues of the function $\frac{1}{z^4-1}$.
5. Expand $f(z) = \frac{z+1}{z-1}$ as a Taylor series about $z = -1$.



MODEL QUESTION PAPER

QP CODE:

Pages: 3

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

THIRD SEMESTER B. TECH DEGREE EXAMINATION, MONTH YEAR

Course Code: B24MA2T03A

Course Name: **COMPLEX VARIABLES AND APPLICATIONS OF PDE**
(CE,ME,EE,EC)

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks

1. Find the partial differential equation of all spheres of fixed radius having their centres in the xy-plane.
2. Solve $\frac{\partial^2 z}{\partial x \partial y} = \frac{x}{y} + a$.
3. Find the steady state temperature distribution in a rod of length 10 cm with ends are kept at $20^\circ C$ and $80^\circ C$.
4. A tightly stretched elastic string of length l fixed at end points is initially at its rest position. If each of its points is displaced by giving a velocity, find its initial conditions and boundary conditions.
5. Test the continuity at $z = 0$ of $f(z) = \begin{cases} \frac{\operatorname{Re}(z)}{1-|z|}, & z \neq 0 \\ 0, & z = 0 \end{cases}$
6. Show that an analytic function with constant real part is constant.
7. Evaluate $\oint_{-\pi i}^{\pi i} \cos z \, dz$.
8. Find the Maclaurin series of $\frac{1}{1+z^2}$.
9. Find the zeros and their order of the function $f(z) = (1 - z^4)^2$.
10. Find the residue at poles for the function $f(z) = \frac{\sinh z}{z^4}$.

PART B

Answer any one question from each module. Each question carries 14 marks

11. (a) Form the partial differential equation by eliminating the arbitrary functions from $z = yf(x) + xg(y)$. 7
 (b) Solve $(y + zx)p - (x + yz)q = x^2 - y^2$. 7

OR

12. (a) Solve $q + xp = p^2$. 7
 (b) Using method of separation of variables, solve $x^2 \frac{\partial u}{\partial x} + y^2 \frac{\partial u}{\partial y} = 0$. 7
13. (a) A string is stretched between the fixed points $(0, 0)$ and $(l, 0)$ and released at rest from the initial deflection given by

$$f(x) = \begin{cases} \frac{2k}{l}x, & \text{when } 0 < x < \frac{l}{2} \\ \frac{2k}{l}(l - x), & \text{when } \frac{l}{2} < x < l \end{cases}$$
 7
 (b) A rod of length l with insulated sides is initially at a uniform temperature u_0 . Its ends are suddenly cooled to 0°C and are kept at that temperature. Find the temperature function $u(x, t)$. 7

OR

14. (a) A tightly stretched homogeneous string of length l with its fixed ends at $x = 0$ and $x = l$ executes transverse vibrations. Motion starts with zero initial velocity by displacing the string into the form $f(x) = k(x - x^2)$. Find the deflection $u(x, t)$ at any time t . 7
 (b) Derive the solutions of one dimensional heat equation $\frac{\partial u}{\partial t} = c^2 \frac{\partial^2 u}{\partial x^2}$ using variable separable method. 7
15. (a) Check whether $f(z) = iz\bar{z}$ is analytic. 7
 (b) Find the image of $x > 1, y > 0$ under the transformation $w = 1/z$. 7

OR

16. (a) Show that $u = x^3 - 3xy^2 - 5y$ is harmonic. Also find the corresponding harmonic conjugate function. 7
 (b) Find the image of $|z| \leq 2, \frac{\pi}{6} < \arg z < \frac{\pi}{3}$ under the mapping $w = z^2$. 7
17. (a) Evaluate $\oint_C (z + \frac{1}{z}) dz$ where C is the unit circle traversed counterclockwise. 7
 (b) Evaluate $\oint_C \frac{5z+7}{z^2+2z-3} dz$ where C is taken counterclockwise around the circle
 (i) $|z - 2| = 2$
 (ii) $|z + i| = 1$. 7

OR

18. (a) Integrate counterclockwise around the unit circle $\oint_C \frac{\sin 2z}{z^4} dz$. 7

(b) Evaluate $\int (z^2 + 3z)dz$ along the circle $|z| = 2$ from $(2, 0)$ to $(0, 2)$ in counter clockwise direction. 7

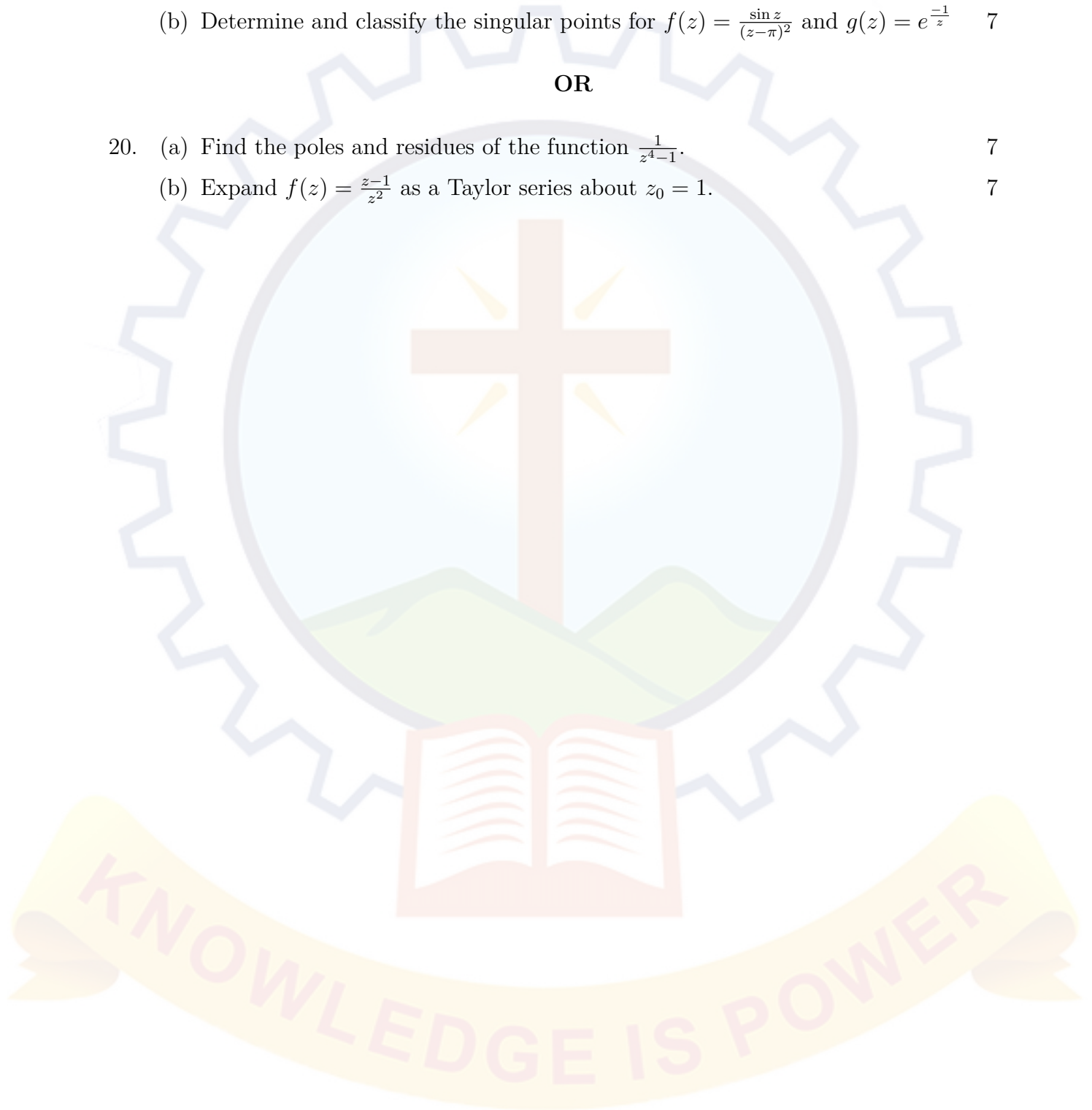
19. (a) Expand $f(z) = \frac{z}{(z+1)(z+2)}$ as a Laurent series about $z = -2$ in $0 < |z + 2| < 1$. 7

(b) Determine and classify the singular points for $f(z) = \frac{\sin z}{(z-\pi)^2}$ and $g(z) = e^{\frac{-1}{z}}$ 7

OR

20. (a) Find the poles and residues of the function $\frac{1}{z^4-1}$. 7

(b) Expand $f(z) = \frac{z-1}{z^2}$ as a Taylor series about $z_0 = 1$. 7



CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE2T01	MECHANICS OF SOLIDS	3	1	0	5	4	2024

Preamble

The course covers basic principles of mechanics of solids, focusing on stress, strain, and deformation in structural elements. Topics such as member behaviour under axial loads, bending, torsion, and column stability are covered, enabling students to understand how materials respond to different forms of loading. By the end of the course, students will be able to analyse and solve problems concerning the behaviour of structures under various loading conditions.

Prerequisites: Engineering Mechanics

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Apply the principles of mechanics to estimate stresses and deformations in engineering structures. (Cognitive knowledge level: Apply).
CO 2	Analyse composite bars under axial loads and compute strain energy for bars subjected to axial and shear stresses. (Cognitive knowledge level: Apply).
CO 3	Calculate and draw shear force and bending moment diagrams (Cognitive knowledge level: Apply).
CO 4	Evaluate the flexural and shear stresses in beams utilizing the principles of simple bending theory (Cognitive knowledge level: Apply).
CO 5	Analyse circular shafts and assess the stability of short and long columns under different boundary conditions. (Cognitive knowledge level: Apply).

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	2	1	0	1	0	0	0	0	0	1
CO 2	3	3	1	1	1	0	0	0	0	0	1
CO 3	3	3	2	0	1	0	0	0	1	0	1
CO 4	3	3	2	1	1	0	0	0	1	0	1
CO 5	3	3	2	1	1	0	0	0	0	1	1

Assessment Pattern

Mechanics of Solids			
Blooms Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	10	10	10
Understand	40	40	40
Apply	50	50	50
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course Project : 10 marks

Self Study : 5 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question carries 14 marks and can have maximum 2 sub-divisions.

SYLLABUS

MODULE 1 (9 hours)

Concepts of stress and strain: Stress and strain Types Stress-strain relation - Hookes law - Stress-strain diagram of mild steel - Elastic Constants Relationships between elastic constants - Axially loaded bars with prismatic and non-prismatic cross section stress, strain and deformation.

Analysis of stress and strain on oblique sections: Stresses on inclined sections for uniaxial and biaxial stress fields. Principal stresses and principal planes in 2D problems- maximum shear stress. Mohrs circle of stress for 2D problems.

MODULE 2 (8 hours)

Behaviour of Composite Bars Under Axial and Thermal Loads: Composite bars - Stress, strain and deformation under axial load - Temperature effects in simple and composite bars.

Strain Energy and Stress Analysis in Axially Loaded Bars: Strain energy - Strain energy in bars carrying axial loads - Stress in bars due to sudden and impact loads - Strain energy due to shear stress.

Stress Distribution in Thin Cylindrical and Spherical Vessels: Thin Cylinders: Stresses in thin cylinders and spheres due to internal pressure.

MODULE 3 (8 hours)

Analysis of Bending Moments and Shear Forces in Beam: Bending Moment & Shear force: Types of support and load Classification of beams based on support - Concept of bending moment and shear force - Relationship between load, shear force and bending moment - Shear force and bending moment diagrams of cantilever beams, simply supported beams and overhanging beams for different type of loading - Point load, UDL and UVL - Point of contraflexure.

MODULE 4 (10 hours)

Bending Stress, Shear Stress and Deflection in Beams : Theory of simple bending Assumptions and limitations - Bending stress in beams - Moment of resistance - Shear stress in beams - Strain energy due to bending in beams. Differential equation for calculating the deflection of beams.

MODULE 5 (10 hours)

Torsion of circular shafts: Torsion of solid and hollow circular shafts - Power transmitted by solid and hollow Circular shafts - Strain energy due to torsion.

Behaviour of column under axial load: Direct and bending stresses in short columns - Kern of a section - Buckling and stability - Eulers buckling/crippling load for columns

with different end conditions - Slenderness ratio - limitation of Eulers formula - Rankines formula.

Text Books

1. R. K. Bansal, A Text book of Strength of Materials, Laxmi Publications (P) Ltd, 6th Edn, 2018.
2. H. J. Shah and S. B. Junnarkar, Mechanics of Structures Vol - I, Charotar Publishing House, 32nd Edn, 2016.
3. B. C. Punmia, Ashok K. Jain, Arun Kumar Jain, Mechanics of Materials, Laxmi Publications (P) Ltd, 2017.

Reference Books

1. Egor P. Popov, Engineering Mechanics of Solids, Prentice Hall International Series.
2. James M Gere, S.P. Timoshenko, Mechanics of Materials, CBS Publishers and Distributors, New Delhi.
3. R.C. Hibbeler, Mechanics of Materials (edn.10), Pearson.
4. S. Ramamrutham and R. Narayanan, Strength of Materials, Dhanpat Rai Publishing Co (P) Ltd.
5. Rattan, Strength of Materials, McGraw Hill Education India.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Topic	No. of Lecture/ Tutorial Hours
1	Module 1	9 hours
1.1	Stress and strain types Stress-strain relation - Hooke's law - Stress-strain diagram of mild steel - Elastic Constants Relationships between elastic constants	2
1.2	Stress, strain and deformation - Axially loaded bars with prismatic and non-prismatic cross section	2
1.3	Analysis of stress and strain on oblique sections - Stresses on inclined sections for uniaxial and biaxial stress fields	2

1.5	Principal stresses and principal planes in 2D problems - maximum shear stress	2
1.6	Mohr's circle of stress for 2D problems	1
2	Module 2	8 hours
2.1	Analysis of composite bars	2
2.2	Temperature effects in simple and composite bars	2
2.3	Strain energy - Strain energy in bars carrying axial loads - Stress in bars due to sudden and impact loads	2
2.4	Strain energy due to shear stress	1
2.5	Stresses in thin cylinders and spheres due to internal pressure	1
3	Module 3	8 hours
3.1	Types of support and load Classification of beams based on support - Relationship between load, shear force and bending moment	1
3.2	Shear force and bending moment diagrams of cantilever beams	2
3.3	Shear force and bending moment diagrams of simply supported beams	2
3.4	Shear force and bending moment diagrams of overhanging beams - Point of contraflexure	3
4	Module 4	10 hours
4.1	Theory of simple bending Assumptions and limitations	2
4.2	Bending stress in beams - Moment of resistance	3
4.3	Shear stress in beams	3
4.4	Strain energy due to bending in beams	1
4.5	Differential equation for calculating the deflection of beams	1

5	Module 5	10 hours
5.1	Torsion of solid and hollow circular shafts	2
5.2	Power transmitted by solid and hollow circular shafts	2
5.3	Strain energy due to torsion	1
5.4	Direct and bending stresses in short columns, Kern of a section	2
5.5	Buckling and stability, Slenderness ratio, Euler's buckling/crippling load for columns with different end conditions	2
5.6	Buckling load with Rankine's formula	1
Total Hours		45 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. What is stress? In what way does the shear stress differ from direct stress?
2. Sketch the stress-strain curve of mild steel and mark the salient points.
3. A bar of 20 mm diameter is subjected to a pull of 50 kN. The measured extension over a gauge length of 20 cm is 0.1 mm and the change in diameter is 0.0035 mm. Calculate the Poissons ratio, Modulus of elasticity, Shear modulus, and Bulk modulus.
4. An element in a stressed material has tensile stress of 500 MN/m^2 and a compressive stress of 350 MN/m^2 acting on two mutually perpendicular planes and equal shear stresses of 100 MN/m^2 on these planes. Find the principal stresses and position of principal planes. Find also the maximum shearing stress.

Course Outcome 2 (CO 2):

1. Define the terms (i) Resilience (ii) Proof resilience and (iii) Modulus of resilience.
2. Explain the effect of temperature change on a composite bar made of two materials.
3. A steel bar ABCD consists of three sections: AB is of 20 mm diameter and 200 mm long; BC is 25 mm square and 400 mm long and CD is of 12 mm diameter and 200 mm long. The bar is subjected to an axial compressive load which induces a stress of 30 MN/m^2 on the largest cross-section. Determine total decrease in length of the bar. $E = 210 \text{ GPa}$
4. A railway track is laid so that there is no stress in the rails at 9°C . The rails are 40 m long. Take $\alpha = 12 \times 10^{-6}$ per $^\circ\text{C}$ and $E = 2 \times 10^5 \text{ N/mm}^2$. Calculate the following:

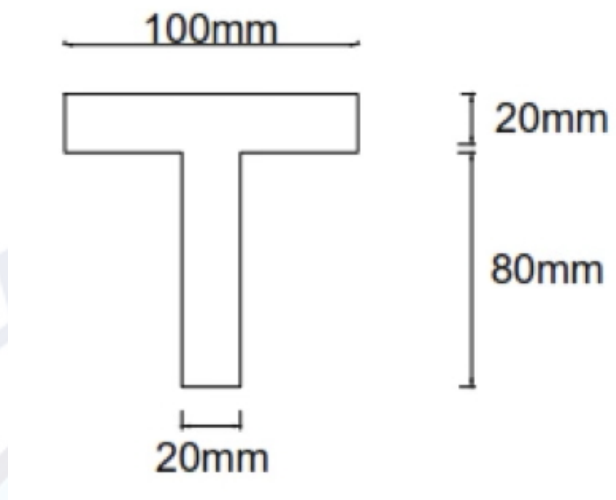
- (i) The stress on the rails at 40°C if there is no allowance for expansion.
- (ii) The stress in the rails at 40°C if there is an expansion allowance of 5 mm per rail.
- (iii) The expansion allowance if the stress in the rail is to be zero when the temperature is 40°C.
- (iv) The maximum temperature to have no stress in the rails if the expansion allowance is 15 mm per rail.

Course Outcome 3 (CO 3):

- 1. What are the main types of supports? Distinguish between roller and hinged supports.
- 2. Explain point of contraflexure.
- 3. A 12 m long beam simply supported at the ends carries a point load of 40 kN at 3 m from the left end and a uniformly distributed load of 10 kN/m on the right half of the span. Draw the shear force and bending moment diagrams indicating principal values.
- 4. A beam 8 m long rests on two supports, one at the right end and the other 2 m from its left-hand end. The beam carries a uniform load of 15 kN/m over its entire length and a concentrated load of 80 kN at the middle of the supports of 6 m span. Draw the bending moment and shear force diagrams and determine the position and amount of maximum bending moment.

Course Outcome 4 (CO 4):

- 1. Derive the relation between slope, deflection, shear force, bending moment, and rate of loading.
- 2. Show that the maximum shear stresses in a rectangular cross-section is 1.5 times the average stress.
- 3. A timber beam 150 mm x 200 mm is used as a simply supported beam of span 3m. Find the maximum uniformly distributed load that can be applied in addition to a concentrated load of 5 kN acting at the mid-span, if the maximum bending stress and shear stress in the beam are not to exceed 15 N/mm² and 2 N/mm² respectively. Neglect the self-weight of the beam.
- 4. A cast iron beam is of T section as shown in the figure. The beam is simply supported on a span of 8m. The beam carries a uniformly distributed load of 1.5 kN/m length on the entire span. Determine the maximum tensile and maximum compressive stresses.



Course Outcome 5 (CO 5):

1. Define slenderness ratio of a column. What is its importance?
2. Define Kern of section.
3. Find the Euler crushing load for a hollow cylindrical cast iron column 20 cm external diameter and 25 mm thick if it is 6 m long and is hinged at both ends. Take $E = 1.2 \times 10^5 \text{ N/mm}^2$. Compare the load with the crushing load as given by the Rankines formula, taking $\alpha_c = 550 \text{ N/mm}^2$ and $\alpha = \frac{1}{1600}$.
4. The external and internal diameters of a hollow shaft are 50 mm and 40 mm respectively. Find the maximum power that can be transmitted by the shaft at 600 rpm, if the permissible shear stress is 100 N/mm^2 and the permissible rate of twist is 3° per meter. Take modulus of rigidity of shaft material, $G = 1 \times 10^5 \text{ N/mm}^2$

MODEL QUESTION PAPER

QP CODE:

Pages: 3

Reg.No.:

Name:

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

THIRD SEMESTER B. TECH DEGREE EXAMINATION, MONTH YEAR

Course Code: B24CE2T01

Course Name: MECHANICS OF SOLIDS

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks

1. Explain the terms stress and strain. What are the different types of stresses and strains?
2. Define the terms (i) Principal planes, (ii) Principal stresses.
3. Explain strain energy, resilience, and proof resilience.
4. Explain the effect of temperature change on a composite bar made of two materials.
5. Derive the relationship between intensity of load, shear force (SF), and bending moment (BM).
6. What is meant by the point of contraflexure? Illustrate with an example.
7. Explain the concept of pure bending with an example.
8. Show that the maximum shear stress in a rectangular cross-section is 1.5 times the average stress.
9. Define Kern of a section.
10. What is slenderness ratio? State its significance.

PART B

Answer any one question from each module. Each question carries 14 marks.

11. A steel bar ABCD consists of three sections: AB is of 20 mm diameter and 200 mm long; BC is 25 mm square and 400 mm long; and CD is of 12 mm diameter and 200 mm long. The bar is subjected to an axial compressive load which induces a stress of 30 MN/m^2 on the largest cross section. Determine the total decrease in length of the bar when the load is applied. $E = 210 \text{ GPa}$.

OR

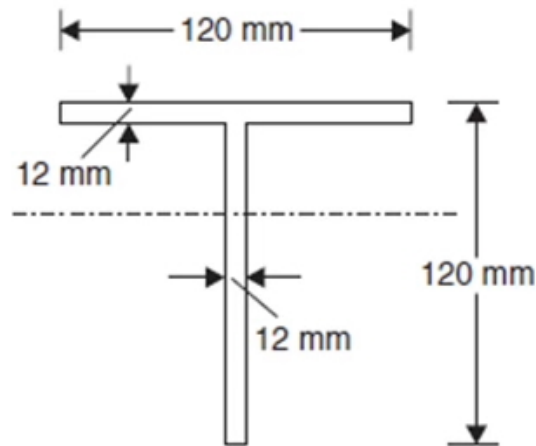
12. A point is subjected to a tensile stress of 50 N/mm^2 and 10 N/mm^2 , acting on two mutually perpendicular planes. A shear stress of 20 N/mm^2 is acting on these planes. Determine the principal stresses and the maximum shear stresses and its planes.
13. A steel tube of 30 mm external diameter and 20 mm internal diameter encloses a copper rod of 15 mm diameter to which it is rigidly joined at each end. If, at a temperature of 100°C , there is no longitudinal stress, calculate the stresses in the rod and tube when the temperature is raised by 200°C . Take $E_s = 2.1 \times 10^5 \text{ N/mm}^2$, $\alpha_s = 11 \times 10^{-6}/^\circ\text{C}$, $E_c = 1 \times 10^5 \text{ N/mm}^2$ and $\alpha_c = 18 \times 10^{-6}/^\circ\text{C}$.

OR

14. (a) Calculate the minimum wall thickness of a thin cylinder 1 m in diameter if it is to withstand an internal pressure of 2 N/mm^2 and hoop stress is not to exceed 40 N/mm^2 . Also find the change in diameter. $E = 210 \text{ GPa}$; Poissons ratio = 0.3.
- (b) A rod 12.5 mm in diameter is stretched 3.2 mm under a steady load of 10 kN. What stress would be produced in the bar by a weight of 700 N falling through 75 mm before commencing to stretch, the rod being initially unstressed? $E = 210 \text{ GPa}$.
15. Draw the SFD and BMD for a simply supported beam of length 9 m and carrying a uniformly distributed load of 10 kN/m for a distance of 6 m from the left end. Also calculate the maximum B M on the section.

OR

16. A beam of length 10 m is placed over simple supports such that the beam overhangs by 2 m at the left side and by 3 m at the right side. The beam carries concentrated loads of 50 kN and 80 kN at the left and right ends respectively. In addition, it carries a uniformly distributed load of 20 kN/m in between the supports. Sketch the shear force and bending moment diagrams indicating all salient features.
17. A cast iron beam of T-shaped cross-section as shown, carries a udl of 1.5 kN/m over the entire span of 8 m. Determine the maximum tensile and compressive stress and draw the bending stress distribution diagram.



OR

18. A simply supported beam AB of 5 m span is carrying a uniformly distributed load of 20 kN/m. The beam is made up of a rectangular cross section of dimensions 300 mm $\times$ 450 mm.
- Draw the bending stress distribution at the critical section for bending.
 - Draw the shear stress distribution considering the critical section for shear.
 - Also calculate bending stress and shear stress on a layer located 50 mm above the neutral axis on the cross section at the mid-point of the beam.
19. Find the Euler's crippling load for a hollow cylindrical cast iron column of 15 cm external diameter and 25 mm thick if it is 6 m long and is hinged at both ends. Compare this load with the crushing load as given by Rankine's formula, taking $\sigma_c = 550 \text{ N/mm}^2$ and Rankine's constant as $\frac{1}{1600}$. For what length of the column would these two formulae give the same crushing load? Take $E = 8 \times 10^4 \text{ N/mm}^2$.

OR

20. Determine the diameter of a solid shaft which will transmit 112.5 kW of power at 200 rpm. Also determine the length of the shaft if the twist must not exceed 1.5 degrees over the entire length. The maximum shear stress is limited to 55 N/mm^2 . Take $G = 0.8 \times 10^5 \text{ N/mm}^2$.

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE2T02	FLUID MECHANICS & HYDRAULICS	3	1	0	5	4	2024

Preamble

The course delves into the fundamental concepts of fluid mechanics, hydraulics of pipes, and open channels. The aim of the course is to enable the students to apply the concepts in analysing and solving real-world problems related to fluid flow and hydraulic structures.

Prerequisites: Engineering Mechanics

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Apply the fundamental concepts to identify types and characteristics of fluid flow, and to estimate fluid pressure and associated forces in practical situations. (Cognitive knowledge level: Apply).
CO 2	Use the principles of buoyancy and flotation to evaluate the stability of floating bodies, and apply fundamental hydrodynamic concepts to explain fluid motion. (Cognitive knowledge level: Apply).
CO 3	Apply the principles of fluid kinetics and Bernoullis equation to analyse flow and compute energy losses and flow characteristics in pipe systems. (Cognitive knowledge level: Apply).
CO 4	Understand the concepts of open channel flow to examine flow types and velocity distribution, calculate discharge using standard flow equations and identify. (Cognitive knowledge level: Apply).
CO 5	Apply the principles of open channel flow to analyse specific energy and hydraulic jump characteristics. (Cognitive knowledge level: Apply).

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	2	1	1	0	0	0	0	0	0	1
CO 2	3	2	1	1	0	0	0	0	0	0	1
CO 3	3	3	2	2	0	1	0	0	0	0	1
CO 4	3	3	2	2	0	1	0	0	0	0	1
CO 5	3	3	2	2	0	2	0	0	0	0	1

Assessment Pattern

Fluid Mechanics & Hydraulics			
Blooms Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	20	20	20
Understand	40	40	40
Apply	40	40	40
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course Project	: 10 marks
Self Study	: 5 marks

End Semester Examination Pattern

There will be two parts: Part A and Part B. Part A contain 10 questions, with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module, of which students should answer any one. Each question carries 14 marks and can have a maximum of 2 sub-divisions.

SYLLABUS

Module 1: Fundamentals of Fluid Properties and Fluid Statics (9 hours)

Fluid properties (mass density, specific weight, viscosity, specific gravity), Classification of Fluids. Fluid statics-variation of pressure in a fluid, measurement of fluid pressure using piezometers and manometers, U-tube manometers - Numerical Problems
Forces on immersed plane placed vertical and inclined positions. Hydrostatic force on curved surfaces Practical application of total pressure on spillway gates.

Module 2: Buoyancy, Floatation, and Fundamentals of Hydrodynamics (9 hours)

Buoyancy and Floatation: Buoyant force, Principle of floatation, stability of floating and submerged bodies, metacentre and metacentric height, analytical and experimental determination of metacentric height - Numerical Problems

Hydrodynamics - Methods of describing fluid motion, Lagrangian and Eulerian methods, velocity and acceleration, types of fluid flow, description of fluid flow - streamline, pathline and streakline; continuity equation in one, two and three dimensions - Numerical Problems.

Module 3: Fluid Kinetics and Pipe Flow Analysis (9 Hours)

Fluid kinetics - forces considered in describing fluid motion, Derivation of Bernoullis equation by integration of Eulers equation along a streamline, Applications of Bernoullis equation - Venturimeter, Pitot tube and Orificemeter;

Pipe flow- computation of major and minor losses in pipes, hydraulic gradient line and total energy line, pipes in series - equivalent pipe, flow through parallel pipes.

Module 4: Open Channel Flow and Flow Measurement (9 Hours)

Open channel flow comparison between pipe flow and open channel flow, velocity distribution in open channels, types of channels, type of flow, geometric elements of channel section, uniform flow computations (Chezys equation, Kutters and Mannings formula); Most economical sections rectangular, triangular and trapezoidal channels, condition for maximum discharge and maximum velocity through circular channels, conveyance and section factor

Flow measurement in channels notches and weirs Discharge equations of rectangular weir, triangular weir, trapezoidal and Cipoletti weir, submerged weir, broad crested weir.

Module 5: Flow Transitions in Open Channels Specific Energy, Critical Flow, and Hydraulic Jump (9 Hours)

Specific energy - specific energy diagram and discharge diagram, Critical flow and its computation. Gradually varied flow, Dynamic equation of gradually varied flow - Rapidly varied flow - Hydraulic jump - conjugate or sequent depths, expression for sequent depths and energy loss for a hydraulic jump in horizontal rectangular channels, types uses and characteristics of hydraulic jump.

Text Books:

1. Modi P. N. and S. M. Seth, Hydraulics & Fluid Mechanics, S.B.H Publishers, New Delhi, 2002.
2. R. K. Bansal, A Textbook of Fluid Mechanics and Hydraulic Machines, Laxmi Publications (P) Ltd.
3. Subramanya K., Theory and Applications of Fluid Mechanics, Tata McGraw-Hill, 1993.
4. Subramanya K., Flow in Open channels, Tata McGraw-Hill, 2009.

Reference Books:

1. Streeter. V.L. Fluid Mechanics, Mc Graw Hill Publishers.
2. Bruce R Munson, Donald F Young. Fundamentals of Fluid Mechanics, John Wiley & sons, 2011.
3. Arora. K.R. Fluid Mechanics, Hydraulics and Hydraulic Machines, Standard Publishers, 2005.
4. Kumar. D.N. Fluid Mechanics and Fluid power Engineering, S. K. Kataria & sons, 2013.
5. Jain A. K., Fluid Mechanics, Khanna Publishers, Delhi, 1996.
6. Narayana Pillai, N. Principles of Fluid Mechanics and Fluid Machines, University Press, 2011.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	9 hours
1.1	Fluid properties (mass density, specific weight, viscosity, specific gravity), Classification of Fluids.	2
1.2	Fluid statics - fluid pressure and variation of pressure in a fluid, Pressure head	1
1.3	Measurement of fluid pressure using piezometers and manometers, U-tube manometers - Numerical Problems	3

1.4	Forces on immersed plane placed vertical and inclined Positions - Numerical Problems	2
1.5	Hydrostatic force on curved surfaces Practical application of total pressure on spillway gates	1
2	Module 2	9 hours
2.1	Buoyancy and Floatation: Buoyant force, Principle of floatation, stability of floating and submerged bodies	2
2.2	Metacentre and metacentric height, analytical and experimental determination of metacentric height - Numerical Problems	3
2.3	Hydrodynamics - Methods of describing fluid motion, Lagrangian and Eulerian methods, velocity and acceleration	2
2.4	Types of fluid flow, description of fluid flow - streamline, pathline and streakline; continuity equation in one, two and three dimensions - Numerical Problems	2
3	Module 3	9 hours
3.1	Fluid kinetics - forces considered in describing fluid motion, Derivation of Bernoullis equation by integration of Eulers equation along a streamline	2
3.2	Applications of Bernoullis equation - Venturimeter, Pitot tube and Orificemeter - Numerical Problems	2
3.3	Pipe flow - computation of major and minor losses in pipes	2
3.4	Hydraulic gradient line and total energy line, pipes in series - equivalent pipe, flow through parallel pipes - Numerical Problems	3
4	Module 4	9 hours
4.1	Open channel flow comparison between pipe flow and open channel flow, velocity distribution in open channels	2
4.2	Types of channels, type of flow, geometric elements of channel section, uniform flow computations (Chezys equation, Kutters and Mannings formula) - Numerical Problems	2

4.3	Most economical sections rectangular, triangular and trapezoidal channels, condition for maximum discharge and maximum velocity through circular channels, conveyance and section factor - Numerical Problems	2
4.4	Flow measurement in channels notches and weirs Discharge equations of rectangular weir, triangular weir, trapezoidal and Cipolletti weir, submerged weir, broad crested weir - Numerical Problems	3
5	Module 5	9 hours
5.1	Specific energy - specific energy diagram and discharge diagram, Critical flow and its computation - Numerical Problems	3
5.2	Gradually varied flow, Dynamic equation of gradually varied flow	2
5.3	Rapidly varied flow - Hydraulic jump - conjugate or sequent depths, expression for sequent depths and energy loss for a hydraulic jump in horizontal rectangular channels	2
5.4	Types, uses and characteristics of hydraulic jump	2
Total		45 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1): Understand and describe the type, characteristics or properties of fluid flow and to apply the fundamental concepts in estimating fluid pressure and forces.

1. Differentiate gauge pressure, atmospheric pressure, and absolute pressure.
2. Determine the total pressure on a circular plate of diameter 1.5 m placed vertically in water with the center of the plate 3 m below the free surface. Find the center of pressure.
3. A square aperture in the vertical side of a tank has one diagonal vertical and is completely covered by a plane plate hinged along one upper side of the aperture. The diagonals of the aperture are 2.4 m long and the tank contains a liquid of specific gravity 1.2. The center of the aperture is 1.8 m below the free surface. Calculate the thrust exerted on the plate by the liquid and the position of the center of pressure.

Course Outcome 2 (CO 2): Apply the concepts of Buoyancy and Floatation to understand the hydrodynamics of fluid flow.

1. State the stability conditions of floating bodies.
2. Show that a cylindrical buoy of 1 m diameter and 2 m height weighing 10 kN will not float vertically in seawater of density 1030 kg/m^3 . Find the force necessary in a vertical chain attached at the center of the base of the buoy that will keep it vertical.
3. Derive the continuity equation in 3-dimensional Cartesian coordinates.
4. An unsteady velocity field is given by $u = t^2 + 3y$ and $v = 4t + 5x$. Calculate the acceleration at the point (5, 3) at time $t = 2$ units.

Course Outcome 3 (CO 3): Understand and apply the concepts of Fluid kinetics and flow through pipes

1. Giving the assumptions, derive Bernoulli's Equation from Euler's equation of motion.
2. A venturimeter $20 \text{ cm} \times 10 \text{ cm}$ is provided in a vertical pipeline to measure the flow of oil of relative density 0.9. The difference in elevations of the throat section and entrance section is 30 cm, with the flow being vertically upwards. The oil-mercury differential U-tube manometer shows a gauge deflection of 10 cm. Calculate the discharge of oil and the pressure.
3. A pipeline of 600 mm diameter is 1.5 km long. To increase the discharge, another pipe of the same diameter is introduced in parallel to the first pipe, for the second half of the length. If $f = 0.04$ and the head at the inlet is 300 mm, calculate the increase in discharge. Neglect minor losses.

Course Outcome 4 (CO 4): Analyse and compute the flow through open channels.

1. The flow in a 2.2 m wide rectangular channel is measured by a rectangular weir with crest length 1 m and height 0.6 m. Find the discharge in the channel when the head over the weir is 0.3 m. Take $C_a = 0.62$. Consider end contractions and velocity of approach.
2. Explain the characteristics of velocity distribution in open channels.
3. Define the terms hydraulic depth and hydraulic radius.

Course Outcome 5 (CO 5): Analyse various types of flow in open channels

1. Derive the dynamic equation of gradually varied flow in a channel, stating the assumptions involved.
2. A rectangular channel 8 m wide carries a discharge of $15 \text{ m}^3/\text{s}$. If the depth of flow is 1.2 m determine:
 - i) specific energy of water flowing through the channel,
 - ii) critical depth and critical velocity, and
 - iii) Froude number.

MODEL QUESTION PAPER

QP CODE:

Pages: 3

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

THIRD SEMESTER B. TECH DEGREE EXAMINATION, MONTH YEAR

Course Code: B24CE2T02

Course Name: FLUID MECHANICS & HYDRAULICS

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks

1. Define specific gravity. How is it different from specific weight?
2. An isosceles triangular plate of base 3 m and altitude 3 m is immersed vertically in an oil of specific gravity 0.8. The base of the plate coincides with the free surface of oil. Determine the total pressure on the plate.
3. How will you determine the metacentric height of a floating body experimentally? Explain with the help of a neat sketch.
4. Differentiate streamline, streakline, and pathline.
5. Explain the use and principle of a Pitot tube.
6. Explain hydraulic gradient line and total energy line with a sketch.
7. Obtain the hydraulic depth and hydraulic mean depth of a triangular channel.
8. What is a Cipolletti weir? Give its significance.
9. Differentiate between:
 - i) Gradually varied flow and rapidly varied flow.
 - ii) Subcritical flow and supercritical flow.
10. Explain the classification of hydraulic jump based on the Froude number.

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. a) Differentiate gauge pressure, atmospheric pressure and absolute pressure. (4)
- b) A U-tube manometer is used to measure the pressure of water in a pipeline which is in excess of atmospheric. The left limb is connected to the pipeline and right limb is open to atmosphere. The free surface of mercury in the right limb is in level with the centre line of the pipe and the level difference of mercury in the limbs of the manometer is 20 cm. Compute the water pressure in the pipeline. If the pressure of water is increased by 50%, compute the manometric reading. (10)

OR

12. a) Obtain the expressions for total pressure and centre of pressure of a lamina placed in fluid in vertical position. (7)
- b) A rectangular opening 2m wide and 1m deep in the vertical side of a tank is closed by a sluice gate of the same size. The gate can turn about the horizontal centroidal axis. The head of water above the upper edge of the gate is 1.5m. Determine (i) the total pressure on the sluice gate and (ii) the torque on the sluice gate. (7)

MODULE 2

13. A rectangular pontoon 10 m long, 7 m broad and 2.5 m deep weighs 700 kN. It carries an empty boiler of 5 m diameter and 590 kN weight on its upper deck. The centre of gravity of the boiler and the pontoon are at their respective centres along a vertical line. Find the metacentric height. Weight density of sea water is 10.104 kN/m^3 . (14)

OR

14. a) Derive the continuity equation in 3D Cartesian coordinates. (8)
- b) Find the acceleration at (1, 2, 3) after 1 sec for a 3D flow given by $u = yz + t$, $v = xz - t$, $w = xy$. (6)

MODULE 3

15. Gasoline (specific gravity 0.82) flows at a rate of 215 l/s in upward direction through an inclined venturimeter fitted to a 300 mm diameter pipe. The venturimeter is inclined at 60° to vertical and its 150 mm diameter throat is 1.2 m from the entrance along its length. Pressure gauges inserted at the inlet and throat show pressures of 0.141 N/mm^2 and 0.077 N/mm^2 respectively. Compute the coefficient of discharge of the venturimeter. If instead of pressure gauges, the entrance and throat are connected to two limbs of a mercury u-tube manometer, determine the manometric reading. (14)

OR

16. A pipeline with diameter 80 cm and length 3000 m connects two open reservoirs of water which have their surface elevations of 100 m and 70 m above a datum. In order to increase the flow rate between the reservoirs by 20%, it is decided to lay an additional pipe of same diameter in parallel to the first one. The second pipeline is to be originated from the upper reservoir and is to be connected at some suitable point. Determine the point of connection, assuming the friction factor as 0.04 for both the lines. Neglect minor losses.

MODULE 4

17. a) Explain the characteristics of velocity distribution in open channels. (4)
b) A lined canal $n = 0.014$ is of trapezoidal section with one side vertical and other with a slope of 1.5H:1V. If the channel is to deliver $9 \text{ m}^3/\text{s}$ when laid on a slope of 0.0002, calculate the dimensions of the efficient section that requires minimum lining. (10)

OR

18. a) A trapezoidal channel discharging water at the rate of $10 \text{ m}^3/\text{s}$ is to be designed for the most economical section. Find the bottom width of the channel and depth of water. The side slope is 60° . Take bed slope as 1 in 750 and Chezy's constant as 66. (10)
b) Explain the characteristics of velocity distribution in open channels. (4)

MODULE 5

19. a) Stating the assumptions underlying it, derive the dynamic equation of gradually varied flow. (10)
b) A rectangular channel 2 m wide carries a discharge of $6 \text{ m}^3/\text{s}$. Calculate the critical depth and specific energy at critical depth. (4)

OR

20. a) Explain the specific energy diagram. (5)
b) In a hydraulic jump occurring in a horizontal rectangular channel, the initial and sequent depths are 0.2 m and 1.2 m respectively. Estimate the discharge per unit width and the energy loss. (9)

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE2T03	FUNCTIONAL PLANNING OF BUILDINGS	2	1	0	4	3	2024

Preamble

This course introduces students to the fundamental concepts of building planning, focusing on design fundamentals, performance factors, and functionality. Students learn about building services, sustainability, and Kerala building rules. Through this course, students apply their knowledge to create buildings that are safe, efficient, sustainable, and meet the needs of their occupants.

Prerequisites: NIL

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Apply building planning, site selection, and aesthetics principles to design functional and visually appealing buildings. (Cognitive knowledge level: Apply).
CO 2	Apply lighting, ventilation, acoustics, and thermal comfort principles to create healthy, comfortable, and functional indoor environments. (Cognitive knowledge level: Apply).
CO 3	Prepare detailed building plans and working drawings for residential and commercial buildings in compliance with Kerala Building Rules. (Cognitive knowledge level: Apply).
CO 4	Explain the integration of electrical, plumbing, HVAC, vertical transportation, and fire safety systems in buildings. (Cognitive knowledge level: Understand).
CO 5	Apply sustainable engineering concepts and intelligent building technologies to develop green and intelligent buildings. (Cognitive knowledge level: Apply).

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	2	3	0	1	2	0	0	0	0	1
CO 2	3	2	3	1	2	2	0	0	0	0	1
CO 3	3	2	3	0	3	3	0	0	2	1	2
CO 4	2	1	2	0	0	3	0	0	0	0	1
CO 5	3	2	3	1	3	3	3	0	0	0	3

Assessment Pattern

Functional Planning Of Buildings			
Blooms Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember			
Understand	40	40	40
Apply	60	60	60
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course Project : 10 marks

Self Study : 5 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contain 10 questions carrying 3 marks each. Part B contains 2 questions from each module out of which 1 to be answered. Each question carries 14 marks and can have a maximum of 2 sub - divisions.

SYLLABUS

Module 1: Building Planning and Aesthetics (6 hours)

Building Planning, Site selection, Principles of planning: Aspect, Prospect, Grouping, Economy, Roominess, Circulation, Flexibility, Furniture requirements, Elegance, Sanitation. Fundamentals of building physics: Orientation-Factors affecting orientation, building form & internal layout, Building Envelope Essentials: Factors to Consider. Aesthetics: Elements of aesthetics - Harmony, Colors, Mass, Balance, Space, Decoration, Proportion, Patterns, Symmetry.

Module 2: Building Performance Factors (6 hours)

Natural Lighting - Daylight factor, Principles of effective natural lighting, Artificial Lighting - Illumination requirements. Ventilation - Functional requirements of ventilation system, Systems of ventilation. Acoustics in functional planning-Basic concepts: sound, noise, and acoustical comfort, sound absorption materials, Acoustical considerations for offices, hospitals, industrial buildings, auditoriums and small lecture halls. Thermal Comfort - Factors affecting thermal comfort. Climate- climatic zones in India, orientation and shape of buildings.

Module 3: Functional requirements of buildings (10 hours)

Functional requirements of buildings Different functional units of a building- Requirements as per KBR regarding Exterior and interior open space, Area and Height limitations, Parking, Parts of building - Staircase, Door, Passage, Sanitation, Lighting, Ventilation, Setback, clearance from electric lines. Requirement as per KBR for High rise building regarding Staircase, Parapets, Fire escape staircase, Ducts, Access, Open spaces, lift, Safety plan. Preparation of line sketches and working drawings of residential buildings and commercial buildings as per area and functional requirements. Preparation of site plan as per Kerala Building Rules. NBC - classification of building - Guidelines for residential, commercial and high-rise building.

Module 4: Building Services (8 hours)

Integration of Services in Buildings - Electrical system components and typical electrical layout diagram, Plumbing design criteria and water supply layout for a residential building, Typical details of sewage disposal arrangements for residential buildings. HVAC and vertical transportation-Basic concept of HVAC load calculation (ASHRAE standards), functioning of elevators and escalators. Fire Safety - Causes of fire and mechanism of fire spread in buildings - Fire alarm system and means of escape - Firefighting installations.

Module 5: Sustainable and Smart Buildings (6 hours)

Innovative Concepts of Functionality - Sustainable Engineering - Concept of green building, Green materials and equipment, green building certification - GRIHA - Intelligent building

- Dimensions of intelligent building, Building Automation system - Design issues related to building automation and its effect on functional efficiency - components and functions, modern security system, inter-communication, monitoring devices, Intelligent lighting system, Case studies of green and intelligent buildings.

Textbooks:

1. Balagopal & T. S. Prabhu, *Building Drawing & Detailing*, Spades Publishers and Distributors, Calicut.
2. Wayne Forster and Dean Hawkes, *Energy Efficient Buildings: Architecture, Engineering, and Environment*, W.W. Norton Company Inc., 2002.
3. Monojit Chakraborti, *Civil Engineering Drawing Including Architectural Aspects*, Kolkata: Bhaktivendanta Book Trust, 2013.
4. Ketki Rangwala Dalal, *Essentials of Civil Engineering*, Charotar Publishing House, Gujarat.
5. Satish Chandra Agarwala, *Architecture and Town Planning*, J.C. Kapur for Dhanpat Rai & Sons Publishers.
6. *Building Technology and Valuation*, Technical Teachers Training Institute.
7. Dr. B. C. Punmia, Er. Ashok K. Jain, Dr. Arun K. Jain, *Building Construction*, Lakshmi Publication Pvt. Ltd., New Delhi.
8. Marshall Long, *Architectural Acoustics*, Second Edition, Academic Press, Waltham, USA, 2014.

References:

1. B. P. Varma, *Civil Engineering Drawing and House Planning*, Khanna Publishers, Delhi.
2. Pritchard, D. C., *Lighting*, Longman Scientific & Technical, Harlow, 1995.
3. Bureau of Energy Efficiency, India, *Design Guidelines for Energy Efficient Multi-Storey Buildings*, 2014.
4. M. V. Chitawadagi, S. S. Bhavikatti, *Building Planning and Drawing*, Dreamtech Press, 2019.
5. F. Hall, *Building Services and Equipment: Volume 1*, Routledge Publishers, 2016.
6. SP 7:2016, *National Building Code of India 2016 (NBC 2016)*, Volume-1 and Volume-2.
7. SP 41, *Handbook on Functional Requirements on Building Other than Industrial Buildings*.
8. *Kerala Municipal Building Rules*, 2019.
9. David T. Allen, David R. Shonnard, *Sustainable Engineering*, Pearson Publishers, 2011.

Course Project:

1. Prepare the plan for a single-storey residential building on a plot of size 16 m $\times$ 25 m. Draw the site plan and layout at a scale of 1:100, a typical sectional view, and elevation.
2. Design a two-storey commercial building (office space) on a plot of size 20 m $\times$ 30 m. Prepare the following drawings: Site plan, Ground floor layout, First floor layout, Typical sectional view, and Elevation.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Topic	No. of Lecture/ Tutorial Hours
1	Module 1	6 hours
1.1	Building Planning, Site selection	1
1.2	Principles of planning: Aspect, Prospect, Grouping, Economy, Roominess, Circulation, Flexibility, Furniture requirements, Elegance, Sanitation	2
1.3	Fundamentals of building physics: Orientation-Factors affecting orientation, building form & internal layout, Shading & Daylight, Building Envelope Essentials: Factors to Consider.	2
1.4	Aesthetics: Elements of aesthetics-Harmony, Colors, Mass, Balance, Space, Decoration, Proportion, Patterns, Symmetry.	1
2	Module 2	6 hours
2.1	Natural Lighting - Daylight factor, Principles of effective natural lighting, Artificial Lighting - Illumination requirements.	1
2.2	Ventilation - Functional requirements of ventilation system, Systems of ventilation.	1

2.3	Acoustics in functional planning-Basic concepts: sound, noise, and acoustical comfort, sound absorption materials, Acoustical considerations for offices, hospitals, industrial buildings, auditoriums and small lecture halls.	2
2.4	Thermal Comfort - Factors affecting thermal comfort.	1
2.5	Climate- climatic zones in India, orientation and shape of buildings.	1
3	Module 3	10 hours
3.1	Functional requirements of buildings Different functional units of a building	1
3.2	Requirements as per KBR regarding Exterior and interior open space, Area and Height limitations, Parking, Parts of building - Staircase, Door, Passage, Sanitation, Lighting, Ventilation, Setback, clearance from electric lines.	2
3.3	Requirement as per KBR for High rise building regarding Staircase, Parapets, Fire escape staircase, Ducts, Access, Open spaces, lift, Safety plan.	2
3.4	Preparation of line sketches and working drawings of residential buildings and commercial buildings as per area and functional requirements.	3
3.5	Preparation of site plan as per Kerala Building Rules.	1
3.6	NBC- classification of building - Guidelines for residential, commercial and high-rise building.	1
4	Module 4	8 hours
4.1	Integration of Services in Buildings - Electrical system components and typical electrical layout diagram,	2
4.2	Plumbing design criteria and water supply layout for a residential building, Typical details of sewage disposal arrangements for residential buildings.	2
4.3	HVAC and vertical transportation-Basic concept of HVAC load calculation (ASHRAE standards), functioning of elevators and escalators.	2

4.4	Fire Safety-Causes of fire and mechanism of fire spread in buildings -Fire alarm system and means of escape - Firefighting installations.	2
5	Module 5	6 hours
5.1	Innovative Concepts of Functionality - Sustainable Engineering-Concept of green building, Green materials and equipment, green building certification-GRIHA	2
5.2	Intelligent building- Dimensions of intelligent building, Building Automation system- Design issues related to building automation and its effect on functional efficiency -components and functions	2
5.3	Modern security system, inter-communication, monitoring devices, Intelligent lighting system, Case studies of green and intelligent buildings	2
Total Hours		36 hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO1): Apply building planning, site selection, and aesthetics principles to design functional and visually appealing buildings. (Cognitive knowledge level: Apply).

1. What are the key factors to consider when selecting a building site, and how do they impact the design of the building?
2. How do orientation, affect the performance of a building?
3. What are the essential factors to consider when designing a building envelope, and how do they impact the building's energy efficiency?

Course Outcome 2 (CO2): Apply lighting, ventilation, acoustics, and thermal comfort principles to create healthy, comfortable, and functional indoor environments. (Cognitive knowledge level: Apply).

1. What is the daylight factor, and how is it used to evaluate natural lighting in buildings?
2. Describe the factors affecting thermal comfort in buildings.
3. An auditorium is being designed for a university. How would you apply acoustical considerations to ensure optimal sound quality and acoustical comfort for the audience?

Course Outcome 3 (CO3): Prepare detailed building plans and working drawings for residential and commercial buildings in compliance with Kerala Building Rules. (Cognitive knowledge level: Analyse).

1. What are the area and height limitations as per Kerala Building Rules (KBR)?
2. Explain the requirements of exterior and interior open spaces as per KBR
3. Draw the site plan of a residential building with setbacks to urban area to plot of size 12 m x 22 m.

Course Outcome 4 (CO4): Explain the integration of electrical, plumbing, HVAC, vertical transportation, and fire safety systems in buildings. (Cognitive knowledge level: Understand).

1. Draw an electrical layout for one bed room residential building showing at least four components.
2. Explain the components of a fire alarm system and means of escape in buildings, including the requirements for fire safety.
3. Explain the basic concept of HVAC load calculation as per ASHRAE standards, including the factors that affect HVAC load

Course Outcome 5 (CO5): Apply sustainable engineering concepts and intelligent building technologies to develop green and intelligent buildings. (Cognitive knowledge level: Apply).

1. What is an intelligent building and its key dimensions?
2. Describe the process of green building certification, including the criteria and requirements.
3. Describe the modern security systems used in intelligent buildings, including inter-communication and monitoring devices

MODEL QUESTION PAPER

QP CODE:

Pages: 3

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

THIRD SEMESTER B. TECH DEGREE EXAMINATION, MONTH YEAR

Course Code: B24CE2T03

Course Name: FUNCTIONAL PLANNING OF BUILDINGS

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks

1. Enlist various factors to be considered in selecting a site for residential building?
2. Describe the factors affecting orientation in building design.
3. Define daylight factor in natural lighting.
4. List the types of sound absorption materials.
5. How do the planning of a public building differ from planning of a residential building?
6. State the importance of site plan in submission drawings.
7. Enumerate the components of a fire alarm system?
8. Describe the requirements for sewage disposal arrangements in residential buildings?
9. Describe the benefits of using intelligent lighting systems in buildings.
10. List the benefits of using green materials in building design.

PART B

Answer any one question from each module. Each question carries 14 marks

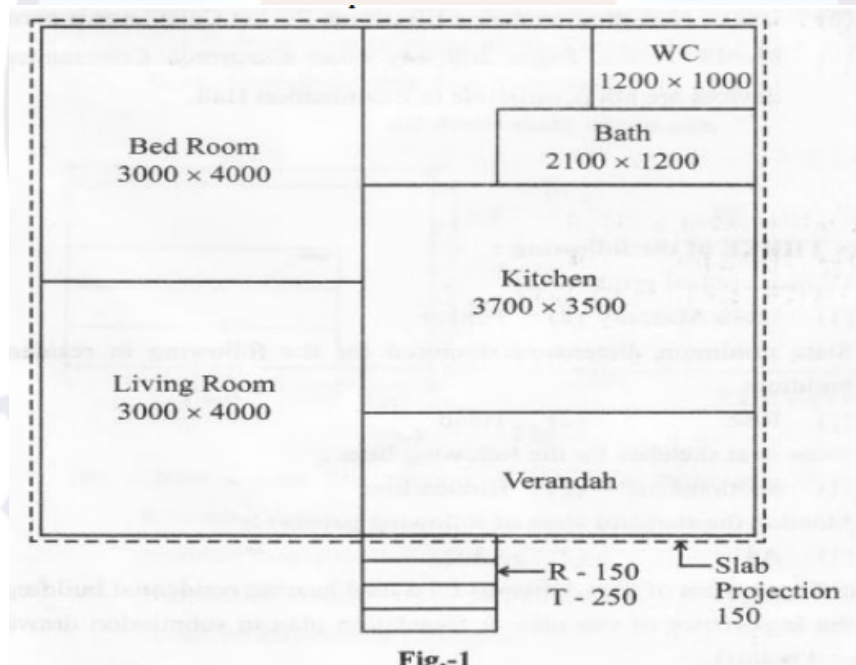
11. Explain the principles of building planning, including aspects, prospect, grouping, economy, roominess, circulation, flexibility, furniture requirements, elegance, and sanitation.

OR

12. Explain the elements of aesthetics in building design, including harmony, colors, mass, balance, space, decoration, proportion, patterns, and symmetry.
13. Describe the different systems of ventilation, including natural, mechanical, and hybrid systems.

OR

14. An industrial facility is experiencing high noise levels due to machinery and equipment. What acoustic solutions can be implemented to reduce noise levels and improve worker safety?
15. Fig. - 1 shows a line plan of load bearing residential building. Draw developed plan with suitable scale. Show all dimensions and table the parts.
Data: 1) Plinth height 0.75 m. 2) Assume Chajjas projection 450 mm. 3) Wall thickness 300 mm for external and 230 mm for internal walls. 4) Assume suitable data if required.



OR

16. Enumerate the basic principles underlying building byelaws and also limitations for the built-up area.
17. Explain the basic concept of HVAC load calculation as per ASHRAE standards and its importance in building design.

OR

18. Discuss the components of an electrical system in a building, including the typical electrical layout diagram.
19. Describe the process of green building certification, including the benefits and requirements.

OR

20. Discuss a case study of an intelligent building, including its design features and benefits.



CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24HU2T02	ENTREPRENEURSHIP AND MANAGEMENT SKILLS FOR ENGINEERS	2	1	0	4	3	2024

Preamble

In today's rapidly evolving world, engineers must go beyond technical expertise and develop entrepreneurial, managerial, and business acumen to drive innovation and create impact. This course equips students to identify opportunities, develop scalable business models, and apply modern management and marketing strategies. Through activity-based learning, case studies, and real-world problem-solving, students will gain practical insights into leadership, business analysis, and intellectual property rights (IPR), preparing them for startups, corporate leadership, and innovation-driven industries.

Prerequisites: NIL

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Understand key principles and functions of management to grasp modern managerial roles (Cognitive Knowledge Level: Understand)
CO 2	Explain the fundamentals of managing people and processes through effective staffing, motivation, leadership, and control strategies. (Cognitive Knowledge Level: Understand)
CO 3	Apply modern marketing strategies and digital transformation to build sustainable businesses. (Cognitive Knowledge Level: Apply)
CO 4	Understand the basics of idea pitching, managing finances and using modern marketing tools. (Cognitive Knowledge Level: Understand)
CO 5	Understand Intellectual Property Rights (IPR) and legal frameworks to protect innovation and navigate startup challenges. (Cognitive Knowledge Level: Understand)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	0	0	0	0	0	1	1	1	1	2	2
CO 2	0	0	0	0	0	1	1	2	2	2	2
CO 3	0	0	0	0	0	0	0	0	0	3	2
CO 4	0	0	0	0	0	0	0	0	0	2	2
CO 5	0	0	0	0	0	1	0	0	1	2	2

Assessment Pattern

Entrepreneurship And Management Skills For Engineers			
Blooms Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	40	30	30
Understand	60	50	50
Apply		20	20
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course Project	: 10 marks
Self Study	: 5 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contains 10 questions (2 questions from each module), of 3 marks each and the student should answer all the questions. Part B contains 2 questions from each module of which student should answer anyone. Each question can have a maximum of 2 sub-divisions and carry 14 marks.

SYLLABUS

Module 1: (6 Hours)

Functions of Management: Introduction to Management: Definitions and scope - Core Functions - Levels of Management - Evolution of Management Thought: Scientific Management (F.W. Taylor), Administrative Management (Henri Fayol), Modern Approaches - Planning and Types of Plans - Organizational Structures: Departmentalization.

Module 2: (7 Hours)

Manpower Planning, Leadership & Control: Staffing - Motivation Theories Leadership - Understanding Negotiation in Leadership: Types of Negotiation Barriers to effective communication - Activity-based learning.

Module 3: (8 Hours)

Entrepreneurial Thinking & Business Design: Entrepreneurial Mindset: Growth mindset, risk-taking, and decision-making - Finding a Good Business Idea - How to prepare an Empathy canvas, Value proposition canvas and Idea canvas - Digital Business Models: Freemium, Subscription, Platform-based - Business Model Canvas: Develop and visualise the business model.

Module 4: (6 Hours)

Startup Pitching, Marketing & Financials: Startup Financials: Revenue models, cost structure, funding stages, valuation basics - Investor Pitching: Structure of a pitch deck, communicating value, funding strategy - Digital branding, social media, performance marketing - Growth Strategies: Network effects, influencer marketing, CRM tools.

Module 5: (9 Hours)

Intellectual Property Rights (IPR) and Legal Framework Overview of Intellectual Property Rights (IPR) - Product patents, Process patents- Prerequisites for filing a patent: Novelty, Inventive step, Industrial applicability -Provisional vs Complete application - Common mistakes to avoid before filing - Anatomy of a Patent Document - Overview of databases - Legal Aspects of Startups- Business Registrations and Legal structures Compliance & Regulatory Requirements.

Reference Books:

1. Ricky W. Griffin, Jean M. Phillips & Stanley M. Gully, Organizational Behavior: Managing People and Organizations, Cengage Learning, 12th Edition, 2019.
2. Stephen P. Robbins & Timothy A. Judge, Organizational Behavior, Pearson Education, 18th Edition, 2019.
3. Heidi M. Neck, Christopher P. Neck & Emma L. Murray, Entrepreneurship: The Practice and Mindset, SAGE Publications Inc., 3rd Edition, 2023.
4. Alejandro Cremades, The Art of Startup Fundraising: Pitching Investors, Negotiating the Deal, and Everything Else Entrepreneurs Need to Know, Wiley, 2023.
5. Dr R. Radhakrishnan & Dr S. Balasubramanian, Intellectual Property Rights: Text and Cases, Excel Books, 2008.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	6 hours
1.1	Introduction to Management: Definitions and scope - Core Functions: Planning, Organizing, Staffing, Directing, Controlling. - Levels of Management: Top, Middle, Lower.	1
1.2	Evolution of Management Thought: Classical approaches -F.W. Taylor, Henri Fayol - Modern Approaches: Systems approach, Contingency approach.	1
1.3	Planning: Importance and steps in planning (objectives, alternatives, evaluation, selection). Types of plans: Strategic, Tactical, Operational, Contingency.	2
1.4	Organizational Structure, Types of Organizational Structures: Functional, Divisional, Matrix, Flat vs. Tall Organizations, Impact of Structure on Business Operations.	2
2	Module 2	7 hours
2.1	Manpower Planning, Job Analysis, Recruitment vs Selection - Motivation Theories: Maslow's Hierarchy of Needs, Herzbergs Two-Factor Theory.	2

2.2	Leadership theories: Theory X and Theory Y- Leadership Styles: Autocratic, Democratic, Laissez-faire - Application and effectiveness in various organizational contexts.	2
2.3	Understanding Negotiation in Leadership: Types of Negotiation: Distributive vs. Integrative, Understanding when to compete and when to collaborate. Team building.	2
2.4	Communication Types: Formal and Informal - Barriers to effective communication. Communication distortion. Case studies.	1
Activity-Based Learning: Leadership Roll Playing Simulation: Real-life negotiation scenarios such as investor discussions or conflict resolution between co-founders to practice persuasive communication and strategic thinking.		
3	Module 3	8 hours
3.1	Entrepreneurial Mindset Growth mindset, risk-taking, and decision-making.	2
3.2	Finding a Good Business Idea - Looking around for real-life problems people face. How to prepare an Empathy canvas, value proposition canvas and Idea canvas.	2
3.3	Planning Your Business on One Page - Use a simple chart called the Business Model Canvas.	2
3.4	How Online Businesses Make Money - Freemium Model (Free basic version, pay for extra features) - Subscription Model (Monthly/Yearly payments for continuous use) - Platform Model (Connecting buyers and sellers, like Amazon or Swiggy).	2
Activity: The students may be encouraged to make a Business model plan of their choice.		
4	Module 4	6 hours
4.1	Startup financials - Key Financial Terms: Revenue, cost, profit, cash flow, gross margin, net profit, burn rate, turnover, ask - Types of Revenue Models, cost structure, funding stages, valuation basics.	2
4.2	Investor Pitching Structure of a pitch deck, communicating value, and funding strategy.	2

4.3	Modern Marketing Digital branding, social media, performance marketing - Growth Strategies: Network effects, influencer marketing, CRM tools.	2
5	Module 5	9 hours
5.1	Overview of Intellectual Property Rights (IPR) - What is a patent and why does it matter - Types of patentable subject matter: Product Patents, Process Patents- Prerequisites for filing a patent: Novelty, Inventive step, Industrial applicability.	2
5.2	Provisional vs Complete application - When to file a patent (timing strategy for start-ups) - Common mistakes to avoid before filing (e.g., disclosing ideas publicly)	1
5.3	Anatomy of a Patent Document: Title, Abstract, Background, Claims, Drawings - Indian vs International Patents: Filing paths and differences (PCT vs national phase) - Overview of databases: Google Patents, USPTO, WIPO, Espacenet.	2
5.4	Business Registrations & Legal Structures - Types of business entities: Sole Proprietorship, Partnership, LLP, Private Ltd, OPC. Startup India Registration Benefits & Eligibility.	2
5.5	Compliance & Regulatory Requirements - GST Registration, ROC Filings. Startup Taxation & Incentives. Taxes applicable to startups (Income Tax, GST, TDS, Angel Tax). Tax Benefits for Startups under Section 80-IAC & DPIIT.	2
Total		36 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Explain the core functions of management and how they support effective organizational operations.
2. How do different levels of management (top, middle, lower) contribute to achieving business goals?
3. Explain the difference between classical and modern approaches to management thought.

Course Outcome 2 (CO 2):

1. How do Maslows Hierarchy of Needs and Herzbergs Two-Factor theory explain employee motivation in the workplace?
2. Enumerate the key differences between Theory X, Theory Y, and Theory Z, and how they influence leadership styles.
3. How do BATNA and ZOPA help leaders make effective negotiation decisions during team conflicts or business deals?

Course Outcome 3 (CO 3):

1. Use the Business Model Canvas to design a simple online learning platform. Include key elements such as customer segments, revenue model, and value proposition.
2. Prepare an Idea Canvas for a mobile app that helps local farmers sell directly to customers. Explain how this solution fits a real-world problem.
3. Choose one digital business model (freemium, subscription, or platform-based) and apply it to a startup idea of your choice. Explain how this model supports long-term business sustainability.

Course Outcome 4 (CO 4):

1. Explain the key components of a startup pitch deck and their role in communicating value to investors.
2. Describe the difference between a revenue model and a cost structure, and why both are important in startup financial planning.
3. What is digital branding, and how can tools like social media and influencer marketing help a new business grow?

Course Outcome 5 (CO 5):

1. Discuss the key differences between product patents and process patents.
2. Explain the basic prerequisites for filing a patent.
3. List any three types of legal business structures in India and describe how choosing the right structure supports startup compliance.

MODEL QUESTION PAPER

QP CODE:

Pages: 3

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

THIRD SEMESTER B. TECH DEGREE EXAMINATION, MONTH YEAR

Course Code: B24HU2T02

**Course Name: ENTREPRENEURSHIP AND MANAGEMENT SKILLS
FOR ENGINEERS**

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks

1. Define the core functions of management with a brief explanation.
2. Differentiate between flat and tall organisational structures.
3. Explain the key difference between Maslows and Herzbergs motivation theories.
4. Differentiate between distributive and integrative negotiation with one example each.
5. List any three key components of the Business Model Canvas and explain their purpose.
6. Explain the concept of a growth mindset in the context of entrepreneurship.
7. State the meaning of burn rate and why it is important for startups.
8. Mention any two components of a startup pitch deck and explain their importance.
9. State the difference between a provisional and a complete patent application.
10. List any two legal compliance requirements for a startup after registration.

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. a) Illustrate the three levels of management with suitable examples and describe the role of each in organizational decision-making. (7 Marks)

- b) Discuss the different types of plans (strategic, tactical, operational, contingency) with examples, and explain how they guide managerial actions. (7 Marks)

OR

12. a) Explain the five core functions of management and discuss their importance in running a business efficiently. (7 Marks)
- b) Compare the classical management theories of F.W. Taylor and Henri Fayol with modern approaches like systems and contingency theory. (7 Marks)

MODULE 2

13. a) Describe Herzbergs Two-Factor Theory and Maslows Hierarchy of Needs. How can managers apply them to motivate employees? (7 Marks)
- b) Explain the steps involved in manpower planning and differentiate between recruitment and selection with examples. (7 Marks)

OR

14. a) You are leading a startup team facing internal disagreements. Explain how different types of negotiation and leadership styles can help resolve the conflict. (7 Marks)
- b) Discuss the impact of communication barriers on leadership effectiveness and provide examples of how leaders can overcome them. (7 Marks)

MODULE 3

15. a) Imagine you've identified a problem faced by college students difficulty in finding affordable and quality food near campus. How would you use an Idea Canvas to shape a possible business solution? (7 Marks)
- b) You are building a mobile app that alerts users about air quality levels in real time. Using an Empathy Canvas, explain how you would understand the daily experience of urban commuters who are your target users. (7 Marks)

OR

16. a) A team of students has developed a low-cost, portable device to detect water leakage in household plumbing systems. Using the Value Proposition Canvas, explain how this solution fits the needs of middle-income homeowners. (7 Marks)
- b) A startup team has developed a low-cost solar-powered drying solution to help small-scale agricultural producers reduce post-harvest losses. Using the Business Model Canvas, outline their customer segments, key partners, and value proposition. (7 Marks)

MODULE 4

17. a) A product-based startup is working on modular housing solutions designed for quick deployment in disaster-hit regions. Describe how the team can develop a strong investor pitch focusing on revenue model, scalability, and social impact. (7 Marks)

- b) A D2C (Direct-to-Consumer) skincare brand is looking to expand via digital platforms. Explain how influencer marketing and CRM tools can be integrated to build customer loyalty and drive conversions. (7 Marks)

OR

18. a) A new mobile app startup wants to attract early investors. Explain the importance of understanding financial terms such as revenue, burn rate, and valuation when preparing for funding. Use simple examples to support your answer. (7 Marks)
- b) A startup developing a wearable health monitoring device is preparing to pitch to early-stage investors. Outline the essential components that should be included in their pitch deck. (7 Marks)

MODULE 5

19. a) A startup has created a catchy logo and app interface. Explain which types of IPR they need to protect and why each is important. (7 Marks)
- b) You have developed a unique cooling technology for electric bikes. Describe the steps you would follow to file a patent in India and explain how it helps protect your innovation. (7 Marks)

OR

20. a) Compare three common legal structures available for startups in India. For a tech-based service startup, which would you recommend and why? (7 Marks)
- b) What are the key tax benefits offered under the Startup India Scheme and Section 80-IAC? How do these help early-stage startups survive financially? (7 Marks)

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE2L03	SURVEYING LABORATORY	0	0	3	2	2	2024

Preamble

The objective of the course is to impart practical experience to students by exposing them to various techniques of field surveying. The course is designed to familiarise students with conventional and advanced surveying instruments.

Prerequisites: Surveying and Geomatics

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	To develop competency in differential and profile levelling techniques
CO 2	To impart proficiency in angular and linear measurements using theodolite and tacheometry
CO 3	To familiarize students with advanced surveying instruments such as total stations
CO 4	To introduce students to modern geospatial techniques like GNSS surveying
CO 5	To integrate surveying skills through a mini project focused on contouring and topographical mapping

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	2	0	2	2	0	0	0	0	0	1
CO 2	3	2	0	2	3	0	0	0	0	0	1
CO 3	2	1	0	2	3	0	0	0	0	0	2
CO 4	2	1	1	2	3	1	0	0	0	0	2
CO 5	2	2	2	3	3	1	0	2	2	1	2

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	10 marks
Continuous Assessment	10 marks
Viva-Voce (Self Study)	10 marks
Test	15 marks
Lab Record	5 marks

Note:

Marks shall not be awarded for the Lab Record in the End Semester Examination. However, students having a certified Lab Record are only eligible to appear for the End Semester Examination. A weightage of 30% of the total marks shall be given for the Viva-Voce in the End Semester Examination.

End Semester Examination (ESE) Pattern

The following guidelines should be followed regarding the award of marks:

Preliminary work	: 20 marks
Implementation / Conducting the experiment	: 20 marks
Performance, result and inference (usage of equipment and troubleshooting)	: 30 marks
Viva voce	: 30 marks

COURSE CONTENT
(Any 8 Experiments Are Mandatory)

Exp. No.	List of Experiments
1	Differential levelling
2	Profile levelling and cross sectioning
3	Distance between accessible points using Theodolite (Repetition Method)
4	Distance between inaccessible points using Theodolite (Repetition Method)
5	Level difference between points using Tangential Tacheometry
6	Distance, gradient, and level difference between two inaccessible points using total station
7	Determination of height of a tall building using total station
8	Determination of area and volume of an embankment using total station
9	Setting out works
10	GNSS surveying
11	Mini project Contouring of a given area using total station or GNSS

Reference Books:

1. Dr. B.C Punmia , Ashok Kumar Jain & Arun Kumar Jain - Surveying , Laxmi publications (P) Ltd , 2005
2. C. Venkatramaiah, Textbook of Surveying, Universities Press (India) Private Limited 2011
3. Prof. T.P.Kenetkar & Prof.S.V.Kulkarni - Surveying and Levelling , Pune Vidyarthi Griha Prakashan,2004
4. R. Agor - A Text book of Surveying and Levelling, Khanna Publishers, 2005
5. S.K.Duggal - Surveying Vol. I, Tata McGraw Hill Ltd ,Reprint 2015. 6. S.K. Duggal - Surveying Vol. II, Tata McGraw Hill Ltd, Reprint 2015

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE2L04	HYDRAULICS LABORATORY	0	0	3	2	2	2024

Preamble

The Fluid Mechanics and Machines Laboratory provides students with practical experience in understanding the behavior of fluids and the operation of fluid machinery. It focuses on key principles of fluid statics and fluid dynamics.

Prerequisites: Basic understanding about the Fluid mechanics.

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Calibrate flow measuring devices, such as venturimeter, orifice meter, and notches. (Cognitive Knowledge Level: Apply)
CO 2	Determine the metacentric height and radius of gyration of floating bodies. (Cognitive Knowledge Level: Apply)
CO 3	Investigate the hydraulic characteristics of orifices under both constant head and time for emptying methods to determine their discharge coefficients. (Cognitive Knowledge Level: Apply)
CO 4	Determine the losses and hydraulic coefficients in pipe and channel flows. (Cognitive Knowledge Level: Apply)
CO 5	Develop practical skills in fluid flow measurement and test on pump and turbine, enabling students to apply theoretical knowledge in real-world hydraulic systems . (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	2	1	3	0	2	0	3	2	1	1
CO 2	3	2	1	3	0	2	0	3	2	1	1
CO 3	3	2	1	3	0	2	0	3	2	1	1
CO 4	3	2	1	3	0	2	0	3	2	1	1
CO 5	3	2	1	3	0	2	0	3	3	1	1

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	10 marks
Continuous Assessment	10 marks
Viva-Voce (Self Study)	10 marks
Test	15 marks
Lab Record	5 marks

End Semester Examination Pattern

The following guidelines should be followed regarding the award of marks:

Preliminary work	: 20 marks
Implementation / Conducting the experiment	: 20 marks
Performance, result and inference (usage of equipment and troubleshooting)	: 30 marks
Viva voce	: 30 marks

SYLLABUS

LIST OF EXPERIMENTS

Exp. No	Description
1	Study of taps, valves, pipe fittings, gauges, and plumbing tools to understand their function, design, and application in fluid systems.
2	Study of the hydraulic ram to understand its application in lifting water using minimal energy.
3	Measurement of metacentric height and radius of gyration in floating bodies.

Exp. No	Description
4	Calibration of a venturimeter to determine the coefficient of discharge.
5	Calibration of an orifice meter to determine the coefficient of discharge.
6	Calibration of a water meter to determine the coefficient of discharge.
7	Calibration of a triangular notch to determine the coefficient of discharge.
8	Calibration of a rectangular notch to determine the coefficient of discharge.
9	Calibration of a trapezoidal notch to determine the coefficient of discharge.
10	Determination of Chezys and Darcys constants for pipe flow.
11	Determination of Chezys and Mannings coefficients for open channel flow.
12	Determination of hydraulic coefficients of orifice under time for emptying method.
13	Determination of hydraulic coefficients of orifice under constant head method.
14	Performance test on Pelton turbine.
15	Performance test on Kaplan turbine.
16	Performance test on Francis turbine.
17	Performance test on a centrifugal pump.
18	Performance test on a reciprocating pump.

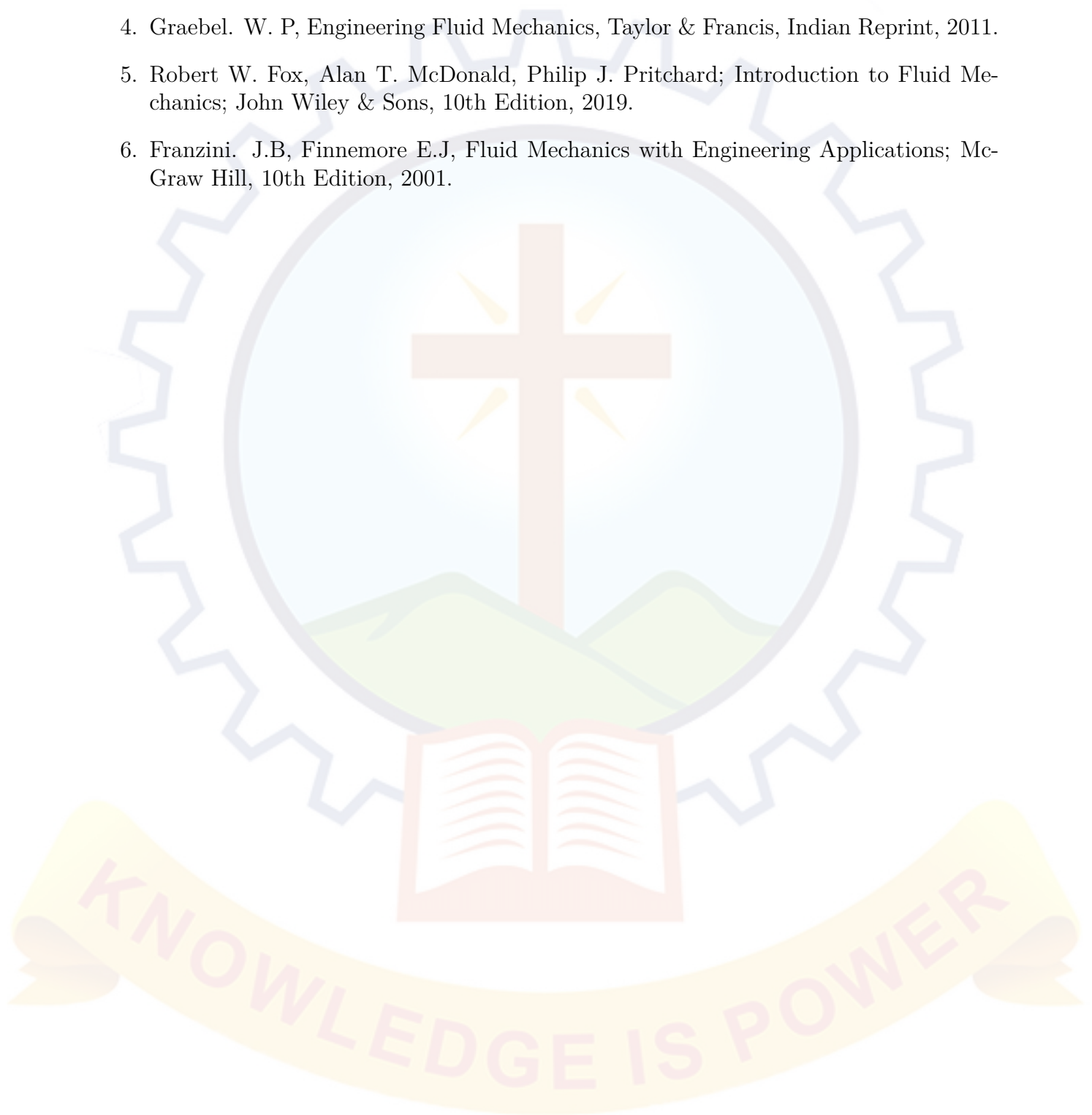
13 experiments are mandatory including any one pump and a turbine.

Reference Books:

1. Yunus A. Cengel, John M. Cimbala; Fluid Mechanics- Fundamentals and Applications, 4th edition, McGraw Hill, 2018.
2. Bansal R.K, A Textbook of Fluid Mechanics and Hydraulic Machines, 11th edition,

Laxmi Publications, 2023.

3. Modi P.N and Seth S.M, Hydraulics and Fluid Mechanics Including Hydraulic Machines, Standard Book House, New Delhi, 22th Edition, 2019.
4. Graebel. W. P, Engineering Fluid Mechanics, Taylor & Francis, Indian Reprint, 2011.
5. Robert W. Fox, Alan T. McDonald, Philip J. Pritchard; Introduction to Fluid Mechanics; John Wiley & Sons, 10th Edition, 2019.
6. Franzini. J.B, Finnemore E.J, Fluid Mechanics with Engineering Applications; McGraw Hill, 10th Edition, 2001.



CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24MC2T04	UNIVERSAL HUMAN VALUES AND CONSTITUTIONAL RIGHTS	2	0	0	2	P/F	2024

Preamble

This course explores various dimensions of human existence, beginning with self-awareness and an understanding of essential needs such as prosperity, happiness, inner peace, and harmonious relationships. It also introduces the preamble and key features of the Indian Constitution, along with the Directive Principles of State Policy, highlighting their importance in shaping governance and promoting social welfare. By the end of the course, students will be better equipped to act responsibly, address challenges with sustainable solutions, and foster positive human relationships grounded in an understanding of human nature.

Prerequisites: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Understand the importance of value education for holistic development and to fulfill human aspirations. (Cognitive Knowledge Level : Understand)
CO 2	Develop more awareness of themselves, and their surroundings(family, society, nature)to build harmonious and respectful relationships.(Cognitive Knowledge Level : Apply)
CO 3	Understand and appreciate the preamble and other features in the Indian Constitution to promote responsible citizenship.(Cognitive Knowledge Level : Understand)
CO 4	Understand the fundamental rights and duties enshrined in the Indian Constitution and the Directive Principles of State Policy and their role in shaping governance and social welfare. (Cognitive Knowledge Level : Understand)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	0	0	0	0	0	2	3	1	1	1	2
CO 2	0	0	0	0	0	2	3	2	1	1	2
CO 3	0	0	0	0	0	2	3	0	2	0	2
CO 4	0	0	0	0	0	2	3	0	2	0	2

Assessment Pattern

Energy Conservation And Environmental Sustainability		
Blooms Category	Continuous Assessment Tests	End Semester Examination (Percentage)
	Test 1 (Percentage)	
Remember	30	30
Understand	60	60
Apply	10	10
Analyse		
Evaluate		
Create		

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	50	50	2 hours

Continuous Internal Evaluation Pattern

Attendance : 10 marks

Continuous Assessment Test (one test, conducted for 50 marks and reduced to 25) : 25 marks

Assignment/Quiz/Course Project/Seminar : 10 marks

Self Study : 5 marks

End Semester Examination Pattern

There will be two parts, Part A and Part B. Part A contains 4 questions carrying 3 marks from each module. Part B contains 2 questions from each module out of which one is to be answered. In Part B, each question of first two modules carries 9 marks and each question of last two modules carries 10 marks.

SYLLABUS

MODULE 1: Introduction to Values (6 hours)

The Need of Value Education-Guidelines for Value Education, Self-exploration as the Process for Value Education-Two parts, Important implications of Self Exploration, Continuous Happiness and Prosperity -A Look at Basic Human Aspirations-Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education)- Method to fulfill the Basic Human Aspirations.

MODULE 2: Harmony in the Human Being, Family and Society (5 hours)

Understanding Human being as the Co-existence of the Self and the Body-Distinguishing between the Needs of the Self and the Body-Harmony of the Self with the Body- Harmony in the Family the Basic Unit of Human Interaction- Understanding Harmony in the Society.

MODULE 3: Introduction to Constitution of India(5 hours)

Definition and Historical Background of the Constitution-Salient Features of the Constitution-Preamble of the Constitution-Union and Its Territory- Meaning and Types of Citizenship-Termination of Citizenship.

MODULE 4: State Policies and Fundamental Rights (8 hours)

Definition of the State-Fundamental Rights- General Nature and Classification-Right to Equality and Right to Freedom-Right Against Exploitation- Right to Freedom of Religion-Cultural and Educational Rights- Right to Constitutional Remedies- Protection Against Conviction for Offences-Right to Information (RTI) and Its Applications-Directive Principles of State Policy- Classification of Directives-Fundamental Duties.

Text Books:

1. A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 3rd Revised Edition, Excel Books, New Delhi, 2023.
2. The Teachers Manual for a Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 3rd Revised Edition, Excel Books, New Delhi, 2023.
3. D D Basu, Introduction to the constitution of India, Lexis Nexis, New Delhi, 26/e, 2022
4. P M Bhakshi, The constitution of India, Universal Law, 19/e, 2023

Reference Books:

1. M Govindarajan, S Natarajan and V S Senthil Kumar, Engineering Ethics, PHI Learning Private Ltd, New Delhi,2012.
2. R S Naagarazan, A text book on professional ethics and human values, New age international (P) limited, New Delhi,2006.

3. Ministry of Law and Justice, The constitution of India, Govt of India, New Delhi,2019.
4. J N Pandey, The constitutional Law of India, Central Law Agency, Allahabad, 51e,2019.
5. M V Pylee, Indias Constitution, S Chand and Company, New Delhi,16e, 2016.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Topic	No. of Lecture/ Tutorial Hours
1	Module 1	6 hours
1.1	The Need of Value Education-Guidelines for Value Education	1
1.2	Self-exploration as the Process for Value Education-Two Parts	1
1.3	Important implications of Self Exploration	1
1.4	Continuous Happiness and Prosperity -A Look at Basic Human Aspirations	1
1.5	Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education)	1
1.6	Method to fulfill the Basic Human Aspirations	1
2	Module 2	5 hours
2.1	Understanding Human being as the Co-existence of the Self and the Body	1
2.2	Distinguishing between the Needs of the Self and the Body	1
2.3	Harmony of the Self with the Body	1
2.4	Harmony in the Family the Basic Unit of Human Interaction	1
2.5	Understanding Harmony in the Society	1
3	Module 3	5 hours
3.1	Definition and Historical Background of the Constitution	1

3.2	Salient Features of the Constitution	1
3.3	Preamble of the Constitution-Union and Its Territory	1
3.4	Meaning and Types of Citizenship	1
3.5	Termination of Citizenship	1
4	Module 4	8 hours
4.1	Definition of the State- Fundamental Rights- General Nature and Classification	1
4.2	Right to Equality and Right to Freedom-Right Against Exploitation- Right to Freedom of Religion	1
4.3	Cultural and Educational Rights- Right to Constitutional Remedies	1
4.4	Protection Against Conviction for Offences	1
4.5	Right to Information (RTI) and Its Applications	1
4.6	Directive Principles of State Policy	1
4.7	Classification of Directives	1
4.8	Fundamental Duties	1

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO1):

1. Explain the basic guidelines for value education. What is the need for these guidelines.
2. Explain the process of self-exploration. What is the expected result of self-exploration?
3. What are the basic human aspirations and what are the requirements to fulfill them? Support your answer with two examples.

Course Outcome 2 (CO2):

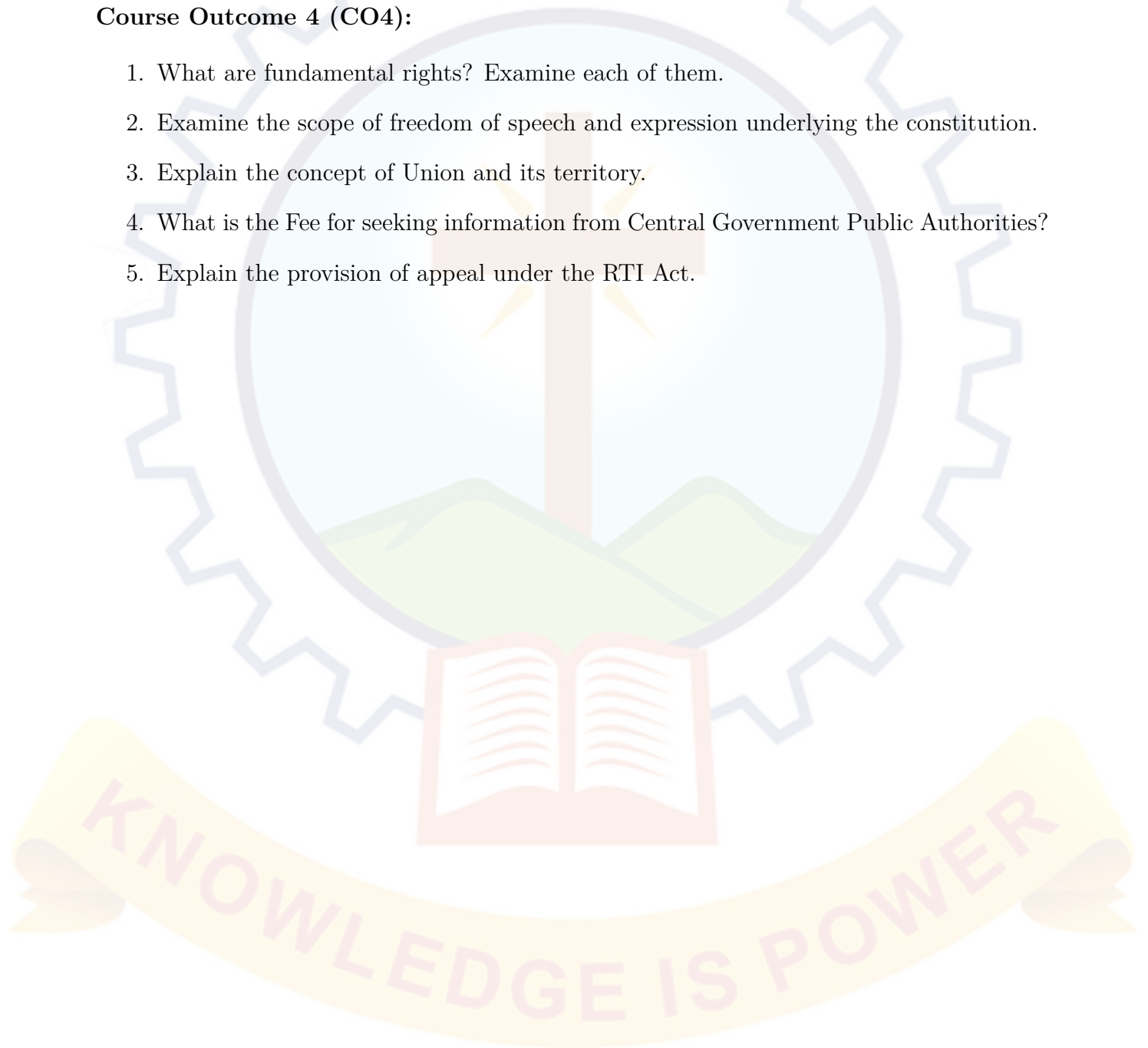
1. Distinguish between animal consciousness and human consciousness.
2. 'Relationship is between one Self (I1) and another Self (I2)'. Examine this statement.
3. What is the building block for harmony in the society? Explain with examples.

Course Outcome 3 (CO3):

1. Describe the historical background of the Indian Constitution.
2. Explain the salient features of the Indian constitution.
3. Summarize the importance of preamble in the implementation of constitution.

Course Outcome 4 (CO4):

1. What are fundamental rights? Examine each of them.
2. Examine the scope of freedom of speech and expression underlying the constitution.
3. Explain the concept of Union and its territory.
4. What is the Fee for seeking information from Central Government Public Authorities?
5. Explain the provision of appeal under the RTI Act.



MODEL QUESTION PAPER

QP CODE:

Pages: 2

Reg.No.:

Name:

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

THIRD SEMESTER B. TECH DEGREE EXAMINATION, MONTH YEAR

Course Code: B24MC2T04

Course Name: **UNIVERSAL HUMAN VALUES AND CONSTITUTIONAL
RIGHTS**

Max. Marks: 50

Duration: 2 hours

PART A

Answer all questions. Each question carries 3 marks

1. Identify the solution which helps human being to transform from animal Consciousness to human consciousness.
2. What is the building block for harmony in the society?
3. Define and explain the term Constitution.
4. The freedom of speech and expression is subject to reasonable restrictions. Explain the statement.

PART B

Answer any one question from each module

5. Explain the basic guidelines for value education. What is the need for these guidelines? (9 Marks)

OR

6. Choose any five things that you consider as human values. Write all the basic guidelines, and check if they satisfy the basic guidelines. (9 Marks)
7. Distinguish between animal consciousness and human consciousness. (9 Marks)

OR

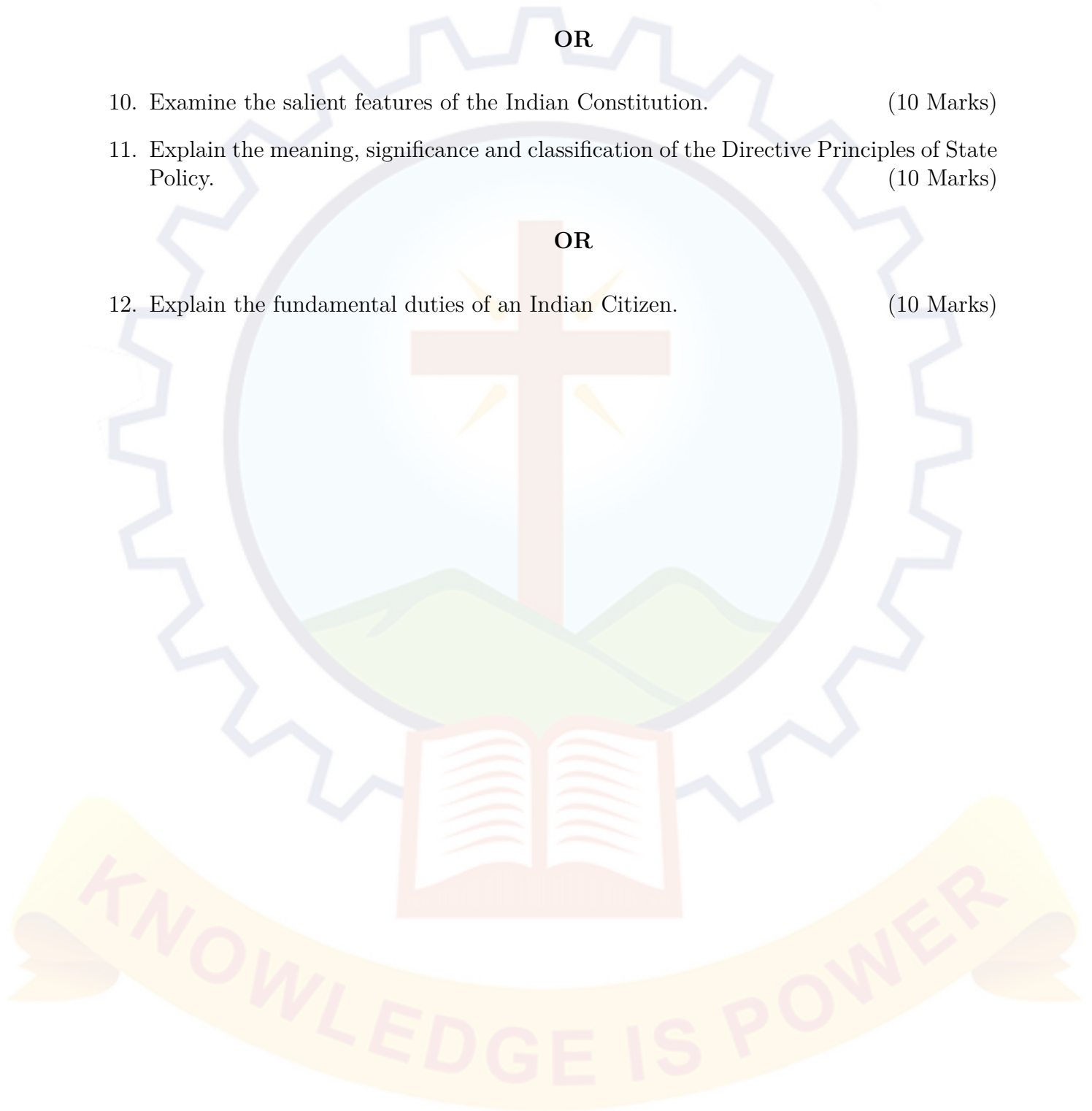
8. Relationship is between one Self (I_1) and another Self (I_2). Examine this statement. (9 Marks)
9. Summarize the various methods of acquiring Indian citizenship. (10 Marks)

OR

10. Examine the salient features of the Indian Constitution. (10 Marks)
11. Explain the meaning, significance and classification of the Directive Principles of State Policy. (10 Marks)

OR

12. Explain the fundamental duties of an Indian Citizen. (10 Marks)



CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24MC2T05	ENERGY CONSERVATION AND ENVIRONMENTAL SUSTAINABILITY	2	0	0	2	P/F	2024

Preamble

This course aims to equip students with fundamental knowledge of energy resources, the need for energy conservation, and the importance of environmental sustainability. It emphasizes the role of engineers in adopting renewable energy technologies, reducing environmental impact, and promoting sustainable development for a greener and more resilient future.

Prerequisites: NIL

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Classify various energy resources and describe the importance of energy conservation (Cognitive Knowledge Level: Understand)
CO 2	Explain the principles of renewable energy systems and their applications (Cognitive Knowledge Level: Understand)
CO 3	Recognize major environmental impacts due to energy consumption and explain basic pollution control measures. (Cognitive Knowledge Level: Understand)
CO 4	Describe sustainability concepts and apply simple strategies for environmental protection and green practices in day-to-day engineering tasks (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	1	0	0	0	2	2	0	0	0	0
CO 2	3	1	1	0	0	1	2	0	0	0	0
CO 3	2	2	0	0	0	2	3	1	0	0	0
CO 4	2	1	2	0	0	2	3	1	1	1	0

Assessment Pattern

Energy Conservation And Environmental Sustainability		
Blooms Category	Continuous Assessment Tests	End Semester Examination (Percentage)
	Test 1 (Percentage)	
Remember	30	30
Understand	50	50
Apply	20	20
Analyse		
Evaluate		
Create		

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	50	50	2 hours

Continuous Internal Evaluation Pattern

Attendance : 10 marks

Continuous Assessment Test (one test, conducted for 50 marks and reduced to 25) : 25 marks

Assignment/Quiz/Course Project/Seminar : 10 marks

Self Study : 5 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contains 4 questions carrying 3 marks each. Part B contains 2 questions from each module out of which anyone is to be answered. In part B, each question of the first two modules carries 9 marks and each question of the last two modules carries 10 marks.

SYLLABUS

Module 1: Energy Resources and Conservation (6 hours)

Types of Energy Resources: Renewable and Non-renewable (with examples), Global and Indian Energy Scenarios, Importance of Energy Conservation, Energy Policy and Planning

Energy Auditing and Efficiency Improvement Techniques - Case studies, Energy-efficient Buildings and Smart Cities

Module 2: Renewable Energy Technologies (6 hours)

Solar Energy, Wind Energy, Other Renewable Sources: Biomass and bioenergy systems, small hydropower, ocean thermal, wave, and tidal energy, Geothermal energy

Energy Storage and Smart Grid Integration: Battery technologies - Role in renewable energy conservation and stability - Decentralized generation and net metering, Advanced and Emerging Technologies: Green hydrogen - Floating solar farms - Offshore wind.

Module 3: Environmental Impact and Pollution Control (6 hours)

Pollution Types and Sources: Air pollution: industrial emissions, vehicular sources - Water pollution: domestic, industrial, agricultural waste - Soil pollution: hazardous waste, agro-chemicals, Pollution Control Methods: Physical, chemical, biological techniques - Air & water treatment technologies

Climate Change and Global Warming: Greenhouse gases and carbon footprint - International agreements, Waste Management Strategies - 3Rs (Reduce, Reuse, Recycle) - waste-to-energy, Environmental Regulations in India: Environmental Protection Act, Air & Water Acts - Hazardous Waste Management Rules, Carbon Neutrality and Zero-emission Policies

Module 4: Sustainability and Green Practices (6 hours)

Principles of Sustainable Development: Intergenerational equity, resource efficiency - Link with UN Sustainable Development Goals (SDGs), Green Buildings and Infrastructure, Green Certification Systems, Carbon Credits.

Carbon Pricing and Energy Subsidies: Internal carbon pricing by organizations - Government schemes, Life Cycle Assessment (LCA): Phases of LCA: Goal definition, inventory, impact assessment - Smart Sustainable Cities and Resilient Infrastructure: Urban planning for sustainability.

TEXTBOOKS AND REFERENCES :

1. G.D. Rai, Non-Conventional Energy Sources, Khanna Publishers
2. R.R. Rao, Environmental Science and Engineering, PHI
3. Craig B. Smith, Energy Management Principles, Pergamon Press.
4. Paul O'Callaghan, Energy Management, McGraw Hill Book Co.

5. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
6. Bradley. A.S; Adebayo,A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	6 hours
1.1	Types of Energy Resources (Renewable and Non-renewable), examples. Global and Indian Energy Scenario: Consumption and production trends, sector-wise demand	1
1.2	Energy Conservation: Residential, Industrial, Transport sectors behavioural & technological interventions	1
1.3	Energy Policy and Planning: National Energy Policy, Energy Conservation Act, BEE initiatives	1
1.4	Energy Auditing: Preliminary & Detailed audits, Performance Indicators, Case Studies	2
1.5	Energy-efficient Buildings & Smart Cities: Passive design, daylighting, automation	1
2	Module 2	6 hours
2.1	Solar Energy: PV systems, solar thermal, rooftop/grid-tied applications	1
2.2	Wind Energy: Onshore/offshore systems, hybrid solar-wind systems	1
2.3	Other Renewables: Biomass, small hydro, ocean, tidal, geothermal energy	1
2.4	Energy Storage: Battery types, conservation role, stability, smart grid integration	1
2.5	Smart Grids and Net Metering: Decentralized generation	1

2.6	Advanced Technologies: Green hydrogen, floating solar farms, offshore wind	1
3	Module 3	6 hours
3.1	Pollution Types: Air, water, and soil pollution sources and effects	1
3.2	Pollution Control: Physical, chemical, and biological treatment methods	1
3.3	Climate Change: GHGs, carbon footprint, international agreements (Kyoto, Paris)	1
3.4	Waste Management: Solid, liquid, biomedical, hazardous 3Rs, waste-to-energy, Environmental regulations	1
3.5	Carbon Neutrality: National missions, zero-emission policies, corporate initiatives,	1
3.6	Circular Economy: Waste elimination	1
4	Module 4	6 hours
4.1	Sustainable Development: Principles, SDGs, resource efficiency	1
4.2	Green Buildings: Concepts, features, materials, passive design, renewables integration, green certifications	1
4.3	Carbon Credits: Earning, trading, CDM, voluntary carbon markets	1
4.4	Carbon Pricing and Subsidies: Internal pricing, UJALA, PM-KUSUM, FAME	1
4.5	Life Cycle Assessment (LCA): Phases, case studies	1
4.6	Smart Cities and Resilience: Urban planning	1
Students shall present a seminar based on case studies of Life Cycle Assessment (LCA) conducted on a product of their choice.		
Total		24 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. List the major renewable and non-renewable energy sources with suitable examples.
2. Explain the significance of energy conservation in the industrial and domestic sectors.
3. Describe the importance of energy conservation in the context of the global and Indian energy scenario.

Course Outcome 2 (CO 2):

1. Describe the working principle of solar photovoltaic and solar thermal systems.
2. Compare wind energy and small hydropower systems based on availability, reliability, and applications.
3. Explain the role of energy storage and smart grid integration in ensuring renewable energy reliability.

Course Outcome 3 (CO 3):

1. Identify major sources of air and water pollution in urban areas.
2. Explain the role of battery storage and smart grid integration in enhancing the efficiency of renewable energy systems
3. Apply the concept of 3Rs to develop a basic household or institutional waste management plan.

Course Outcome 4 (CO 4):

1. Describe the concept of sustainable development and its connection with UN Sustainable Development Goals (SDGs).
2. Explain the basic features of green buildings and the benefits of green certification.
3. Describe simple green practices that can be adopted by engineers in daily professional work to promote environmental sustainability.

MODEL QUESTION PAPER

QP CODE:

Pages: 2

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

THIRD SEMESTER B. TECH DEGREE EXAMINATION, MONTH YEAR

Course Code: B24MC2T05

**Course Name: ENERGY CONSERVATION AND ENVIRONMENTAL
SUSTAINABILITY**

Max. Marks: 50

Duration: 2 hours

PART A

Answer all questions. Each question carries 3 marks

1. List any three renewable energy sources with one example each.
2. Explain the concept of net metering in decentralized energy generation.
3. What are the major sources of air pollution in urban areas?
4. Describe any two strategies for promoting sustainability in everyday engineering practices.

PART B

Answer one full question from each module

5. a) Classify energy resources with examples. (4 marks)
b) Explain the significance of energy conservation in the Indian context. (5 marks)

OR

6. a) Describe energy auditing and mention any two efficiency improvement techniques. (5 marks)
b) What is the role of energy-efficient buildings in smart city development? (4 marks)
7. a) Explain the working principle of wind turbines with a neat diagram. (5 marks)
b) Describe any two advanced renewable energy technologies. (4 marks)

OR

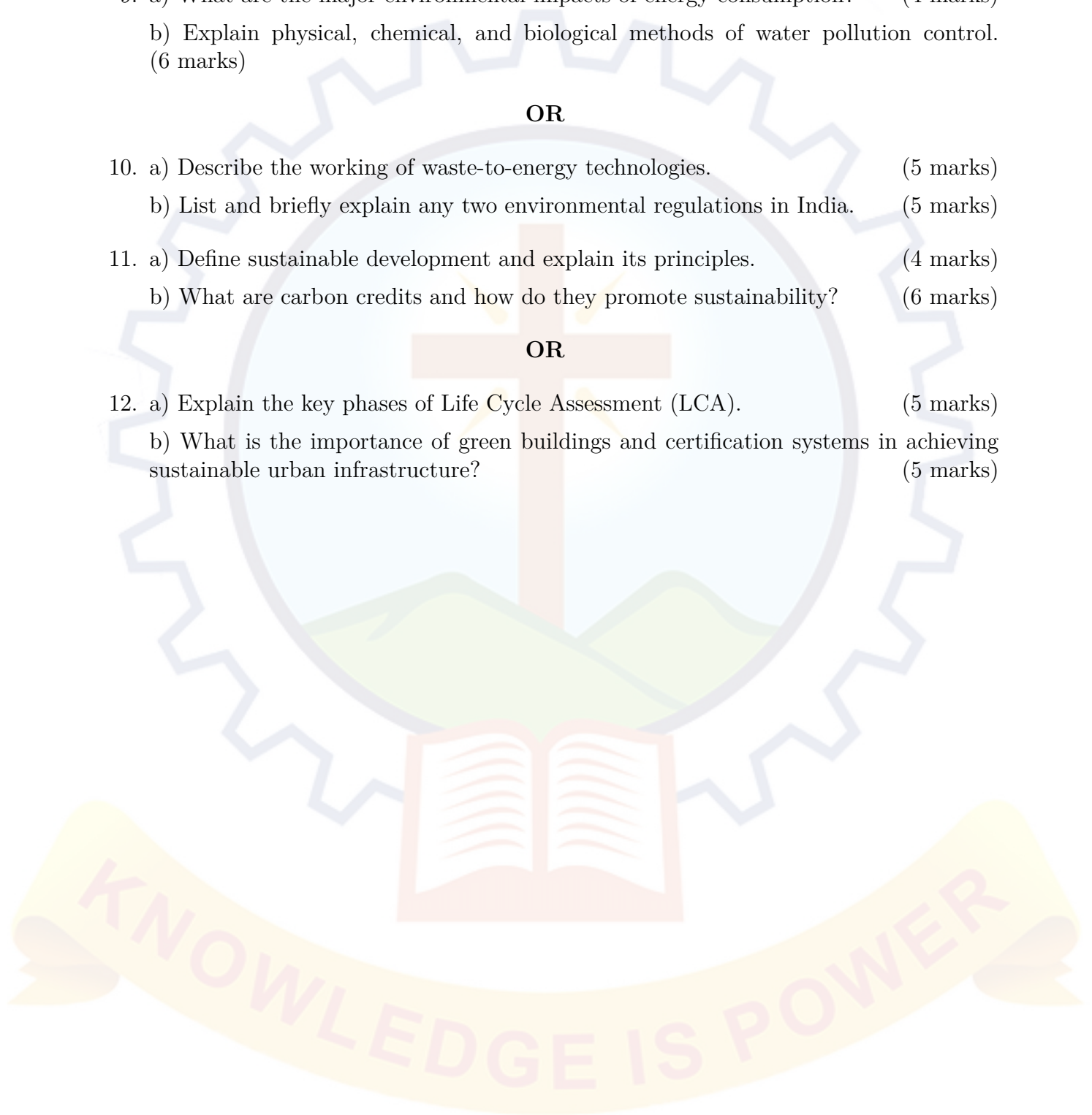
8. a) Discuss the types and role of energy storage systems in renewable energy. (5 marks)
b) Explain the concept of smart grid integration. (4 marks)
9. a) What are the major environmental impacts of energy consumption? (4 marks)
b) Explain physical, chemical, and biological methods of water pollution control. (6 marks)

OR

10. a) Describe the working of waste-to-energy technologies. (5 marks)
b) List and briefly explain any two environmental regulations in India. (5 marks)
11. a) Define sustainable development and explain its principles. (4 marks)
b) What are carbon credits and how do they promote sustainability? (6 marks)

OR

12. a) Explain the key phases of Life Cycle Assessment (LCA). (5 marks)
b) What is the importance of green buildings and certification systems in achieving sustainable urban infrastructure? (5 marks)



CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CEM32	WATER AND AIR QUALITY	3	1	0	5	4	2024

Preamble

This course offers an in-depth exploration of air and water quality, emphasizing pollution sources, their environmental effects, monitoring methods, and sustainable management practices aimed at improving environmental quality.

Prerequisites: NIL

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Apply effective management strategies to sustainably protect and restore surface water bodies in accordance with environmental regulations. (Cognitive Knowledge Level: Apply)
CO 2	Apply sustainable management and remediation strategies to protect groundwater resources in alignment with environmental and public health guidelines. (Cognitive Knowledge Level: Apply)
CO 3	Understand the fundamental concepts of air quality, identify key pollutants and their impacts on human health and environment. (Cognitive Knowledge Level: Understand)
CO 4	Understand appropriate air pollution sampling strategies. (Cognitive Knowledge Level: Understand)
CO 5	Apply appropriate engineering and regulatory control strategies for mitigation of air pollution. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	1	0	0	0	0	2	0	0	0	0	1
CO 2	1	0	0	0	0	2	0	0	0	0	1
CO 3	1	0	0	0	0	2	0	0	0	0	1
CO 4	1	0	0	0	0	2	0	0	0	0	1
CO 5	1	0	0	0	0	2	0	0	0	0	1

Assessment Pattern

Water And Air Quality			
Blooms Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	40	40	40
Understand	30	30	30
Apply	30	30	30
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course Project : 10 marks

Self Study : 5 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contain 10 questions carrying 3 marks each. Part B contains 2 questions from each module out of which 1 to be answered. Each question carries 14 marks and can have a maximum of 2 sub - divisions.

SYLLABUS

MODULE 1: Surface Water Quality Management (9 hours)

Introduction to Surface Water Quality – Physical, chemical and biological properties of water - Water Quality Standards and Regulations - Sources of Surface Water Pollution - Water Quality Monitoring and Sampling - Biological and Ecological Impacts of Surface Water Pollution - Water Borne Diseases - Water Quality Modeling - Water Quality Management Strategies - Mitigation and Remediation of Surface Water Pollution - Climate Change and Water Quality - Restoration of Polluted Water Bodies.

MODULE 2: Ground Water Quality Management (9 hours)

Definition and importance of groundwater - Types of groundwater (confined, unconfined, artesian) - Groundwater Quality Parameters - Sources of Groundwater Contamination - Groundwater Contamination and Transport - Groundwater Sampling and Analysis - Groundwater Quality Assessment and Indices - Groundwater Treatment and Remediation - Groundwater Management and Policy - Climate Change and Groundwater Quality - Emerging Issues in Groundwater Quality - Groundwater Pollution and Health Impact

MODULE 3: Air Quality (9 hours)

Introduction to Air Quality and Atmospheric Composition - Sources of Air Pollution - Classification of Air Pollutants and Their Characteristics - Meteorological Parameters Affecting Air Quality - Health and Environmental Impacts of Air Pollution - Air Quality Standards and Regulations - Air Quality Index - Air Quality Management and Planning - Indoor Air Quality - Sources of indoor pollutants - Air Quality Case Studies and Global Perspectives

MODULE 4: Air Pollution Sampling & Measurement (9 hours)

Principles of Air Sampling - Particulate Matter Sampling - High Volume Sampler (HVS), Respirable Dust Sampler (RDS), PM10 and PM2.5 samplers, Cascade impactors and cyclone separators - Gaseous Pollutant Sampling - Sampling of SO₂, NO_x, CO, O₃, VOCs, Absorption, adsorption, and condensation techniques, Bubblers and impingers, Passive sampling methods - Indoor Air Quality Monitoring - Sampling strategies for indoor environments, Instruments for CO₂, VOCs, Radon, PM

MODULE 5: Control of Air Pollution (9 hours)

Control Technologies for Gaseous Pollutants-Control of SO_x and NO_x Emissions, Control of Volatile Organic Compounds, Control of Carbon Monoxide - Control Technologies for Particulate Matter - Settling chambers, cyclone separators, fabric filters (baghouses), electrostatic precipitators (ESPs), and scrubbers - Control Technologies for Odor and Hazardous Air Pollutants (HAPs) - Advanced Air Pollution Control Technologies

Textbooks:

1. Howard S. Peavy, Donald R. Rowe, and George Tchobanoglous, Environmental Engineering, McGraw-Hill Education, 2013.

2. Mackenzie L. Davis and David A. Cornwell, Introduction to Environmental Engineering, McGraw-Hill Education, 2014.
3. G.S. Birdie, Water Supply and Engineering, Dhanapat Rai Publishing Company, 2014.
4. J. Arceivala and Shyam R. Asolekar, Wastewater Treatment for Pollution Control and Reuse, McGraw-Hill Education, 2007.

References:

1. S.K. Garg, Sewage Disposal and Air Pollution Engineering, Khanna Publishers, 2008.
2. Metcalf & Eddy Inc., George Tchobanoglous, H. David Stensel, Ryujiro Tsuchihashi, and
3. Franklin L. Burton, Wastewater Engineering: Treatment and Resource Recovery, McGraw-Hill Education, 2014.
4. Clair Sawyer, Perry McCarty, and Gene Parkin, Chemistry for Environmental Engineering and Science, McGraw-Hill Education, 2003.
5. Duggal K.N., Elements of Environmental Engineering, S. Chand and Co. Ltd., New Delhi, 2014.
6. WHO, Global Air Quality Guidelines, World Health Organization, 2021.
7. U.S. Environmental Protection Agency (EPA), Air Quality Index (AQI) Basics, EPA, 2020.
8. M.N. Rao and H.V.N. Rao, Air Pollution, Tata McGraw-Hill Education, 2007.
9. B.C. Punmia, Water Supply Engineering, Laxmi Publications, 2014.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Topic	No. of Lecture/ Tutorial Hours
1	Module 1	9 hours
1.1	Introduction to Surface Water Quality - Physical, chemical and biological properties of water	2
1.2	Water Quality Standards and Regulations-Sources of Surface Water Pollution	2
1.3	Water Quality Monitoring and Sampling-Biological and Ecological Impacts of Surface water Pollution-Water Borne Diseases	2
1.4	Water Quality Modeling-Water Quality Management Strategies-Mitigation and Remediation of Surface Water Pollution	2
1.5	Restoration of Polluted Water Bodies	1
2	Module 2	9 hours
2.1	Definition and importance of groundwater -Types of groundwater (confined, unconfined, artesian) - Groundwater Quality Parameters	2
2.2	Groundwater Contamination and Transport- Groundwater Sampling and Analysis - Groundwater Quality Assessment and Indices	3
2.3	Groundwater Treatment and Remediation- Groundwater Management and Policy- Climate Change and Groundwater Quality	2
2.4	Emerging Issues in Groundwater Quality-Groundwater Pollution and Health Impact	2
3	Module 3	9 hours
3.1	Introduction to Air Quality and Atmospheric Composition -Sources of Air Pollution	1

3.2	Classification of Air Pollutants and Their Characteristics- Meteorological Parameters Affecting Air Quality	3
3.3	Health and Environmental Impacts of Air Pollution	1
3.4	Air Quality Standards and Regulations- Air Quality Index -Air Quality Management and Planning	2
3.5	Indoor Air Quality - Sources of indoor pollutants - Air Quality Case Studies and Global Perspectives	2
4	Module 4	9 hours
4.1	Principles of Air Sampling- Particulate Matter Sampling- High Volume Sampler (HVS) Respirable Dust Sampler (RDS), PM10 and PM2.5 samplers, Cascade impactors and cyclone separators	3
4.2	Gaseous Pollutant Sampling - Sampling of SO ₂ , NO _x , CO, O ₃ , VOCs, Absorption, adsorption, and condensation techniques, Bubblers and impingers, Passive sampling methods	3
4.3	Indoor Air Quality Monitoring- Sampling strategies for indoor environments, Instruments for CO ₂ , VOCs, Radon, PM	3
5	Module 5	9 hours
5.1	Control Technologies for Gaseous Pollutants-Control of SO _x and NO _x Emissions, Control of Volatile Organic Compounds, Control of Carbon Monoxide	3
5.2	Control Technologies for Particulate Matter- Settling chambers, cyclone separators, fabric filters (baghouses), electrostatic precipitators (ESPs), and scrubbers	3
5.3	Control Technologies for Odor and Hazardous Air Pollutants (HAPs)- Advanced Air Pollution Control Technologies	3
Total Hours		45 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Outline the importance of air quality and sources of air pollution
2. Enumerate the importance of air quality standards
3. Define Air Quality Index

Course Outcome 2 (CO 2):

1. Discuss the importance of particulate matter sampling and gaseous pollutant sampling
2. Elaborate the significance of indoor air quality monitoring

Course Outcome 3 (CO 3):

1. Discuss in detail various control technologies for gaseous pollutants and particulate matter
2. Enumerate the Control Technologies for Odor and Hazardous Air Pollutants

Course Outcome 4 (CO 4):

1. Outline various strategies for water quality management
2. Enumerate the significance of water quality standards

Course Outcome 5 (CO 5):

1. Enumerate various aspects of ground water contamination
2. Discuss various strategies for sustainable groundwater management

MODEL QUESTION PAPER

QP CODE:

Pages: 2

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

THIRD SEMESTER B. TECH DEGREE EXAMINATION, MONTH YEAR

Course Code: B24CEM32

Course Name: WATER AND AIR QUALITY

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks

1. Differentiate primary and secondary air pollutants.
2. Write a short note on photo-chemical smog.
3. Discuss principles of Air sampling.
4. Write a short note on gaseous pollutant sampling.
5. Discuss the importance of cyclone separators.
6. Write a short note on electrostatic precipitators .
7. What is meant by water quality standards?
8. Define Water quality and explain Water Quality monitoring.
9. Discuss different types of ground water.
10. Enumerate the sources of groundwater pollution.

PART B

Answer any one question from each module. Each question carries 14 marks.

11. a) Discuss the effects of air pollutants on human health and environment. (10)
b) Explain the significance of air quality index. (4)

OR

12. Explain any two case studies in relation with air pollution events (14)

13. Briefly explain various methods for particulate matter sampling (14)

OR

14. Explain various methods for gaseous pollutant sampling (14)

15. Explain various measures to control gaseous air pollutants. (14)

OR

16. Discuss any four control measures for particulate matter in ambient air (14)

17. What are different types and sources of water pollution? Explain various control measures. (14)

OR

18. Describe various water borne diseases (14)

19. How does groundwater pollution affect human health and the environment? (14)

OR

20. a) Write a note on common groundwater pollutants? (7)

- b) How can we prevent and address groundwater pollution? (7)

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CEM33	TRAFFIC SAFETY	3	1	0	5	4	2024

Preamble

Road safety is a critical aspect of transportation engineering that aims to minimize accidents, injuries, and fatalities on road networks. This course provides an in-depth understanding of road safety principles, accident analysis, enforcement strategies, and safety measures in road design. By integrating theoretical concepts with practical applications, students will gain insights into safety policies, risk assessment methods, and the role of technology in enhancing road safety. The course will equip students with the knowledge required to design safer transportation systems and implement effective accident prevention strategies.

Prerequisites: NIL

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Understand road safety policies, accident trends, analyse crash scientifically using models such as Haddons matrix. (Cognitive Knowledge Level: Apply)
CO 2	Understand vehicle restraint systems, road safety legislation, enforcement strategies, and the role of speed in crashes. (Cognitive Knowledge Level: Understand)
CO 3	Understand the principles of safe road design, intersection planning, public transport safety, pedestrian and cyclist safety, and traffic calming measures. (Cognitive Knowledge Level: Understand)
CO 4	Analyse the suitability of data collection methods for safety studies, safety indicators, risk assessment techniques, and perform blackspot analysis.. (Cognitive Knowledge Level: Apply)
CO 5	Understand the role of Intelligent Transportation Systems (ITS) in road safety, safety audit principles, road crash scene management, and pre-hospital trauma care. (Cognitive Knowledge Level: Understand)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	3	2	2	1	0	1	0	0	0	2
CO 2	3	3	3	2	2	2	1	0	0	1	2
CO 3	3	3	3	3	2	3	1	2	1	1	2
CO 4	3	3	3	3	2	3	2	1	1	0	2
CO 5	3	2	2	3	3	3	2	1	1	1	3

Assessment Pattern

Traffic Safety			
Blooms Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	30	30	30
Understand	50	50	50
Apply	20	20	20
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course Project : 10 marks

Self Study : 5 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contain 4 questions carrying 3 marks each. Part B contains 4 questions from each module out of which 2 to be answered. Each question carries 14 mark and can have maximum 2 sub- divisions.

SYLLABUS

MODULE 1 (9 hours)

Introduction to Road Safety: Introduction, Traffic accident statistics and trends, Road safety policy models, Safe systems approach, Vision Zero, Scientific crash analysis with Haddons matrix

MODULE 2 (9 hours)

Vehicle Restraint Systems & Road Safety Enforcement: Vehicle Restraint systems, Road safety legislation and Enforcement, Road safety education and promotion, Role of speed in crashes

MODULE 3 (9 hours)

Safety Strategies for Road, Vehicle and User: Safety in road design, Safe intersection design principles, Signage and markings, Traffic Calming, Public transport safety, Pedestrian road safety, Cyclist road safety

MODULE 4 (9 hours)

Road Safety Data Analysis and Risk Assessment: Data collection methods for safety studies, Safety Indicators, Risk Assessment, Blackspot analysis, Hill road safety

MODULE 5 (9 hours)

Advanced Road Safety Measures and Emergency Response: Role of ITS in safety, Safety audit principles, Road crash scene management, Pre-hospital Trauma care

Textbooks:

1. George Yannis, Simon Cohen, John Hollo, Traffic Safety, CRC Press, 1st Edition, 2016.
2. A. Gupta, Road Traffic Safety and Accident Prevention, Narosa Publishing, 2018.
3. Rune Elvik, Truls Vaa, The Handbook of Road Safety Measures, Emerald Group Publishing, 2nd Edition, 2009.
4. Richard Tay, Traffic Safety, Nova Science Publishers, 2010.

Reference:

1. OECD/ITF, Towards Zero: Ambitious Road Safety Targets and the Safe System Approach, OECD Publishing, 2008.
2. World Health Organization (WHO), Global Status Report on Road Safety, WHO Press, 2018.
3. AASHTO, Highway Safety Manual (HSM), AASHTO Publications, 1st Edition, 2010.

4. TRB (Transportation Research Board), Highway Capacity Manual (HCM), National Research Council, 6th Edition, 2016.
5. Institute of Transportation Engineers (ITE), Traffic Engineering Handbook, Wiley, 7th Edition, 2016.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Topic	No. of Lecture/ Tutorial Hours
1	Module 1	9 hours
1.1	Introduction: Importance of road safety, accident statistics, and trends (global & national)	1
1.2	Road safety policy models: Traditional and modern approaches	2
1.3	Safe systems approach: Principles and application in road safety	2
1.4	Vision Zero: Concept, implementation, and case studies	2
1.5	Scientific crash analysis using Haddons matrix	2
2	Module 2	9 hours
2.1	Vehicle restraint systems: Types and effectiveness (seat belts, airbags, barriers)	2
2.2	Road safety legislation: Laws, enforcement agencies, penalties	2
2.3	Road safety education and awareness campaigns	2
2.4	Role of speed in crashes: Speed limits, enforcement, speed calming measures	3
3	Module 3	9 hours
3.1	Safety in road design: Principles, factors affecting road safety	2

3.2	Safe intersection design: Roundabouts, signalized & unsignalized intersections	2
3.3	Signage and markings: Types, importance, visibility considerations	2
3.4	Public transport safety: Bus stops, transit lanes, safety measures	1
3.5	Pedestrian and cyclist safety: Infrastructure, crosswalks, bike lanes	1
3.6	Traffic calming techniques: Speed humps, chicanes, road diets	1
4	Module 4	9 hours
4.1	Data collection methods for road safety studies	2
4.2	Safety indicators: Crash rates, injury severity, exposure measures	2
4.3	Risk assessment in road safety: Identifying and mitigating risks	3
4.4	Blackspot analysis and safety challenges in hill roads	2
5	Module 5	9 hours
5.1	Role of Intelligent Transport Systems (ITS) in road safety	3
5.2	Road safety audits: Process, guidelines, and best practices	2
5.3	Road crash scene management: Emergency response and investigation	2
5.4	Pre-hospital trauma care: First aid and medical emergency management	2
Total Hours		45 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Explain the significance of road safety in the context of global and national accident statistics. How do accident trends influence policymaking?

2. Compare the Safe Systems Approach and Vision Zero in terms of their principles and implementation strategies.
3. Using Haddons Matrix, analyze a real-world crash scenario and identify factors that contributed to the accident.

Course Outcome 2 (CO 2):

1. Describe the different types of vehicle restraint systems (seat belts, airbags, crash barriers). How do they reduce crash severity?
2. Explain the importance of road safety legislation in reducing road accidents. Provide examples of key traffic laws.
3. Analyze the relationship between vehicle speed and crash severity. How can speed management strategies help in accident prevention?

Course Outcome 3 (CO 3):

1. What are the key considerations for designing a safe intersection? Compare different intersection types in terms of safety.
2. Explain the role of road markings and signage in reducing accidents. Provide examples of effective road signs.
3. Discuss the challenges faced by pedestrians and cyclists in urban traffic systems. Suggest measures to enhance their safety.

Course Outcome 4 (CO 4):

1. Describe different data collection methods used for road safety studies. How does crash data help in risk assessment?
2. What are safety performance indicators, and how are they used in evaluating road safety?
3. Explain the concept of blackspot analysis. How can it help in identifying and mitigating high-risk locations?

Course Outcome 5 (CO 5):

1. How can Intelligent Transportation Systems (ITS) enhance road safety? Provide real-world examples.
2. Outline the key principles of road safety audits. What aspects are assessed during a road safety audit?
3. Explain the importance of pre-hospital trauma care in reducing fatalities after a road crash. What are the key elements of an effective emergency response system?

MODEL QUESTION PAPER

QP CODE:

Pages: 2

Reg.No.:

Name:

**MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM**

THIRD SEMESTER B. TECH DEGREE EXAMINATION, MONTH YEAR

Course Code: B24CEM33

Course Name: TRAFFIC SAFETY

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks

1. What is the Safe Systems Approach in road safety?
2. Explain Haddons Matrix and its significance in crash analysis.
3. What are vehicle restraint systems? Give two examples.
4. How does speed influence road crashes?
5. What are the key principles of safe intersection design?
6. Define traffic calming. Mention two commonly used traffic calming measures.
7. What is blackspot analysis in road safety?
8. List two important safety indicators used in road safety studies.
9. How does Intelligent Transportation Systems (ITS) help in accident prevention?
10. What are the key components of pre-hospital trauma care in road crash management?

PART B

Answer any one question from each module. Each question carries 14 marks.

11. a) Explain the Safe Systems Approach and its importance in road safety. (7 marks)
b) Describe the Vision Zero concept and its implementation in different countries. (7 marks)

OR

12. a) Discuss the Haddons Matrix as a tool for crash analysis. (7 marks)
b) Apply Haddons Matrix to a real-world accident scenario and suggest preventive measures. (7 marks)
13. a) What are vehicle restraint systems? Explain their role in improving road safety. (7 marks)
b) Compare the effectiveness of seat belts and airbags in reducing injury severity. (7 marks)

OR

14. a) Explain the importance of road safety legislation and enforcement in reducing accidents. (7 marks)
b) Discuss the role of public awareness and education in improving road user behavior. (7 marks)
15. a) What are the key considerations in safe road design? Explain with examples. (7 marks)
b) Discuss traffic calming measures and their effectiveness in accident reduction. (7 marks)

OR

16. a) Describe the principles of safe intersection design with suitable examples. (7 marks)
b) Compare the advantages and disadvantages of at-grade and grade-separated intersections. (7 marks)
17. a) What are the various methods of data collection in road safety studies? (7 marks)
b) Explain the importance of risk assessment in road safety management. (7 marks)

OR

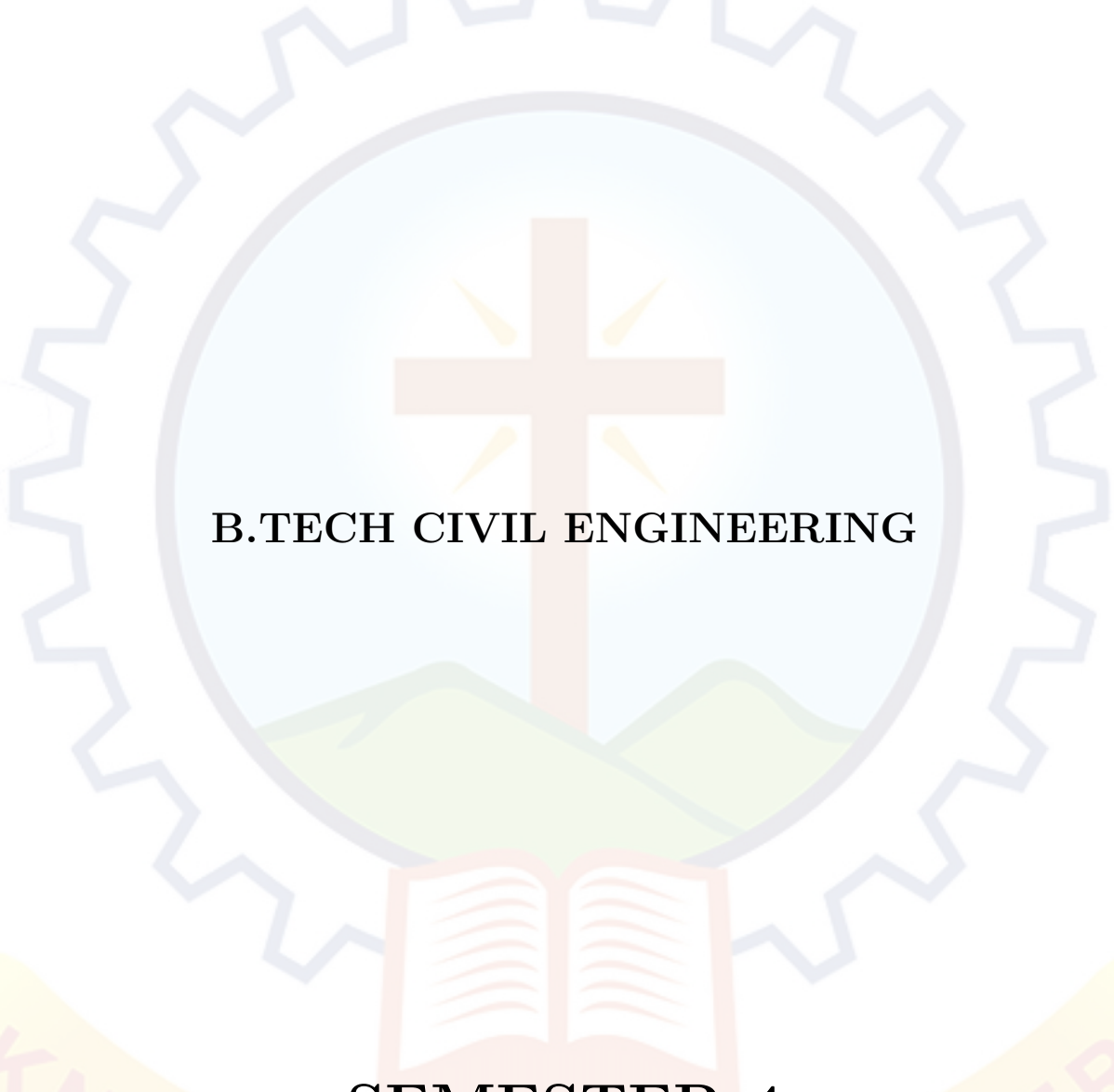
18. a) Define blackspot analysis and describe its role in accident prevention. (7 marks)
b) Discuss the challenges and solutions for hill road safety. (7 marks)
19. a) How does Intelligent Transportation Systems (ITS) contribute to road safety? (7 marks)
b) Explain the role of real-time data and sensors in accident prevention. (7 marks)

OR

20. a) What are the key principles of road crash scene management? (7 marks)
b) Explain the importance of pre-hospital trauma care in post-crash response. (7 marks)

MAR ATHANASIOUS COLLEGE OF ENGINEERING

Government Aided, Autonomous Institution
Kothamangalam, Kerala, India



B.TECH CIVIL ENGINEERING

SEMESTER 4

SYLLABUS

KNOWLEDGE IS POWER

SEMESTER 4

SLOT	COURSE NO.	COURSES	L-T-P-S	HOURS	CREDIT
A	B24MA2T04B	STATISTICAL ANALYSIS AND NUMERICAL METHODS	3-1-0-5	4	4
B	B24CE2T04	STRUCTURAL ANALYSIS	3-1-0-5	4	4
C	B24CE2T05	SOIL MECHANICS	3-1-0-5	4	4
D	B24CE2T06	HIGHWAY AND PAVEMENT ENGINEERING	3-1-0-4	4	4
E	B24HU2T01	BUSINESS ECONOMICS AND FINANCIAL MANAGEMENT	3-0-0-4	3	3
F	B24CE2T07	CONSTRUCTION TECHNOLOGY & MANAGEMENT	2-1-0-4	3	3
G	B24CE2L05	MATERIAL TESTING LABORATORY - I	0-0-3-2	3	2
H	B24CE2L06	CIVIL ENGINEERING DRAFTING LAB	0-0-3-2	3	2
M	B24CEM4x	MINOR	3-1-0-5	4	4
N	B24CEH4x	HONOURS	3-1-0-5	4	4
TOTAL				36	25

MINOR COURSES

COURSE NO.	COURSES
B24CEM42	SOLID WASTE MANAGEMENT
B24CEM43	LAND USE AND URBAN PLANNING

HONOURS COURSES

COURSE NO.	COURSES
B24CEH41	STRUCTURAL FORMS AND MATERIALS
B24CEH42	NON-DESTRUCTIVE TESTING
B24CEH43	CLIMATE CHANGE AND SUSTAINABILITY
B24CEH44	CONSTRUCTION SCHEDULING & PLANNING
B24CEH45	PUBLIC TRANSPORT SYSTEMS
B24CEH46	REINFORCED SOIL AND GEOSYNTHETICS

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24MA2T04B	STATISTICAL ANALYSIS AND NUMERICAL METHODS	3	1	0	5	4	2024

Preamble

This course aims to introduce students to the modern theory of probability and statistics covering important models of discrete and continuous random variables. It also covers techniques of parameter estimation and hypothesis testing. A brief course in numerical methods familiarises students with some basic numerical techniques for finding roots of equations, evaluating definite integrals solving systems of linear equations and solving ordinary differential equations which are especially useful when analytical solutions are hard to find.

Prerequisites: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Utilize the concept, properties and important models of discrete random variables and, using them, solve suitable random phenomena. (Cognitive Knowledge Level: Apply)
CO 2	Utilize the concept, properties and important models of continuous random variables and, using them, solve suitable random phenomena. (Cognitive Knowledge Level: Apply)
CO 3	Develop statistical inferences concerning characteristics of a population based on attributes of samples drawn from the population (Cognitive Knowledge Level: Apply)
CO 4	Evaluate roots of equations, evaluate definite integrals and perform interpolation on given numerical data using standard numerical techniques (Cognitive Knowledge Level: Apply)
CO 5	Apply standard numerical techniques for solving systems of equations, fitting curves on given numerical data and solving ordinary differential equations. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	2	1	0	1	0	0	0	0	0	0	0
CO 2	2	1	0	1	0	1	0	0	0	0	0
CO 3	2	1	0	1	0	0	0	0	0	0	0
CO 4	1	2	0	1	1	0	0	0	0	0	1
CO 5	1	2	0	1	1	1	0	0	0	0	1

Assessment Pattern

Statistical Analysis And Numerical Methods			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (% Marks)
	Test 1 (% Marks)	Test 2 (% Marks)	
Remember	30	30	30
Understand	40	40	40
Apply	30	30	30
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course Project	: 10 marks
Self Study	: 5 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contain 10 questions carrying 3 marks each. Part B contains 2 questions from each module out of which 1 to be answered. Each question carries 14 marks and can have maximum 2 sub divisions.

SYLLABUS

MODULE 1: Discrete probability distributions(9 hours)

Discrete random variables and their probability distributions, Expectation, mean and variance, Binomial distribution, Poisson distribution, Poisson approximation to the binomial distribution, Discrete bivariate distributions, marginal distributions, Independent random variables, Expectation -multiple random variables

MODULE 2 : Continuous probability distributions (9 hours)

Continuous random variables and their probability distributions, Expectation, mean and variance, Uniform, exponential , normal distributions , Continuous bivariate distributions, marginal distributions, Independent random variables, Expectation-multiple random variables, i.i.d random variables and Central limit theorem (without proof)

MODULE 3 :Testing of Hypothesis (9 hours)

Population and samples, Sampling distribution of the mean and proportion, Confidence interval for single mean and single proportions. Test of hypotheses: Large sample test for single mean and single proportion, equality of means and equality of proportions of two populations, small sample t-tests for single mean of normal population, equality of means.

MODULE 4 : Numerical methods -I(9 hours)

Errors in numerical computation-round-off, truncation and relative error, Solution of equations – Newton-Raphson method . Interpolation-finite differences, Newton's forward and backward difference method, Newton's divided difference method and Lagrange's method. Numerical integration-Trapezoidal rule and Simpson's 1/3rd rule (Proof or derivation of the formulae not required for any of the methods in this module)

MODULE 5 : Numerical methods -II(9 hours)

Solution of linear systems-Gauss-Seidel and Jacobi iteration methods. Curve fitting-method of least squares, fitting straight lines and parabolas. Solution of ordinary differential equations - Euler and Classical Runge-Kutta method of second and fourth order(Proof or derivation of the formulae not required for any of the methods in this module)

Text Books:

1. Jay L. Devore, Probability and Statistics for Engineering and the Sciences, 8th edition, Cengage, 2012

2. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley Sons, 2016.

Reference Books:

1. Hossein Pishro-Nik, Introduction to Probability, Statistics and Random Processes, Kappa Research, 2014 (Also available online at www.probabilitycourse.com)
2. Sheldon M. Ross, Introduction to probability and statistics for engineers and scientists, 4th edition, Elsevier, 2009.
3. T. Veera Rajan, Probability, Statistics and Random processes, Tata McGraw-Hill, 2008
4. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36 Edition, 2010.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Topic	No. of Lecture/ Tutorial Hours
1	Module 1 (Discrete Probability distributions)	9 hours
1.1	Discrete Probability distributions	3
1.2	Binomial distribution-mean, variance, Poisson distribution-mean, variance, Poisson approximation to binomial	3
1.3	Discrete bivariate distributions, marginal distributions, Independence of random variables (discrete), Expected values	3
2	Module 2 (Continuous Probability distributions)	9 hours
2.1	Continuous random variables and probability distributions, expected value, mean and variance	2
2.2	Uniform, exponential and normal distributions, mean and variance of these distributions	4
2.3	Continuous bivariate distributions, marginal distributions, Independent random variables, Expected values, Central limit theorem.	3

3	Module 3 (Testing of Hypothesis)	9 hours
3.1	Population and samples, Sampling distribution of single mean and single proportion	1
3.2	Confidence interval for single mean and single proportions	2
3.3	Hypothesis testing basics, large sample test for single proportion, single proportion	2
3.4	Large sample test for equality of means and equality of proportions of two populations	2
3.5	t-distribution and small sample t-test for single mean and pooled t test for equality of means	2
4	Module 4 (Numerical methods-I)	9 hours
4.1	Roots of equations - Newton-Raphson	2
4.2	Interpolation-finite differences, Newton's forward and backward formula	3
4.3	Newton's divided difference method, Lagrange's method	2
4.4	Numerical integration-trapezoidal rule and Simpson's 1/3rd rule	2
5	Module 5 (Numerical methods-II)	9 hours
5.1	Solution of linear systems-Gauss-Siedal method, Jacobi iteration	2
5.2	Curve-fitting-fitting straight lines and parabolas to pairs of data points using method of least squares	2
5.3	Solution of ODE-Euler and Classical Runge-Kutta methods of second and fourth order	5
Total Hours		45 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO1): Understand the concept, properties and important models of discrete random variables and, using them, analyse suitable random phenomena.

1. The probability that a batsman scores a century in a cricket match is $\frac{1}{3}$. Find the probability that out of 5 matches, he may score century in (i) at least 2 matches (ii) at most 2 matches (iii) no match.
2. Three balls are drawn at random without replacement from a box containing 2 white, 3 red and 4 black balls. If X denotes the number of white balls drawn and Y denotes the number of red balls drawn, find the joint probability distribution of (X, Y).
3. Of all customers purchasing automatic garage-door openers, 75% purchase a chain-driven model. Let X the number among the next 15 purchasers who select the chain-driven model.
 - (a) What is the pmf of X?
 - (b) If the store currently has in stock 10 chain-driven models and 8 shaft-driven models, what is the probability that the requests of these 15 customers can all be met from existing stock?

Course Outcome 2 (CO2): Understand the concept, properties and important models of continuous random variables and, using them, analyse suitable random phenomena

1. A random variable has a normal distribution with standard deviation 10. If the probability that it will take on a value less than 82.5 is 0.82, what is the probability that it will take on a value more than 58.3?
2. Assume that the time between arrivals of customers at a particular bank is exponentially distributed with a mean of 4 minutes
 - a) Find the probability that the time between arrivals is greater than 5 minutes.
 - b) Find the probability that the time between arrivals is between 1 and 4 minutes.
3. Verify whether X and Y are independent if $f(x, y) = 24xy$, $0 \leq x \leq 1$, $0 \leq y \leq 1$, $0 \leq x + y \leq 1$.

Course Outcome 3 (CO3): Analyse stochastic processes using autocorrelation, power spectrum and understand multivariable probability distribution.

1. In a random sample of 500 people selected from the population of a city 60 were found to be left-handed. Find a 95% confidence interval for the proportion of lefthanded people in the city population.

2. A magazine reported the results of a telephone poll of 800 adult citizens of a country. The question posed was: "Should the tax on cigarettes be raised to pay for health care reform?" The results of the survey were: Out of the 800 persons surveyed, 605 were non-smokers out of which 351 answered "yes" and the rest "no". Out of the remaining 195, who were smokers, 41 answered "yes" and the remaining "no". Is there sufficient evidence, at the 0.05 significance level, to conclude that the two populations smokers and non-smokers differ significantly with respect to their opinions?
3. A sample of 20 items has mean 42 and SD 5. Test whether the sample is from a population with mean 45? (5 % level of significance)

Course Outcome 4 (CO4): Compute roots of equations, evaluate definite integrals and perform interpolation on given numerical data using standard numerical techniques.

1. Use Newton-Raphson method find correct to 4 decimals places, the root between 0 and 1 of the equation $x^3 - 6x + 4 = 0$.
2. A river is 80m wide. The depth y in meters at a distance x meters from one bank is given by the following table. Find approximately the area of cross section.

X	0	10	20	30	40	50	60	70	80
Y	0	5	8	10	15	12	7	3	1

3. Using Lagrange's interpolation formula, fit a polynomial to the given data

X	1	2	7	8
Y	4	5	5	4

Course Outcome 5 (CO5): Apply standard numerical techniques for solving systems of equations, fitting curves on given numerical data and solving ordinary differential equations.

1. Solve the equations using Gauss-Seidel method:

$$x + 2y + z = 3$$

$$2x + 3y + 2z = 5$$

$$3x - 5y + 5z = 2$$

$$3x + 9y - z = 4$$

2. Obtain the value of y at $x = 0.2$ using Runge-Kutta method of fourth order for the differential equation: $\frac{dy}{dx} = 1 + y^2$, with $h = 0.2$, $y(0) = 0$
3. Write the normal equations for fitting the curve $y = a + bx$.

MODEL QUESTION PAPER

QP CODE:

Pages: 4

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

FOURTH SEMESTER B. TECH DEGREE EXAMINATION, MONTH YEAR

Course Code: B24MA2T04B

Course Name: **STATISTICAL ANALYSIS AND NUMERICAL METHODS**

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks

1. Determine the binomial distribution for which the mean is 4 and the variance is 3.
2. Suppose $E(X) = 5$ and $E[X(X - 1)] = 25$. Find $E(X^2)$.
3. Derive the mean and variance of the exponential distribution.
4. The lifetime of a particular variety of bulbs is a random variable with mean 1200 hours and standard deviation 250 hours. Use the Central Limit Theorem to find the probability that the average lifetime of 60 bulbs exceeds 1250 hours.
5. For the population of individuals who own an iPhone, $p = 0.25$ is the proportion that has a given app. For a random sample of size $n = 4$, find the mean and standard deviation of the sampling distribution of the population proportion.
6. If the mean age of 64 men engaged in an occupation is 52.4 years with standard deviation 10.2 years, construct the 90% confidence limits for the mean age of all men in that occupation.
7. Use the trapezoidal rule to evaluate $\int_0^1 x^3 dx$ considering five subintervals.
8. Write the formula for finding $\sqrt{5}$ using Newton-Raphson's Method.
9. Using Euler's method, find $y(0.2)$ if $y' = x + y$, $y(0) = 1$.
10. Obtain the value of y at $x = 0.1$ using the Runge-Kutta method of second order for the differential equation $y' = -y$, $y(0) = 1$.

PART B

Answer any one question from each module. Each question carries 14 marks.

MODULE 1

11. (a) A car hire firm has 2 cars which it hires out day by day. The number of demands for a car on each day is distributed as a Poisson distribution with mean 2. Calculate the proportion of days on which (i) neither car is used (ii) some demand is refused. (7)
- (b) Suppose that 20% of all copies of a particular textbook fail a certain binding strength test. Let X denote the number among 15 randomly chosen copies that fail the test. Using the table of Binomial distributions or by direct calculation. 1) Find the probability that at most 8 will fail the test. 2) Find the probability that exactly 8 will fail the test. 3) Find the probability that at least 8 will fail the test. 4) Find the probability that failure is between 4 and 7 (inclusive). (7)

OR

12. (a) A Random variable X has the following probability distribution function.

X	0	1	2	3	4	5	6	7	8
Y	a	$3a$	$5a$	$7a$	$9a$	$11a$	$13a$	$15a$	$17a$

- Determine (i) the value of a (ii) $P(X \leq 3)$ (iii) $P(X \geq 3)$ (iv) $P(4 \leq X \leq 7)$ (7)
- (b) The joint probability mass function of X and Y is given by $p(x, y) = (x + 2y) \div 18$ if $(x, y) = (1, 1), (1, 2), (2, 1), (2, 2)$. Find (i) Marginal distributions (ii) Verify whether X and Y are independent. (7)

MODULE 2

13. (a) The weight of certain brand of shampoo packets are uniformly distributed between 9.3 gm and 10.5 gm. In a random lot of 100 packets how many packets (i) exceed 10 gm (ii) are below 10.2 gm. (7)
- (b) In a normal distribution 7% of the items are under 35 and 10% of the items are above 55. Calculate the mean and variance. (7)

OR

14. (a) The time in hours required to repair a machine is exponentially distributed with mean 20. What is the probability that the required time (i) exceeds 30 hours? (ii) between 16 hours and 24 hours? (7)
- (b) The joint PDF of continuous random variable X and Y is given by

$$f(x, y) = \begin{cases} kxy, & 0 \leq x \leq 4, 1 \leq y \leq 5 \\ 0, & \text{otherwise} \end{cases}$$

- Find (i) the value of k (ii) $P(X > 3, Y < 4)$ (iii) marginal distributions (iv) Check whether X and Y are independent. (7)

MODULE 3

15. (a) A die is thrown 9000 times and 3220 times shown 5 or 6. Is the die unbiased at 5% level of significance? (7)
- (b) A random sample of size 6 has mean 25 and variance 3.83. Can the sample be regarded as taken from a population with mean lesser than 29 at 1% level of significance? (7)

OR

16. (a) The mean weight obtained from a random sample of size 100 is 64 gm. The standard deviation of the weight distribution of the population is 3 gm. Test the statement that the mean weight of the population is 67 gm at 5% level of significance (7)
- (b) The average marks scored by 50 students of class A is 42.75 with variance 1.98. The average marks scored by 60 students of class B is 42.15 with variance 1.82. Based on this data can we conclude that students of class A perform better than students of class B at 5% level of significance level? (7)

MODULE 4

17. (a) Use Lagrange's interpolation formula to find $y(2)$ from the following table

X	1	3	4
Y	1	27	64

- (7)
- (b) Find the positive root of the equation $x^3 + x + 1 = 0$ using Newton-Raphson method correct to 4 decimal places. (7)

OR

18. (a) Evaluate $\int_0^2 xe^x dx$ using Simpson's $\frac{1}{3}$ rd rule with $n = 8$. (7)
- (b) Compute $y(13)$ using Newton's Backward difference formula, if given

X	3	6	9	12	15
Y	18	27	36	45	54

(7)

MODULE 5

19. (a) Solve by Gauss-Seidel method the following system:

$$28x + 4y - z = 32$$

$$x + 3y + 10z = 24$$

$$2x + 17y + 4z = 35$$

(7)

- (b) Fit a straight line to the points $(0, 2)$, $(2, 0)$, $(3, -2)$, $(5, -3)$ using method of least squares. (7)

OR

20. (a) Apply Gauss-Seidel method to solve the equations

$$20x + y - 2z = 17$$

$$3x + 20y - z = -18$$

$$2x - 3y + 20z = 25$$

(7)

- (b) Solve using Runge-Kutta method of order 4: $y' = 8.5 - 20x + 12x^2 - 2x^3$, $y(0) = 1$ for $x = 0.5$ [Choose $h = 0.5$]. (7)

KNOWLEDGE IS POWER

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE2T04	STRUCTURAL ANALYSIS	3	1	0	5	4	2024

Preamble

This course is designed to equip students with the essential methods for analysis of structural systems. It covers the concepts such as indeterminacy, analysis of statically determinate and indeterminate structures and the calculation of internal forces and deflections. The course introduces analysis of special structures such as arches, cables and suspension. Students will also learn to analyse effects of moving loads on structures and construct influence line diagrams.

Prerequisites: Engineering Mechanics, Mechanics of Solids

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Calculate structural responses for statically determinate beams and trusses (Cognitive knowledge level: Apply).
CO 2	Determine deflections and internal forces in statically determinate and indeterminate structures using principles such as virtual work and method of consistent deformations. (Cognitive knowledge level: Apply).
CO 3	Analyse continuous beams and portal frames, considering sway and settlement effects, using the Slope Deflection and Moment Distribution Methods (Cognitive knowledge level: Analyse).
CO 4	Calculate the forces in arches, cables and suspension bridges by evaluating various loading conditions. (Cognitive knowledge level: Apply).
CO 5	Determine the effects of moving loads on beams and construct influence lines for reactions, shear forces and bending moments under various loading conditions. (Cognitive knowledge level: Apply).

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	3	1	0	1	0	0	0	0	0	1
CO 2	3	3	2	1	1	0	0	0	0	0	1
CO 3	3	3	2	2	1	0	0	0	1	0	1
CO 4	3	3	2	1	1	1	0	0	0	0	1
CO 5	3	3	2	1	1	0	0	0	1	0	1

Assessment Pattern

Structural Analysis			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	10	10	10
Understand	40	40	40
Apply	50	40	40
Analyse		10	10
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course Project	: 10 marks
Self Study	: 5 marks

End Semester Examination Pattern

The question paper shall contain two questions from each module. Student has to answer any one question from each module. Each question carries 20 marks and can have maximum 3 sub-divisions.

SYLLABUS

MODULE 1 (9 hours)

Introduction to determinacy: Statically determinate and indeterminate structures

Statically determinate beams: Analysis of simply supported and cantilever beams - Method of successive integrations, Moment area method, Conjugate beam method

Statically determinate truss: Method of joints, Method of sections

MODULE 2 (9 hours)

Deformation response of statically determinate structures using energy methods: Principle of virtual work, Maxwell's law of reciprocal deflections, Unit load method for determination of deflection of beams and trusses

Statically Indeterminate Structures: Degree of static and kinematic indeterminacy - Introduction to force and displacement methods - Method of consistent deformations - Analysis of beams with single redundancy - Concepts of effect of pre-strain - lack of fit, temperature changes and support settlement

MODULE 3 (9 hours)

Slope deflection method: Fundamental equations - Analysis of continuous beams, Analysis of portal frames

Moment distribution method: Carryover moment, Stiffness, Distribution factor, Analysis of continuous beams, Analysis of portal frames

MODULE 4 (9 hours)

Arches: Theory of arches – Eddy's theorem - Analysis of three-hinged arches - Parabolic and circular arches (with supports at same level) - Determination of horizontal thrust, bending moment, normal thrust and radial shear

Cables: Analysis of forces in cables under concentrated and uniformly distributed loads - Anchor Cable supports

Suspension Bridges: Un-stiffened suspension bridges, Maximum tension in the suspension cable and backstays, Pressure on towers

MODULE 5 (9 hours)

Moving loads and influence lines: Introduction to moving loads - Concept of influence lines - Influence lines for reaction, shear force and bending moment in simply supported beams – Analysis for single concentrated load, several concentrated loads, uniformly distributed load shorter and longer than the span – Conditions for maximum bending moment and shear force.

Textbooks:

1. Devdas Menon, Structural Analysis, Narosa Publications, 2023
2. S Rajasekaran and G Sankarasubramanian, Computational Structural Mechanics, PHI Ltd., 2015
3. G S Pandit, S P Gupta, R Gupta, Theory of Structures, Mc Graw Hill Education India Pvt Ltd, 2017
4. R Vaidyanathan, P Perumal, Structural Analysis (Vol. I & II), Laxmi Publications, 2023
5. S.S Bhavikkatti, Structural Analysis II, Vikas Publication House (P) Ltd, 2021

Reference:

1. R. C. Hibbeler Structural Analysis, Pearson Education, 2021
2. Wang C K, Intermediate Structural Analysis, McGraw Hill, 2017

COURSE CONTENTS AND LECTURE SCHEDULE

No	Topic	No. of Lecture/ Tutorial Hours
1	Module 1	9 hours
1.1	Introduction to determinacy: Statically determinate and indeterminate structures	1
1.2	Analysis of statically determinate beams with method of successive integrations	1
1.3	Analysis of statically determinate beams with Moment area method and Conjugate beam method	3
1.4	Analysis of truss with method of joints	2
1.5	Analysis of truss with method of sections	2
2	Module 2	9 hours
2.1	Principle of virtual work, Maxwell's law of reciprocal deflections	2

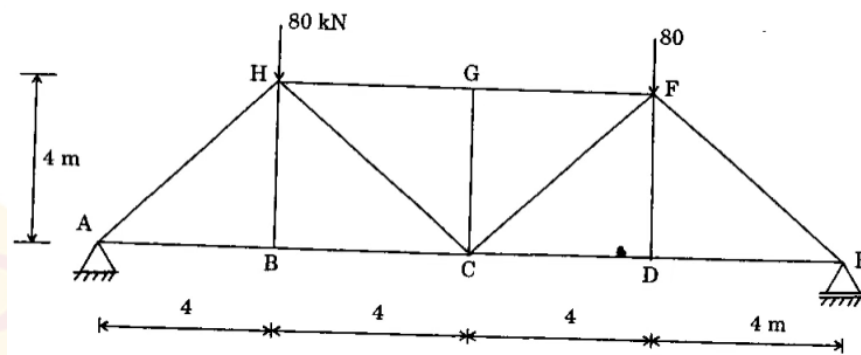
2.2	Unit load method for determination of deflection of beams	1
2.3	Unit load method for determination of deflection of truss	2
2.4	Degree of static and kinematic indeterminacy - Introduction to force and displacement methods	1
2.5	Method of consistent deformations - Analysis of beams with single redundancy	2
2.6	Concepts of effect of pre-strain, lack of fit, temperature changes and support settlement.	1
3	Module 3	9 hours
3.1	Slope deflection method: Concept and derivation	1
3.2	Slope deflection method: Analysis of continuous beams	2
3.3	Slope deflection method: Analysis of frames	2
3.4	Moment distribution method: Carryover moment, Stiffness, Distribution factor	1
3.5	Moment distribution method: Analysis of continuous beams	2
3.6	Moment distribution method: Analysis of frames	1
4	Module 4	9 hours
4.1	Theory of arches – Eddy's theorem	2
4.2	Analysis of three-hinged arches - Parabolic and circular arches (with supports at same level) - Determination of horizontal thrust, bending moment, normal thrust and radial shear	2
4.3	Analysis of forces in cables under concentrated and uniformly distributed loads	2
4.4	Anchor Cable supports	1
4.5	Un-stiffened suspension bridges, Maximum tension in the suspension cable and backstays, Pressure on towers	2

5	Module 5	9 hours
5.1	Introduction to moving loads - Concept of influence lines – Conditions for maximum bending moment and shear force	2
5.2	Influence lines for reaction, shear force and bending moment in simply supported beams	3
5.3	Analysis for single concentrated load, several concentrated loads, uniformly distributed load shorter and longer than the span	4
Total Hours		45 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO1): Calculate structural responses for statically determinate beams and trusses

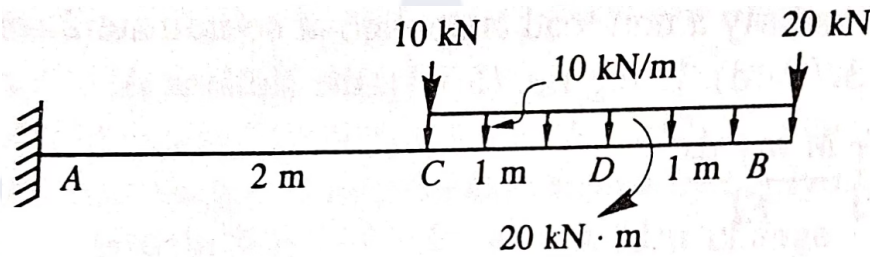
1. Explain the method of sections for analysis of trusses
2. Determine the slope at the supports of a simply supported beam loaded with uniformly distributed load over the entire length of beam using conjugate beam method.
3. Determine the vertical displacement at the joint C of the truss. Assume area of cross section as 500 mm^2 and Young's modulus as 200 GPa for all members.



Course Outcome 2 (CO2): Determine deflections and internal forces in statically determinate and indeterminate structures using principles such as virtual work and method of consistent deformations.

1. Identify the reasons for lack of fit in trusses and explain how to incorporate their effects into analysis of structures.

2. Derive expression for strain energy for a straight prismatic bar of length L and cross-sectional area A , if subjected to an axial tensile force T .
3. Determine the slope and deflection at point B of the cantilever beam.



Course Outcome 3 (CO3): Analyse continuous beams and portal frames, considering sway and settlement effects, using the Slope Deflection and Moment Distribution Methods

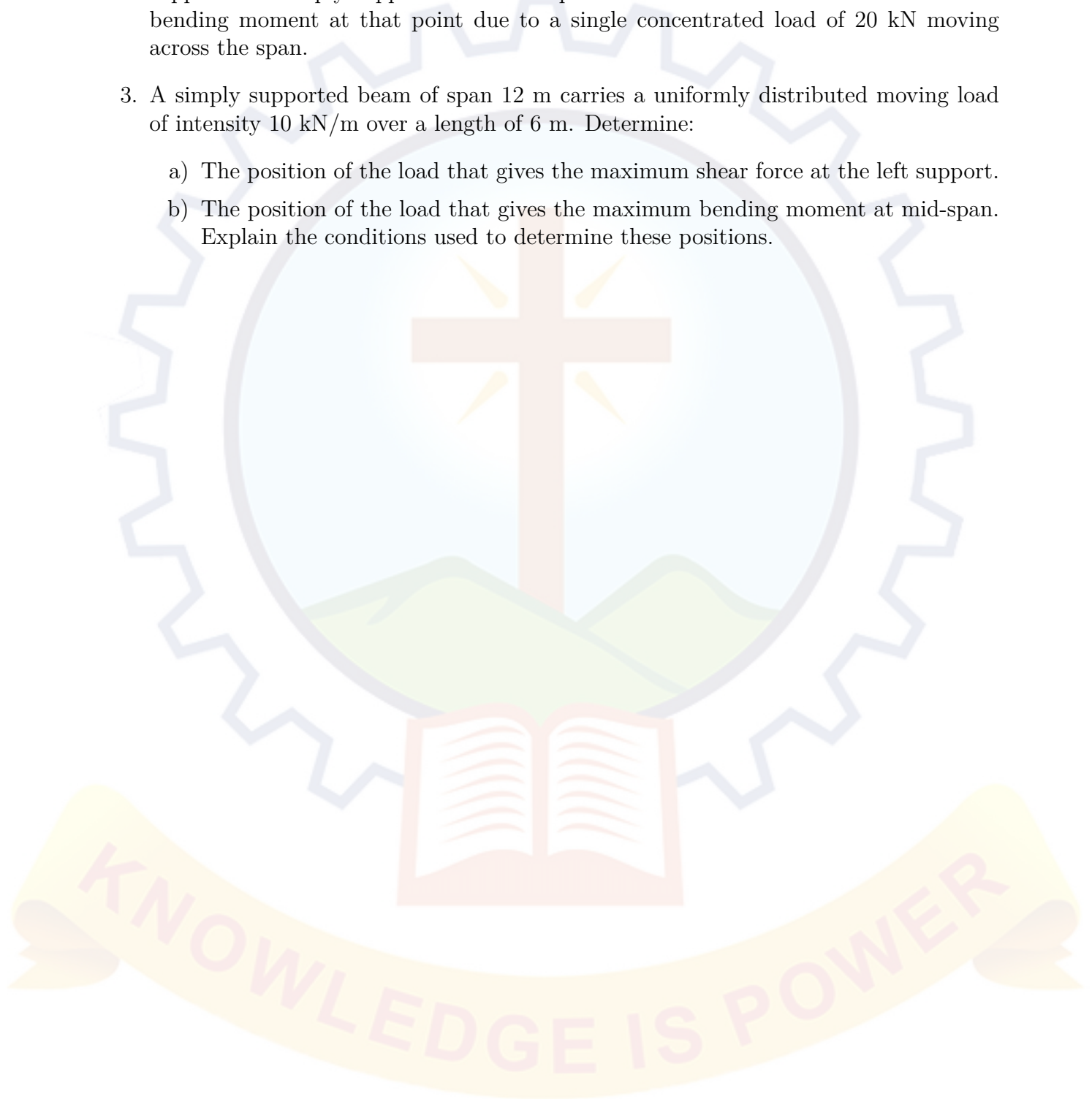
1. Analyse a fixed beam with uniformly distributed load over the left half of the span using slope deflection equations. Draw bending moment diagram and shear force diagram.
2. Analyse a propped cantilever beam with a single point load acting at the centre using moment distribution method. Draw bending moment diagram and shear force diagram.
3. Explain with illustrations:
 - i. Carryover factor
 - ii. Carryover moment
 - iii. Stiffness

Course Outcome 4 (CO4): Calculate the forces in arches, cables and suspension bridges by evaluating various loading conditions.

1. Develop the equations for support reactions and horizontal thrust, when cable is subjected to a uniformly distributed load over the entire span.
2. Prove that a freely suspended cable subjected to a uniformly distributed load takes the shape of a parabola.
3. A cable is hanging between two supports A and B at a horizontal distance of 60 m. Three concentrated loads of 30 kN, 20 kN and 40 kN are hanging from points C, D and E at horizontal distances of 20 m, 30 m & 40 m respectively from support A. Point C is 5 m below supports A and B. Determine the support reactions, cable tensions with inclination and the length of the cable.

Course Outcome 5 (CO5): Determine the effects of moving loads on beams and construct influence lines for reactions, shear forces and bending moments under various loading conditions.

1. Illustrate the significance of influence lines in analysing structures subjected to moving loads.
2. Draw the influence line for bending moment at a point located 4 meters from the left support of a simply supported beam of span 10 meters and determine the maximum bending moment at that point due to a single concentrated load of 20 kN moving across the span.
3. A simply supported beam of span 12 m carries a uniformly distributed moving load of intensity 10 kN/m over a length of 6 m. Determine:
 - a) The position of the load that gives the maximum shear force at the left support.
 - b) The position of the load that gives the maximum bending moment at mid-span.Explain the conditions used to determine these positions.



MODEL QUESTION PAPER

QP CODE:

Pages: 3

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

FOURTH SEMESTER B. TECH DEGREE EXAMINATION, MONTH YEAR

Course Code: B24CE2T04

Course Name: **STRUCTURAL ANALYSIS**

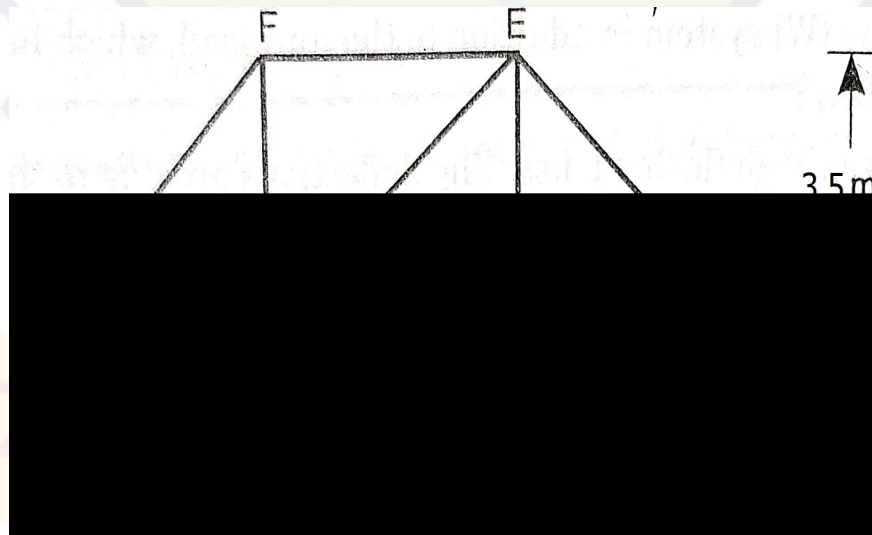
Max. Marks: 100

Duration: 3 hours

Answer all questions

Each question carries 20 marks

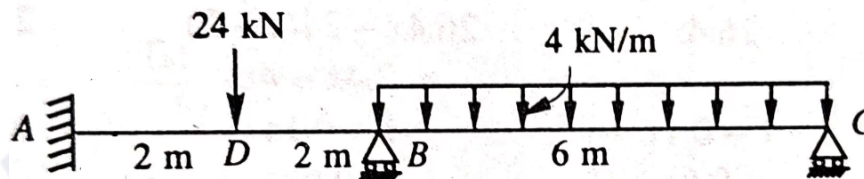
1. (a) Find slope and deflection at the free end of a cantilever beam with a point load acting at the centre of the span using moment area method. (4 marks)
(b) Calculate the member forces of the given truss using method of joints. (16 marks)



OR

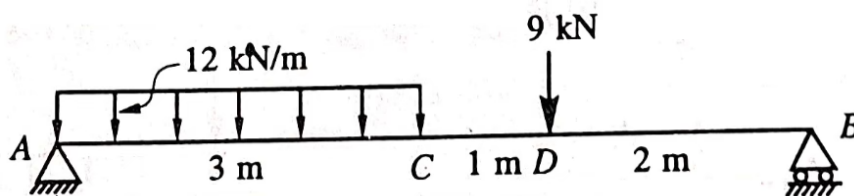
2. (a) Find slope and deflection at the centre of a simply supported beam with uniformly distributed load acting over the entire span using conjugate beam method. (4 marks)
(b) Using the method of successive integration, derive the expressions for the slopes at both supports and the maximum deflection for a simply supported beam subjected to a point load P placed at a distance a from one support. (16 marks)

3. (a) Determine the static and kinematic indeterminacy of a single span beam fixed at both ends. (4 marks)
 (b) Analyse the beam shown in figure using method of consistent deformation and draw bending moment diagram and shear force diagram. (16 marks)

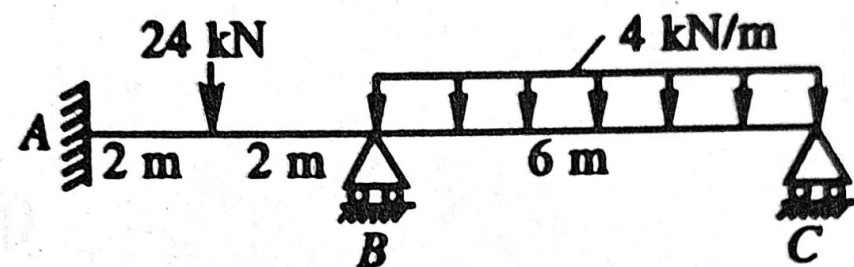


OR

4. (a) Explain with illustrations, how the pre-strains like lack of fit, temperature changes and support settlements affect response of structures. (4 marks)
 (b) Determine slope at the point A and deflection at the point C using unit load method. (16 marks)

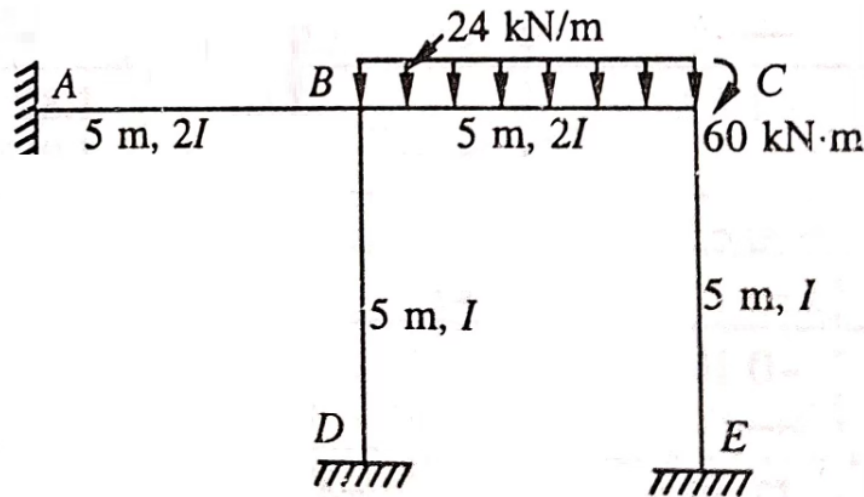


5. Analyse the continuous beam shown in figure using slope deflection method for (i) unyielding support (ii) yielding support which permit a clockwise rotation of $\frac{4}{EI}$ at A and downward settlement of $\frac{24}{EI}$ at B and $\frac{12}{EI}$ at C. Also draw the bending moment diagram. Assume flexural rigidity EI as constant. (20 marks)



OR

6. Analyse the rigid jointed frame shown in figure using moment distribution method and draw the bending moment diagram. (20 marks)



7. (a) State and explain Eddy's theorem. (4 marks)
 (b) A three-hinged parabolic arch hinged at the springing points A and B and crown point C, has a span of 40 m and a central rise of 8 m. It carries a uniformly distributed load 50 kN/m over the left half of the span and a concentrated load of 80 kN at the centre of the right half of the span. Find the reactions at the supports, normal thrust, radial shear and bending moment at a section D which is at 8 m from the left support. (16 marks)

OR

8. (a) Illustrate parts of a suspension bridge and indicate the path of load transfer. (4 marks)
 (b) The cable of a suspension bridge is of span 100 m and maximum dip 18 m with supporting piers 20 m high. It supports a uniformly distributed load of 10 kN/m over horizontal span. The anchor cable is at 30° to the horizontal. If the cable passes over frictionless pulley on top of the pier, determine the vertical and horizontal force transmitted to the supporting pier and the maximum bending moment in the pier. (16 marks)
9. (a) Develop influence line diagrams for shear force and bending moment at any section of a simply supported beam with a single concentrated moving load. (4 marks)
 (b) A uniformly distributed load 50 kN/m and 8 m long crosses a girder of 30 m span from left to right. Draw the influence line diagram for shear force and bending moment at a section 10 m from left support. Calculate the maximum shear force and bending moment at this section using these diagrams. (16 marks)

OR

10. (a) Derive the condition for maximum bending moment at a section at a beam due to the movement of a uniformly distributed load of length shorter than the span of the beam. (4 marks)
 (b) A train of moving loads 50 kN, 60 kN, 30 kN and 70 kN spaced at equal distance of 3 m is moving from left to right with 50 kN leading over a simply supported beam of span 30 m. Compute the maximum shear force and bending moment at a point 10 m from the left support. Also determine the absolute maximum bending moment that will develop on the beam. (16 marks)

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE2T05	SOIL MECHANICS	3	1	0	5	4	2024

Preamble

Introduction of basic concepts and laboratory tests used to evaluate properties of soils: Students learn about classification, compaction permeability, consolidation, and shear strength. There will be practical implications by numerical calculations and experiments, and students develop the capability to understand and respond to geotechnical problem-solving issues faced by civil engineers.

Prerequisites: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Understand the fundamental soil phase relationships and standard laboratory tests used to determine the physical properties of soils. (Cognitive knowledge level: Understand)
CO 2	Understand the classification, consistency, and compaction characteristics of soils through standard procedures and indices. (Cognitive knowledge level: Understand)
CO 3	Apply the principles of effective stress and permeability to analyze seepage and flow through soils. (Cognitive knowledge level: Apply)
CO 4	Understand the process of one-dimensional consolidation and its influence on soil settlement behavior. (Cognitive knowledge level: Understand)
CO 5	Apply shear strength theories and laboratory test results to evaluate the strength characteristics of soils. (Cognitive knowledge level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	2	0	2	1	0	0	0	0	0	2
CO 2	3	2	1	2	1	0	0	0	0	0	2
CO 3	3	3	2	2	1	1	1	0	0	0	2
CO 4	3	2	1	2	1	0	1	0	0	0	2
CO 5	3	3	2	3	1	0	0	0	0	0	2

Assessment Pattern

Soil Mechanics			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (% Marks)
	Test 1 (% Marks)	Test 2 (% Marks)	
Remember	40	20	25
Understand	40	40	35
Apply	20	40	40
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course Project : 10 marks

Self Study : 5 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contain 10 questions carrying 3 marks each. Part B contains 2 questions from each module out of which 1 to be answered. Each question carries 14 mark and can have maximum 2 sub- divisions.

SYLLABUS

MODULE 1 (9 hours)

Overview: Importance in Civil Engineering; Soil formation processes, Major soil deposits of India, Classification based on grain size.

Soil Phases and Relationships: Three-phase diagram, weight-volume relationships, Void ratio, porosity, degree of saturation, air content, water content, specific gravity, unit weight – Numerical problems

Basic Tests: Determination of Water content by oven drying, Specific gravity using pycnometer - Determination of Field density by Sand Replacement and Core Cutter method.

MODULE 2 (9 hours)

Gradation of Soil: Sieve analysis – Numerical problem, Hydrometer analysis-stokes's law, gradation of soil, limitations

Consistency of soil: Atterberg Limits and indices – Plasticity charts – activity of soil-laboratory tests for Liquid Limit (Casagrande's apparatus), Plastic Limit and Shrinkage Limit – Numerical problems

Soil Classification Systems: AASHTO, USCS, Indian Standard Classification, Numerical problems Relative. Density- Numerical problems.

Soil Compaction: Definition, Proctor test, Modified Proctor test, Optimum Moisture Content and Maximum Dry Density, Zero Air voids line, factors affecting compaction.

MODULE 3 (9 hours)

Effective Stress Principle: Total, neutral and effective stress – Pressure diagrams in layered soil with water table, saturated by capillary action, subjected to surcharge load – Numerical problems.

Permeability of Soils: Darcy's Law, factors affecting permeability, laboratory determination of permeability. Seepage analysis- Quick sand condition – Critical hydraulic gradient

MODULE 4 (9 hours)

Consolidation of Soils: Definition One-dimensional consolidation, Terzaghi's theory, settlement analysis, consolidation tests. e-log p curve - Compression index, Recompression index and Pre-consolidation Pressure - Normally consolidated, over consolidated and under consolidated soils - Terzaghi's theory of one-dimensional consolidation with its assumptions - average degree of consolidation – Time factor - Coefficient of consolidation - Numerical problems - Laboratory consolidation test – Determination of Coefficient of Consolidation.

MODULE 5 (9 hours)

Shear Strength: Mohr-Coulomb failure criterion, stress-strain behaviour of soils. Mohr circle method- Determination of principal planes and stresses– relationship between shear parameters and principal stresses – Numerical problems. Testing methods - Direct Shear Test, Triaxial Shear Test (UU, CU, CD), Unconfined Compression Test, Vane shear test. Numerical problems.

Text Books:

1. Ranjan G. and A. S. R. Rao, Basic and Applied Soil Mechanics, New Age International, 2002.
2. Arora K. R., Geotechnical Engineering, Standard Publishers, 2006.
3. Das B. M., Principles of Geotechnical Engineering, Cengage India Pvt. Ltd., 2010.
4. Terzaghi K. and R. B. Peck, Soil Mechanics in Engineering Practice, John Wiley, 1967.

Reference Books:

1. A V Narasimha Rao and C Venkat Ramaiah, Numerical Problems, Examples and Objective questions in Geotechnical Engineering, Universities Press (India) Ltd., 2000
2. Muni ram Budhu, Soil Mechanics and Foundations, Wiley, 2010
3. Jonathan Knappett, Craig R F, Craig's Soil Mechanics, CRC Press, 2020

COURSE CONTENTS AND LECTURE SCHEDULE

No	Topic	No. of Lecture/ Tutorial Hours
1	Module 1	9 hours
1.1	Overview: Importance in Civil Engineering; Soil formation processes, Major soil deposits of India, Classification based on grain size.	3
1.2	Soil Phases and Relationships: Three-phase diagram, weight-volume relationships, Void ratio, porosity, degree of saturation, air content, water content, specific gravity, unit weight – Numerical problems	3

1.3	Basic Tests: Determination of Water content by oven drying, Specific gravity using pycnometer - Determination of Field density by Sand Replacement and Core Cutter method.	3
2	Module 2	9 hours
2.1	Gradation of Soil: Sieve analysis – Numerical problem, Hydrometer analysis-stokes's law, gradation of soil, limitations	2
2.2	Consistency of soil: Atterberg Limits and indices – Plasticity charts – activity of soil-laboratory tests for Liquid Limit (Casagrande's apparatus), Plastic Limit and Shrinkage Limit – Numerical problems	2
2.3	Soil Classification Systems: Indian Standard Classification, Numerical problems	2
2.4	Relative Density- Numerical problems.	1
2.5	Soil Compaction: Definition, Proctor test, Modified Proctor test, Optimum Moisture Content and Maximum Dry Density, Zero Air voids line, factors affecting compaction.	2
3	Module 3	9 hours
3.1	Effective Stress Principle: Total, neutral and effective stress - Pressure diagrams in layered soil with water table, saturated by capillary action, subjected to surcharge load.	3
3.2	Numerical problems.	2
3.3	Permeability of Soils: Darcy's Law, factors affecting permeability, laboratory determination of permeability	3
3.4	Seepage analysis- Quick sand condition – Critical hydraulic gradient.	1
4	Module 4	9 hours
4.1	Consolidation of Soils: Definition One-dimensional consolidation, Terzaghi's theory, settlement analysis, consolidation tests. e-log p curve - Compression index, Recompression index and Pre-consolidation Pressure	2
4.2	Normally consolidated, over consolidated and under consolidated soils	1

4.3	Terzaghi's theory of one-dimensional consolidation with its assumptions - average degree of consolidation – Time factor - Coefficient of consolidation	1
4.4	Numerical problems	3
4.5	Laboratory consolidation test – Determination of Coefficient of Consolidation.	2
5	Module 5	9 hours
5.1	Shear Strength: Mohr-Coulomb failure criterion, stress-strain behavior of soils.	1
5.2	Mohr circle method- Determination of principal planes and stresses– relationship between shear parameters and principal stresses	2
5.3	Numerical problems	3
5.4	Testing methods - Direct Shear Test, Triaxial Shear Test (UU, CU, CD), Unconfined Compression Test, Vane shear test. Numerical problems of vane shear test.	3
Total Hours		45 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO1): Remember the fundamental soil phase relationships and standard laboratory tests used to determine the physical properties of soils.

1. Define specific gravity and unit weight of soil.
2. List the steps involved in determining water content using the oven-drying method.
3. State the relationship between void ratio, porosity, and degree of saturation.

Course Outcome 2 (CO2): Understand the classification, consistency, and compaction characteristics of soils through standard procedures and indices.

1. Explain the procedure for performing a sieve analysis and how to interpret a particle size distribution curve.
2. Describe the Atterberg limits and their significance in soil classification.
3. Discuss the factors affecting the compaction of soils in the field.

Course Outcome 3 (CO3): Apply the principles of effective stress and permeability to analyze seepage and flow through soils.

1. A saturated soil layer has a unit weight of 20 kN/m^3 , and the unit weight of water is 9.81 kN/m^3 .
Calculate the effective stress at a depth of 5 meters below the ground surface.
2. A soil sample has a hydraulic conductivity of $1 \times 10^{-5} \text{ m/sec}$. If the hydraulic gradient is 0.5 and the cross-sectional area of the sample is 0.1 m^2 , apply Darcy's Law to determine the discharge (Q) through the soil.
3. Analyze the seepage condition leading to a quicksand condition using the concept of critical hydraulic gradient.

Course Outcome 4 (CO4): Understand the process of one-dimensional consolidation and its influence on soil settlement behaviour.

1. Describe the assumptions of Terzaghi's one-dimensional consolidation theory.
2. Explain the significance of the compression index in consolidation behaviour.
3. Interpret the e - $\log p$ curve obtained from a laboratory consolidation test.

Course Outcome 5 (CO5): Apply shear strength theories and laboratory test results to evaluate the strength characteristics of soils.

1. A vane shear test conducted in the field on soft clay recorded a torque of 5.5 Nm. The vane has a diameter of 50 mm and height of 100 mm. Calculate the undrained shear strength of the clay.
2. Explain the Mohr-Coulomb failure criterion and illustrate how it helps in evaluating the shear strength of soils under different loading conditions.
3. How does the angle of internal friction (ϕ) affect the shear strength of granular soils?

MODEL QUESTION PAPER

QP CODE:

Pages: 3

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

FOURTH SEMESTER B. TECH DEGREE EXAMINATION, MONTH YEAR

Course Code: B24CE2T05

Course Name: *SOIL MECHANICS*

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks

1. Explain the three-phase diagram of soil with a neat sketch. In what conditions does the three-phase system become a two-phase system?
2. A given soil has equal volume of voids and volume of solids. Estimate its void ratio and porosity.
3. Define Stoke's law and explain its significance.
4. Explain the activity of soil. If a soil has an activity value of 2, what is the type of soil?
5. In what conditions do soils behave as quick? Explain using the concept of critical hydraulic gradient.
6. List any six factors which affect the permeability of soil.
7. Enumerate the assumptions adopted in Terzaghi's theory of consolidation.
8. Differentiate between over-consolidated, under-consolidated, and normally consolidated soils.
9. A sample of dry cohesionless soil was tested in a Triaxial Testing machine. If the angle of shearing resistance is 35° and confining pressure is 100 kPa, determine the deviator stress at failure.
10. Explain the demerits of the Direct Shear Test.

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE - 1

11. (a) Explain with a neat figure Core Cutter method
(b) There are two borrow areas A and B which have soils with void ratios of 0.80 and 0.70, respectively. The in-place water content is 20% and 15%, respectively. The fill at the end of construction will have a total volume of $10,000 \text{ m}^3$, bulk density of 2 Mg/m^3 and a placement water content of 22%. Determine the volume of the soil required to be excavated from both areas. $G = 2.65$. If the cost of excavation of soil and transportation is Rs. 200/- per 100 m^3 for area A and Rs. 220/- per 100 m^3 for area A, which of the borrow area is more economical?
12. (a) Explain the procedure of sand replacement method
(b) In a compaction test on a soil, the mass of wet soil when compacted in the mould was 1.855 kg. The water content of the soil was 16%. If the volume of the mould was 0.945 litres, determine the dry density, void ratio, degree of saturation and percentage air voids. Take $G = 2.68$.

MODULE - 2

13. (a) Enumerate modified proctor test with a neat sketch. Explain OMC, MDD and zero air void line.
(b) The sieve analysis of a soil gave the following results:
 - % passing 75μ sieve = 4
 - % retained on 4.75 mm sieve = 50
 - Coefficient of curvature = 2
 - Uniformity coefficient = 5

Classify the soil as per ISC

14. (a) Explain the procedure for determination of liquid limit with a neat figure.
(b) A soil has a liquid limit of 25% and a flow index of 12.5%. If the plastic limit is 15%, determine the plasticity index and the toughness index. If the water content of the soil in its natural condition in the field is 20%, find the liquidity index and the relative consistency.

MODULE - 3

15. (a) Explain variable head permeability test with a neat figure
(b) The falling-head permeability test was conducted on a soil sample of 4 cm diameter and 18 cm length. The head fell from 1.0 m to 0.40 m in 20 minutes. If the cross-sectional area of the stand pipe was 1 cm^2 , determine the coefficient of permeability

16. (a) Explain constant head permeability test with a neat figure
- (b) A soil profile consists of a surface layer of sand 3.5 m thick ($\rho = 1.65 \text{ Mg/m}^3$), an intermediate layer of clay 3 m thick ($\rho = 1.95 \text{ Mg/m}^3$) and the bottom layer of gravel 3.5 m thick ($\rho = 1.925 \text{ Mg/m}^3$). The water table is at the upper surface of the clay layer. Determine the effective pressure at various levels immediately after placement of a surcharge load of 58.86 kN/m^2 to the ground surface.

MODULE - 4

17. (a) Graphically explain the determination of preconsolidation pressure
- (b) A stratum of clayey soil of 2 m thick and has an initial overburden pressure of 50 kPa at its middle. Determine final settlement due to an increase in pressure of 40 kPa at the middle of clay layer. The clay is over-consolidated, with a preconsolidation pressure of 75 kPa. The values of the coefficients of recompression and compression index are 0.05 and 0.25, respectively. Take initial void ratio as 1.40.
18. (a) Explain in detail the procedure of laboratory consolidation test
- (b) A 3 m thick clay layer beneath a building is overlain by a permeable stratum and is underlain by an impervious rock. The coefficient of consolidation of the clay was found to be $0.025 \text{ cm}^2/\text{minute}$. The final expected settlement for the layer is 8 cm.
- (a) How much time will it take for 80% of the total settlement to take place?
- (b) Determine the time required for a settlement of 2.5 cm to occur.
- (c) Compute the settlement that would occur in one year.

MODULE - 5

19. (a) Explain in detail Triaxial shear test with a neat figure
- (b) Following results were a series of CU test on soil. Determine c and ϕ of the soil

Sample number	Confining pressure (kPa)	Deviator stress at failure (kPa)
1	100	600
2	200	750
3	300	870

20. (a) Explain laboratory vane shear test with a neat figure
- (b) A shear vane 7.5 cm dia and 11.25 cm long was pressed into soft clay at the bottom of the bore hole. Find shear strength of soil if the torque required for failure was 40 Nm.

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE2T06	HIGHWAY AND PAVEMENT ENGINEERING	3	1	0	4	3	2024

Preamble

This course equips students with essential knowledge of highway and pavement engineering, preparing them to design and manage road infrastructure that meets safety, efficiency, and sustainability standards. It fosters an understanding of key principles in geometric design, traffic flow, and pavement performance, while also introducing modern advancements such as Intelligent Transportation Systems (ITS). By developing analytical and problem-solving skills, students will be able to contribute effectively to the planning, construction, and maintenance of transportation networks.

Prerequisites: NIL

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Explain the fundamentals of road transportation, including road classification, user and vehicle characteristics, and environmental impacts of highway systems. (Cognitive Knowledge Level: Understand)
CO 2	Apply geometric design principles to highway alignment, sight distance, and curve design, ensuring safety and efficiency. (Cognitive Knowledge Level: Apply)
CO 3	Analyze traffic characteristics, perform traffic flow studies, and design traffic control devices and intersections for efficient traffic management. (Cognitive Knowledge Level: Analyse)
CO 4	Evaluate pavement materials, design flexible pavements using IRC guidelines, and analyze traffic and stress impacts on pavements. (Cognitive Knowledge Level: Understand)
CO 5	Identify common pavement failures, understand construction technologies, and develop maintenance strategies using modern pavement management systems and ITS applications. (Cognitive Knowledge Level: Understand)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	0	1	0	0	2	0	0	0	0	0
CO 2	3	3	3	0	0	0	0	0	0	0	0
CO 3	3	3	2	0	0	0	0	0	0	0	0
CO 4	3	0	3	0	2	0	0	0	0	0	0
CO 5	3	0	0	1	0	2	0	0	0	0	2

Assessment Pattern

Highway And Pavement Engineering			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	20	20	20
Understand	30	30	30
Apply	30	30	30
Analyse	20	20	20
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course Project	: 10 marks
Self Study	: 5 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contain 10 questions carrying 3 marks each. Part B contains 2 questions from each module out of which 1 to be answered. Each question carries 14 mark and can have maximum 2 sub- divisions.

SYLLABUS

Module 1: Introduction to Road Transportation (5 hours)

Introduction to highways, Classification of roads, Road User Characteristics, Vehicle Characteristics, Road Vehicle Dynamic, Highway Cross-Section Elements, Highway Alignment Environmental Impact of Highway Systems

Module 2: Geometric Design of Highways (11 hours)

Sight Distances: Stopping, overtaking, and headlight sight distance. Horizontal Alignment: Superelevation, transition curve, extra widening. Vertical Alignment: Design of grades and curves, Grade Compensation, Coordination of Horizontal and Vertical Alignment

Module 3: Traffic Theory / Traffic Flow Studies (10 hours)

Traffic Characteristics: Volume, speed, density, capacity, headway, delay – definitions and relations, Traffic Control Devices: Signs, markings, islands, signals, Intersections: At-grade (incl. rotary) and grade-separated, Traffic Signals: Isolated/coordinated signals, saturation flow, lost time, phases, Webster's method.

Module 4: Pavement Engineering (10 hours)

Types of Pavements, Characterization of pavement materials- Desirable properties and tests on materials and mix, Visco-elastic property of bitumen, Introduction to aggregate packing, Aggregate gradation, Traffic and Stress Analysis: Layered elastic theories, load equivalency factors, Introduction to Mechanistic empirical design procedure, IRC Method of Flexible Pavement Design

Module 5: Pavement Failures, Construction, and Maintenance (9 hours)

Stresses in rigid pavements, IRC method of rigid pavement design, Pavement Failures- (causes & remedies), Introduction to Pavement Construction Technology, best practices in flexible and rigid pavement construction.

Textbooks:

1. Khanna, S.K. and Justo C.E.G. and A Veeraragavan, Highway Engineering, Revised 10 th Edition, Nem Chand & Bros.
2. Huang, Y., Pavement Analysis and Design, 2nd Edition, Prentice-Hall, 2004

Reference:

1. Kadiyali, L.R. and N.B. Lal, Principles and Practices of Highway Engineering, Khanna Publishers, 2013

2. Rogers, M., Highway Engineering, 2nd Edition, Blackwell Publishing, 2008
3. Mannering, F.L. and Washburn S.S., Principles of Highway Engineering and Traffic Analysis, 5th Edition, John Wiley, 2009
4. L R Kadiyali, Traffic Engineering and Transport Planning, Khanna Publishers
5. E J Yoder and M W Witzczak, Principles of Pavement Design 2ed, Wiley, 2011
6. Relevant IRC Codes, MORTH, AASHTO Codes and HCM

COURSE CONTENTS AND LECTURE SCHEDULE

No	Topic	No. of Lecture/ Tutorial Hours
1	Module 1	5 hours
1.1.	Introduction : Importance of highway system in overall infrastructural development of a nation and its implication on humans and environment. Challenges and issues faced. Classification of roads: Classification based on importance and functionality.	1
1.2	Road User Characteristics: Visual acuity, legibility distance, reading time of signs, visual field, peripheral vision, hearing, reaction time, walking speed, driver eye height - Vehicle Characteristics: Static and dynamic characteristics - Road vehicle dynamics – Skid resistance, light reflection, roughness, skidding, slipping	2
1.3	Highway Cross-Section Elements, Camber and its design, Right of way, shoulder, camber, carriage way. Highway alignment, Requirements and factors controlling alignment of roads	1
1.4	Environmental Impact of Highway Systems: case study, Green highway concept	1
2	Module 2	11 hours
2.1	Sight Distances: Stopping sight distance-lag and braking distance, Overtaking sight distance, headlight sight distance	2

2.2	Horizontal Alignment: Superelevation, transition curve, extra widening	4
2.3	Vertical Alignment: Design of grades and curves	3
2.4	Coordination of Horizontal and Vertical Alignment	2
3	Module 3	10 hours
3.1	Traffic Characteristics: Volume, time mean speed, space mean speed, density, capacity, time headway, space gap, travel time, delay-Definitions and relations between them.	4
3.2	Traffic Control Devices: Signs, markings, islands, signals Intersections: At-grade including rotary, grade-separated	3
3.3	Traffic Signals: Isolated and coordinated signals, Saturation flow, Loss times, phase, Isolated signal design using Webster's method	3
4	Module 4	10 hours
4.1	Types of Pavements – Classification, Structure and functions, Composite and special pavements	1
4.2	Bitumen grading, Visco-elastic property of bitumen (basic understanding only) Tests on bitumen, desirable range of test values for different types.	1
4.3	Introduction to aggregate packing, Aggregate gradation, Tests on aggregate, desirable properties.	2
4.4	Subgrade soil testing methods: CBR, OMC, Tests on mix	1
4.5	Layer theory (introduction only), ESWL, Equivalent standard axle, environmental design considerations,	2
4.6	Introduction to Mechanistic empirical design procedure, Rutting and Fatigue life calculations, Design of layer thickness according to IRC charts	2
5	Module 5	9 hours
5.1	Introduction to stresses in rigid pavements and Design procedure according to relevant IRC codes.	4

5.2	Pavement Failures in Flexible and Rigid pavements: causes and remedies.	2
5.3	Pavement Construction Technology-Best practices for flexible and rigid pavement construction (brief description only)	3
Total Hours		45 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Explain the different characteristics of road users and provide examples of how these characteristics influence the process of highway design.
2. What do you understand by camber of a road? List out the necessities of providing it and identify the factors influencing its design.

Course Outcome 2 (CO 2):

1. The speed of overtaking and overtaken vehicles in a two-way traffic road are 75 and 40 kmph respectively.
 - i) Calculate the Stopping Sight Distance for a design speed of 70 kmph.
 - ii) Calculate safe overtaking sight distance for given data. Assume acceleration of overtaking vehicle as 0.99 m/s^2
 - iii) Draw a neat sketch indicating the positions of required sign posts for the above designed overtaking zone.
2. A vertical summit curve is formed by $n_1 = +3.0\%$ and $n_2 = -5.0\%$. Design the length of the summit curve for $V = 80 \text{ kmph}$.

Course Outcome 3 (CO 3):

1. A fixed time 2-phase signal is to be provided at an intersection having a N-S and E-W road where only straight-ahead traffic is permitted. The hour flows are given in the table. Calculate the optimum cycle time and green time for the minimum overall delay. The time lost per phase due to starting delays can be assumed to be 2 seconds. The value of the amber period is 2 seconds. Sketch the timing diagram for each phase. (10 marks)

	N	S	E	W
Design hour flow (q) in PCUs/hour	800	400	750	1000
Saturation flow (s) in PCUs/hour	2400	2000	3000	3000

2. Discuss any two advantages and two disadvantages of rotary intersections.

Course Outcome 4 (CO 4):

1. It is proposed to widen an existing 2-lane National Highway Section to 4-lane divided road. Design the pavement for new carriage way with the following data:
Current traffic = 300 CV/day (sum of both directions)
Construction period = 4 years
Design life = 15 years
Traffic growth rate = 7.5% per annum
Vehicle damage factor = 2.5 standard axles per CV
Design CBR of subgrade soil = 4%
Draw a neat sketch indicating the thickness of pavement layers as per IRC 37:2018 catalogs.
2. Differentiate between the unsaturated and saturated flow regimes using a typical volume-density plot.

Course Outcome 5 (CO 5):

1. Explain common flexible pavement failures and their causes.
2. Write a short note on design considerations for overlay of pavement.

MODEL QUESTION PAPER

QP CODE:

Pages: 2

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

FOURTH SEMESTER B. TECH DEGREE EXAMINATION, MONTH YEAR

Course Code: B24CE2T06

Course Name: HIGHWAY AND PAVEMENT ENGINEERING

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Explain the classification of roads and their importance in transportation planning.
2. Discuss the impact of road user characteristics on highway design.
3. Define stopping sight distance and list the factors affecting it.
4. Explain the importance of superelevation in horizontal alignment design.
5. Draw the fundamental traffic flow diagrams.
6. Illustrate any two types of grade separated intersections using a neat sketch.
7. List the differences between flexible and rigid pavements.
8. Explain the significance of load equivalency factors in pavement design.
9. State the difference between tack coat and prime coat.
10. List and explain any two indices used for pavement performance and condition evaluation.

PART B

Answer any one question from each module. Each question carries 14 marks.

11. a) Describe the various highway cross-section elements and their functional significance. (7 marks)
b) Discuss the environmental impacts of highway systems and possible mitigation measures. (7 marks)

OR

12. a) Discuss the requirements and factors controlling alignment of roads. (7 marks)
- b) Discuss the role of vehicle dynamics in highway design. (7 marks)
13. a) For a vertical curve, $n_1 = +1/50$ and $n_2 = -1/80$, SSD = 180 m, OSD = 640 m. Due to site constraints, L is limited to 500 m. Calculate the length of summit curve to meet SSD, ISD, and OSD. Discuss results. (7 marks)
- b) Discuss the design considerations for vertical curves in highway alignment. (7 marks)

OR

14. a) Derive the design formula for mechanical widening provided by IRC 78,1980. (7 marks)
- b) Explain how horizontal and vertical alignments are coordinated in highway design. (7 marks)
15. a) Explain the concept of level of service (LOS) and its role in traffic engineering. (7 marks)
- b) Discuss the different types of traffic control devices and their applications. (7 marks)

OR

16. a) Explain the different data collection techniques for O-D survey. (7 marks)
- b) Describe the method of determining Passenger Car Unit (PCU) values in traffic studies. (7 marks)
17. a) Explain the different types of pavement structures and their applications. (7 marks)
- b) Discuss the characterization of bitumen and their role in pavement performance. (7 marks)

OR

18. a) Explain the concept of layered elastic theory in pavement design. (7 marks)
- b) Design the pavement with granular base and sub-base course with the following data:
 - a. Dual two-lane carriageway
 - b. Initial traffic in the year of completion = 400 CVPD (sum of both directions)
 - c. Traffic growth = 7.5%
 - d. Design Life = 15 years
 - e. VDF = 2.62
 - f. Design CBR of Subgrade Soil = 5%.(7 marks)
19. a) Explain common rigid pavement failures and their causes. (7 marks)
- b) Discuss the importance of pavement management systems and their role in maintenance. (7 marks)

OR

20. a) Briefly describe the procedure to be followed for Life Cycle Analysis of pavements. (7 marks)
- b) Discuss the application of Intelligent Transportation Systems (ITS) in pavement maintenance and monitoring. (7 marks)

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24HU2T01	BUSINESS ECONOMICS AND FINANCIAL MANAGEMENT	3	0	0	4	3	2024

Preamble

This course will aid and equip the students to comprehend the various concepts in Business Economics and Finance. They will gain an understanding of price, demand, production, costs and revenue. They will also learn about the functioning of various markets and fathom the problems affecting the world of business. They will be introduced to national income accounting and to the financial tools used in personal finance. The students will also gain an insight into business financing and the functioning of the stock market.

Prerequisites: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Understand the fundamental concepts and theories of demand, supply, and production to various related economic issues. (Cognitive Knowledge Level: Understand)
CO 2	Understand the concepts relating to costs and revenue to the functioning of firms in different market situations and solve simple business problems using break even analysis. (Cognitive Knowledge Level: Understand)
CO 3	Apply the basic macroeconomic principles to economic concepts influencing the economy as a whole like national income accounting, monetary and fiscal policy, balance of payments and international trade. (Cognitive Knowledge Level: Apply)
CO 4	Make use of the possibilities of financial management to acquire knowledge in the functioning of the Indian financial system and evaluate decisions regarding personal finance. (Cognitive Knowledge Level: Apply)
CO 5	Develop decision making capability by acquiring knowledge in stock markets, mutual funds, business financing and international financing. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	1	1	0	1	0	0	0	0	1	1	1
CO 2	1	1	1	1	1	1	0	0	1	1	1
CO 3	1	1	0	1	1	0	0	0	1	1	1
CO 4	1	0	1	1	0	1	1	1	1	2	1
CO 5	1	1	1	0	0	1	1	1	1	1	1

Assessment Pattern

Business Economics And Financial Management			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (% Marks)
	Test 1 (% Marks)	Test 2 (% Marks)	
Remember	50	30	30
Understand	50	40	40
Apply		30	30
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course Project : 10 marks

Self Study : 5 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contain 10 questions carrying 3 marks each. Part B contains 2 questions from each module out of which 1 to be answered. Each question carries 14 marks and can have maximum 2 sub divisions.

SYLLABUS

MODULE 1 : Fundamentals of Business Economics (8 Hours)

Introduction – Demand and its determinants – Law of demand – Elasticity of demand: Price, Income and Cross - Measurement of elasticity and its applications (Numerical problems) – Supply and its determinants – Determination of Equilibrium Price – Changes in demand and supply and its effects Utility – Law of diminishing marginal utility - Consumer surplus - Producer surplus.

Production concepts: Production function - Cobb Douglas function (Numerical problems) - Average product - Marginal product - Law of variable proportions – Law of Returns to Scale.

MODULE 2 : Cost, Revenue and Markets (7 Hours)

Concepts of cost: Opportunity cost - Explicit and implicit cost – Private and social cost- Short run cost curves – Fixed, variable, total, average and marginal cost curves - Long run cost curves.

Concepts of revenue: Average and marginal revenue - Shutdown point - Break Even analysis (Numerical problems).

Markets: Perfect Competition, Monopoly, Monopolistic Competition, Oligopoly - Cartel and Collusion (Features and equilibrium of a firm) - Product pricing: Cost plus pricing – Target return pricing – Penetration pricing – Predatory pricing – Going rate pricing – Price skimming – Administered pricing.

MODULE 3 : National Income, Inflation and International Trade (7 Hours)

Circular flow of income - Multi-sector model - National income concepts: GNP, GDP, NNP, NI, PI, DPI, PCI - Methods of measuring national income – Difficulties (Numerical problems).

Inflation –Types - Causes and effects – Measures to control inflation - Monetary and fiscal policies – Deflation.

International Trade - Balance of payments – Components – Deficit - Devaluation – Tariff and non-tariff barriers.

MODULE 4 : Fundamentals of Financial Management (7 hours)

Introduction - Reserve Bank of India – Functions - Credit control techniques: Quantitative and qualitative techniques - Working capital management - Factors affecting working capital - Management of cash and marketable securities - Receivables management - Balance Sheet - Profit and Loss Account.

Personal Finance: Personal budget – Tracking income and expenses - 50-30-20 budgeting rule – Emergency fund – Debit vs Credit instruments – Diversification of Investments – Shares vs Bonds - Power of Compounding – Financial independence – Types of Insurance - Digital technology in Finance.

MODULE 5 : Business Financing (7 hours)

Introduction: The Stock Market: Functions, Problems faced by the stock market in India – Demat account and trading account – Market indices: Sensex and Nifty - Derivatives: Forwards, Futures, Options, Swaps - Mutual Funds – Types.

Sources of business financing: Equity capital - Preference capital - Debenture capital - Term loans - Retained earnings - Money market – Instruments - International Financing - FDI, FII.

Text Books:

1. Dominic Salvatore “Principles of Microeconomics”, Oxford University Press, 2009
2. Gregory N Mankiw, “Principles of Macro Economics”, Cengage Learning India, 2022.
3. Prasanna Chandra, “Financial Management”, McGraw Hill, 2022

Reference Books:

1. Paul A Samuelson, “Economics”, McGraw Hill, 2019.
2. A. Koutsoyiannis, “Modern microeconomics”, Palgrave MacMillan, 1979.
3. Geetika Piyali Ghosh and Chodhury “Managerial Economics”, McGraw Hill, 2017.
4. M Y Khan & P K Jain, “Financial Management”, McGraw Hill, 2018.
5. Ruddar Datt, Indian Economy”, S.Chand and Company Ltd, 2018.
6. Dwivedi D N, “Macro Economics”, McGraw Hill, 2018.
7. Gregory N Mankiw, “Principles of Micro Economics”, Cengage Learning India, 2020
8. James C Van Horne, “Financial Management and Policy”, Pearson Education, 20

COURSE CONTENTS AND LECTURE SCHEDULE

No	Topic	No. of Lecture/ Tutorial Hours
1	Module 1	8 hours
1.1	Introduction - Demand and its determinants – Law of demand – Elasticity of demand – Measurement of elasticity and its applications (Numerical problems).	2
1.2	Supply and its determinants – Determination of equilibrium price – Changes in demand and supply and its effects.	2
1.3	Law of diminishing marginal utility - Consumer surplus - producer surplus	2
1.4	Production concepts: Production function - Cobb Douglas function (Numerical problems) - Average product - Marginal product - Law of variable proportions - Law of Returns to Scale.	2
Activity 1: OPEC decides to reduce its output of oil. Using demand and supply curves, bring out the effect of this on the price of oil in the world market. Activity 2: Derive the determination of the equilibrium price of a super luxury and an economy car.		
2	Module 2	7 hours
2.1	Concepts of cost - Opportunity cost - Explicit and implicit cost – Private and social cost- Short run cost curves – Fixed, variable, total, average and marginal cost curves - Long run cost curves.	2
2.2	Concepts of revenue – Average and marginal revenue - Shutdown point – Break Even analysis (Numerical problems).	2
2.3	Markets: Perfect Competition, Monopoly, Monopolistic Competition, Oligopoly - Cartel and Collusion (Features and equilibrium of a firm).	2
2.4	Product pricing: Cost plus pricing – Target return pricing – Penetration pricing – Predatory pricing – Going rate pricing – Price skimming – Administered pricing.	1

Activity 1: Determination of equilibrium price and output in oligopoly companies in India. Activity 2: Pricing strategy followed by Apple in regard to their mobiles.		
3	Module 3	7 hours
3.1	Circular flow of income - Multi-sector model - National income concepts – GNP, GDP, NNP, NI, PI, DPI, PCI - Methods of measuring national income – Difficulties (Numerical problems).	2
3.2	Inflation –Types - Causes and effects – Measures to control inflation - Monetary and fiscal policies – Deflation.	2
3.3	International Trade - Balance of payments – Components – Deficit.	2
3.4	Devaluation — Tariff and non-tariff barriers.	1
Activity 1: Compare the present BoP position of India and China. Activity 2: Impact of tariff wars in today's global scenario.		
4	Module 4	7 hours
4.1	Introduction - Reserve Bank of India – Functions - Credit control techniques: Quantitative and qualitative techniques.	2
4.2	Working capital management - Factors affecting working capital.	1
4.3	Management of cash and marketable securities - Receivables management. Balance Sheet - Profit and Loss Account.	2
4.4	Personal Finance: Budget – Tracking income and expenses - 50-30-20 budgeting rule – Emergency fund – Debit vs Credit Cards – Diversification of Investments – Shares vs Bonds - Power of Compounding – Financial independence – Insurance – Types of Insurance - Digital technology in Finance.	2
Activity 1: Investigate the historical returns offered by different asset classes. Activity 2: Steps needed to circumnavigate financial challenges like student loans, buying a car, purchasing a home vs renting, etc.		

5	Module 5	7 hours
5.1	Introduction - The Stock Market – Functions, Problems faced by the stock market in India – Demat account and trading account – Market indices: Sensex and Nifty.	3
5.2	Derivatives: Forwards, Futures, Options, Swaps - Mutual Funds – Types.	1
5.3	Sources of business financing: Equity capital - Preference capital - Debenture capital - Term loans - Retained earnings.	2
5.4	International Financing - FDI, FII.	1
Activity 1: Research and present the stock performance of a company. Activity 2: Investigate the impact of foreign direct investment into India, taking the examples of multinational companies.		
Total Hours		36 Hours

* Activities are a desirable part of the course.

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO1):

1. State the Law of demand.
2. With the help of a figure, elucidate the concept of consumer surplus.
3. Define utility. State the Law of diminishing marginal utility.

Course Outcome 2 (CO2):

1. Distinguish between explicit and implicit cost.
2. Bring out the relationship between average and marginal revenue.
3. How does a firm under monopoly attain equilibrium?

Course Outcome 3 (CO3):

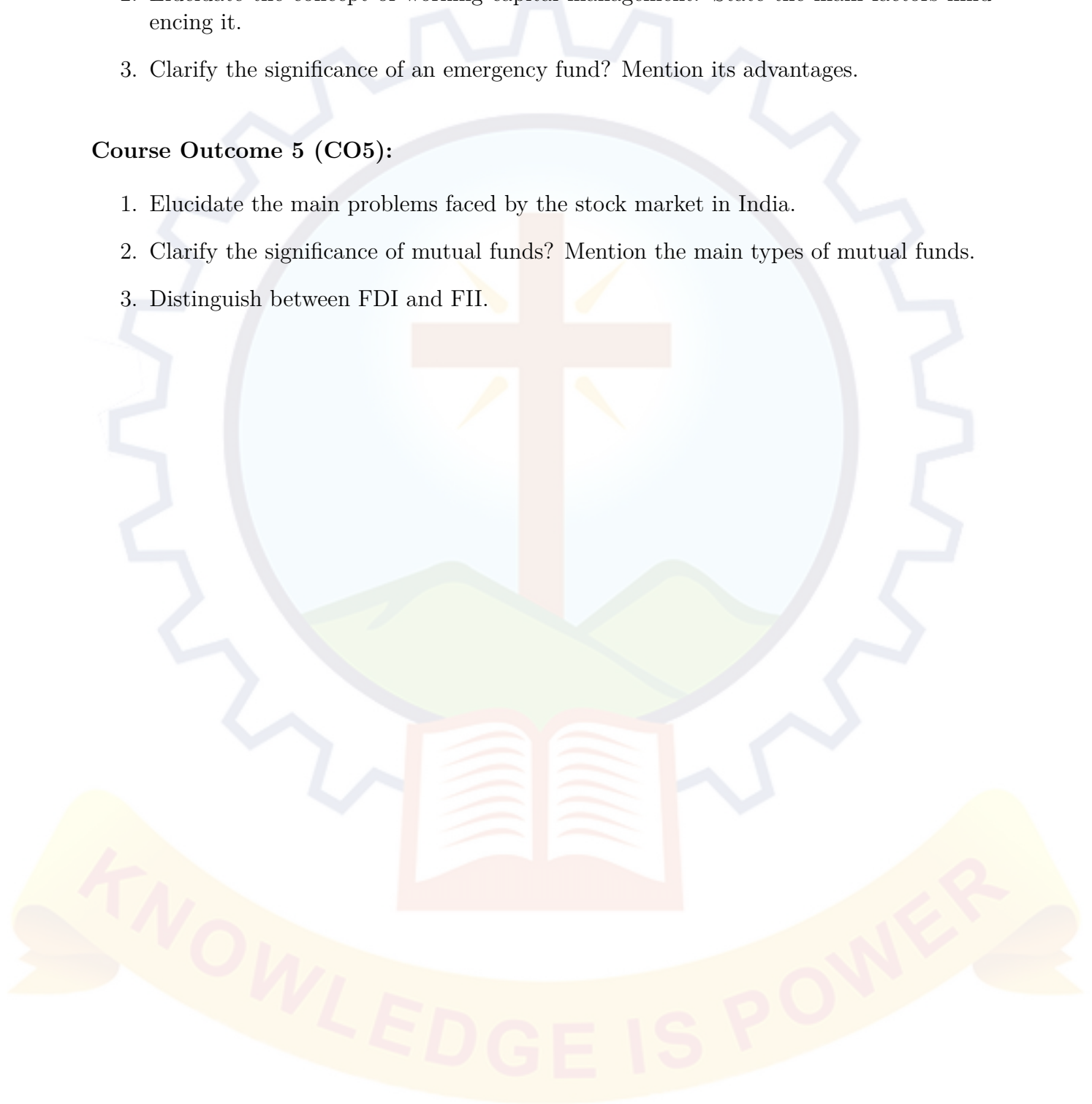
1. With the help of a figure, examine the circular flow of income in a multi sector economy.
2. State the government measures to control inflation.
3. What are non-tariff barriers? Give two examples.

Course Outcome 4 (CO4):

1. Mention any four functions of the RBI.
2. Elucidate the concept of working capital management. State the main factors influencing it.
3. Clarify the significance of an emergency fund? Mention its advantages.

Course Outcome 5 (CO5):

1. Elucidate the main problems faced by the stock market in India.
2. Clarify the significance of mutual funds? Mention the main types of mutual funds.
3. Distinguish between FDI and FII.



MODEL QUESTION PAPER

QP CODE:

Pages: 3

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

FOURTH SEMESTER B. TECH DEGREE EXAMINATION, MONTH YEAR

Course Code: B24HU2T01

**Course Name: BUSINESS ECONOMICS AND FINANCIAL
MANAGEMENT**

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks

1. With the help of a figure, elucidate the concept of consumer surplus.
2. A tea company sold 40000 kg of tea when the price of coffee was Rs.50 per kg. Later they were able to sell 45000 kg when the price of coffee increased to Rs.70 per kg. Calculate the cross elasticity of demand for tea.
3. Distinguish between explicit and implicit cost.
4. List the features of a firm under perfect competition.
5. Define cost plus pricing. Mention its advantage.
6. Write a note on non-tariff barriers. Give two examples.
7. Define Cash Reserve Ratio.
8. Write a note on the significance of receivables management.
9. Distinguish between demat account and trading account.
10. What is FDI? Mention two of its merits.

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. a. State the Law of Demand. Also mention the assumptions and exceptions of the law. (7 Marks)
- b. What is the Cobb-Douglas production function? Mention its feature. If the production function of a firm is $Q = 30L^{1/2}K^{1/2}$, find out the average and marginal product of labour from the function, if 225 units of labour is combined with 196 units of capital. (7 Marks)

OR

12. a. State the Law of Diminishing Marginal Utility. Also mention the assumptions and importance of the law. (7 Marks)
- b. Define Income Elasticity. When the income of a consumer was Rs. 50,000 per month, the quantity demanded of a good was 100 units. When his income increased to Rs. 80,000, his demand increased to 110 units. Is the good a normal or an inferior one? Give reason. (7 Marks)

MODULE 2

13. a. State the features of a firm under perfect competition. With the help of a figure, explain the determination of equilibrium price and output under perfect competition. (7 Marks)
- b. A firm sells its product at Rs. 400 per unit. To produce a unit, it needs raw materials for Rs. 150, labour for Rs. 70 and incurs other variable expenses for Rs. 40. The firm's fixed expenses are Rs. 15,00,000. Find the breakeven quantity of the firm. (7 Marks)

OR

14. a. State the features of a firm under monopolistic competition. With the help of a figure, explain the determination of equilibrium price and output under monopolistic competition. (7 Marks)
- b. The value of the total sales of a company is Rs. 1,00,000. Its fixed cost is Rs. 20,000, while its variable cost is Rs. 50,000. Calculate:
- (a) the P/V ratio
 - (b) breakeven point
 - (c) margin of safety at this level of sales
 - (d) If it sells each unit for Rs. 20, how many units should the company sell to break even?
 - (e) Find the sales required to earn a profit of Rs. 20,000.

(7 Marks)

MODULE 3

15. a. With the help of a figure, examine the circular flow of income in a multi-sector economy. (7 Marks)

- b. From the following data,
Gross National Product = Rs. 14,700 crores
GST = Rs. 1,100 crores
Undisbursed Profit = Rs. 2,000 crores
Corporate Income Tax = Rs. 1,000 crores
Depreciation = Rs. 1,500 crores
Net Factor Income from Abroad = Rs. 5,200 crores
Income Tax = Rs. 500 crores
Subsidies = Rs. 400 crores
Social Security Contribution = Rs. 300 crores

Calculate:

- (i) GDP
- (ii) NI
- (iii) PI

(7 Marks)

OR

16. a. Elucidate the economic problem of inflation. What are its main types? State the government measures to control inflation. (7 Marks)
- b. In an economy, the total expenditure of the people on various goods and services is Rs. 2,000 crores. The government spending is Rs. 500 crores while the total investment is Rs. 300 crores. Exports are Rs. 200 crores and imports are Rs. 100 crores. The depreciation is Rs. 80 crores. Find the value of GNP. (7 Marks)

MODULE 4

17. a. Discuss the functions of the RBI. What are the main quantitative techniques used by the RBI? (7 Marks)
- b. State the meaning of balance sheet in accounting. Draw a format of the balance sheet showing the different entries. (7 Marks)

OR

18. a. Write a note on the management of cash and marketable securities. (7 Marks)
- b. State the significance of profit and loss account. Illustrate a format of the profit and loss account. (7 Marks)

MODULE 5

19. a. Elaborate the main functions performed by the stock market in an economy. (7 Marks)
- b. Elucidate the various sources of business financing available to companies. (7 Marks)

OR

20. a. Elaborate the meaning of mutual funds. Discuss the different types of mutual funds. (7 Marks)
- b. Distinguish between FDI and FII. (7 Marks)

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE2T07	CONSTRUCTION TECHNOLOGY AND MANAGEMENT	2	1	0	4	3	2024

Preamble

This course provides a comprehensive understanding of construction materials, technologies, and management practices essential for civil engineering. Students will explore traditional and advanced construction materials, cost-effective methods, prefabrication, prestressing principles. Emphasis is placed on mechanization, automation, and the efficient management of construction equipment. The course also covers project management, tendering processes, and contract types, along with construction planning techniques such as bar charts, milestone charts, CPM, and PERT. By the end of this course, students will be equipped to apply these concepts effectively in real-world construction projects.

Prerequisites: Basic civil Engineering

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Identify and understand various construction materials, building components, and structural systems used in the construction industry. (Cognitive Knowledge Level: Understand)
CO 2	Understand and apply various construction technologies, including scaffolding, formwork, prefabrication, prestressing techniques, 3D printing, and identify the causes of building failures. (Cognitive Knowledge Level: Understand)
CO 3	Understand modern construction materials, construction automation methods, and manage various construction equipment effectively. (Cognitive Knowledge Level: Understand)
CO 4	Understand the lifecycle and management of construction projects, including project phases, tendering processes, and various contract types. (Cognitive Knowledge Level: Understand)
CO 5	Apply construction planning techniques, including work breakdown structures, scheduling, bar charts, milestone charts, network analysis, CPM, and PERT. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	2	1	0	0	1	0	0	0	0	1
CO 2	2	3	2	1	2	1	0	0	0	0	1
CO 3	2	1	2	0	3	1	0	0	0	0	2
CO 4	1	0	1	0	0	1	2	1	1	3	1
CO 5	2	2	2	1	2	0	0	1	1	3	1

Assessment Pattern

Construction Technology And Management			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	30	20	20
Understand	50	50	50
Apply	20	30	30
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course Project : 10 marks

Self Study : 5 marks

End Semester Examination Pattern

End Semester Examination Pattern: There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question carries 14 marks and can have maximum 2 sub-divisions.

SYLLABUS

Module 1: Standard Construction Techniques (6 hours)

Construction Technology: Steel and masonry construction. Cost-effective construction – soil-cement block masonry, voided slab technology, filler slab technology, Scaffolding – uses and classification, Formwork – requirements of good formwork and classification - Construction safety- Methods and equipment

Module 2: Advanced Construction Techniques (8 hours)

Prefabricated construction and erection-Modular construction – Basic concept of prestressing – A fundamental understanding of pre-tensioned and post-tensioned construction, 3D printing, rapid wall construction and slip form technique, Reinforced brick masonry, Raised Access Flooring technology, Tunnel Form Construction

Module 3: (8 hours)

Construction equipments and automation - Mechanisation in construction – Earth moving, handling, pneumatic and hoisting equipment – Pile driving equipment - Advanced tunneling equipment– Soil compaction & stabilization equipment's –Bridge erection equipment- Concrete pumping- Automation in construction

Module 4: (7 hours)

Construction Project Management: Construction projects, categories, life cycle of a project – Pre-project phase, project phase, post-project phase, Detailed Project Report – Contents Tendering - types of tenders, stages in tendering, Contracts: Types of contracts – item rate contract, lumpsum contract, percentage rate contract, turnkey contracts, concession contracts– EPC

Module 5: (7 hours)

Construction Planning: Work breakdown structure Types of Schedules – Construction schedule, Material schedule, labour schedule, equipment schedule, financial schedule, Bar chart, Mile Stone Charts, Networks - Network representation – Activity on Node (AON) and activity on arrow (AOA) Diagram, Network analysis – Critical Path Method (CPM), Programme Evaluation and Review Technique(PERT) – Concepts and problems

Text Books:

1. Kumar Neeraj Jha (2015), Construction Project Management: Theory and Practice, Pearson India Education Services Pvt.Ltd.
2. Neville A. M. and Brooks J. J., Concrete Technology, Pearson Education, 2019

Reference Books:

1. Mehta and Monteiro, Concrete-Micro structure, Properties and Materials , McGraw Hill Professional 2017
2. Varghese P. C. (2007), Building Construction, Prentice Hall India.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Topic	No. of Lecture/ Tutorial Hours
1	Module 1	6 hours
1.1	Construction Technology: steel and masonry construction. Cost-effective construction	2
1.2	Soil-cement block masonry, voided slab technology, filler slab technology, Scaffolding – uses and classification	2
1.3	Filler slab technology, Scaffolding – uses and classification, Formwork – requirements of good formwork and classification, Construction safety-methods and equipment	2
2	Module 2	8 hours
2.1	Prefabricated construction and erection - Modular construction – Basic concept of prestressing – a fundamental understanding of pre-tensioned and post-tensioned construction	4
2.2	3D printing, rapid wall construction and slip form technique	2
2.3	Reinforced brick masonry, Raised Access Flooring technology, Tunnel Form Construction.	2

3	Module 3	8 hours
3.1	Modern construction materials – Intelligent buildings – building automation.	2
3.2	Mechanisation in construction – Earth moving, handling, pneumatic and hoisting equipment – pile driving equipment – equipments– Advanced tunneling equipment	4
3.3	Soil compaction & stabilization equipments – Automation in construction -owning and operating works of construction equipment.	2
4	Module 4	7 hours
4.1	Construction Project Management: Construction projects, categories, life cycle of a project – pre-project phase, project phase, post-project phase, Detailed Project Report – contents	3
4.2	Tendering: Types of tenders, stages in tendering	2
4.3	Contracts: Types of contracts – item rate contract, lumpsum contract, percentage rate contract, turnkey contracts, concession contracts – EPC	2
5	Module 5	7 hours
5.1	Construction Planning: Work breakdown structure Types of Schedules – Construction schedule, Material schedule, labour schedule, equipment schedule, financial schedule	2
5.2	Bar chart, Mile Stone Charts, Networks, Network representation – Activity on Node (AON) and activity on arrow (AOA) Diagram	2
5.3	Network analysis – Critical Path Method (CPM), Programme Evaluation and Review Technique(PERT) – concepts and problems	3
Total Hours		36 Hours

MODEL QUESTION PAPER

QP CODE:

Pages: 2

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

FOURTH SEMESTER B. TECH DEGREE EXAMINATION, MONTH YEAR

Course Code: B24CE2T07

Course Name: CONSTRUCTION TECHNOLOGY AND MANAGEMENT

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Explain the classification of scaffolding and its uses in construction.
2. What are the requirements of good formwork?
3. Define modular construction and explain its key benefits.
4. Compare pre-tensioned and post-tensioned construction methods in prestressing.
5. List different types of earth-moving equipment and their applications.
6. What are the advantages of automation in construction equipment operations?
7. What are the types of contracts used in construction projects? Provide examples.
8. List the stages involved in tendering and their importance.
9. Differentiate between Activity on Node (AON) and Activity on Arrow (AOA) diagrams.
10. What is the significance of milestone charts in construction scheduling

PART B

Answer any one question from each module. Each question carries 14 marks.

11. Discuss the construction techniques adopted for cement block masonry, voided slab technology, and filler slab technology, along with their applications.

OR

12. Compare steel and masonry construction techniques, highlighting their advantages and limitations.
13. Discuss the slip form technique and rapid wall construction, emphasizing their importance in modern construction practices.

OR

14. Elaborate on the concept of 3D printing in construction and its future impact on the industry.
15. Discuss the significance of construction equipment mechanization and automation in improving project efficiency.

OR

16. Describe the mechanisms and applications of hoisting equipment, pneumatic handling equipment, and earth-moving equipment used in a construction site.
17. Explain the life cycle of a construction project, detailing the phases from pre-project to post-project stages.

OR

18. Compare EPC and turnkey contracts in terms of implementation, financial benefits, and risk-sharing.
19. Describe the Critical Path Method (CPM) and Program Evaluation and Review Technique (PERT), including examples of their applications in construction planning.

OR

20. Discuss the preparation of different types of schedules (construction schedule, material schedule, labor schedule, equipment schedule, financial schedule) for effective construction planning.

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE2L05	MATERIAL TESTING LABORATORY - I	0	0	3	2	2	2024

Preamble

This course offers a comprehensive insight into civil engineering materials, emphasizing the relationship between their structural characteristics and properties, as well as practical applications. Through experimental work, students will analyze mechanical features such as tensile, shear, bending, and torsional strength. Additionally, students will develop skills to compute stress, strain, and displacement, applying these principles to the design and analysis of real-world structures.

Prerequisites: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Perform standard mechanical tests (tension, torsion, bending, shear, and impact) on different engineering materials to determine key mechanical properties: (Cognitive Knowledge Level: Apply)
CO 2	Evaluate material hardness using Vickers and Brinell hardness testing methods and interpret the results for different materials: (Cognitive Knowledge Level: Evaluate)
CO 3	Analyse the behaviour of materials and structural elements like springs and beams under load. (Cognitive Knowledge Level: Analyse)
CO 4	Apply theoretical principles such as Maxwell's reciprocal theorem to validate experimental observations: (Cognitive Knowledge Level: Apply)
CO 5	Demonstrate technical skills in measuring, recording, and interpreting data from material testing experiments while adhering to safety and accuracy standards: (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	3	2	2	3	1	1	1	2	2	2
CO 2	3	3	2	2	3	1	1	1	2	2	2
CO 3	3	3	2	3	2	1	1	1	2	2	2
CO 4	3	2	2	3	2	1	1	1	2	2	2
CO 5	2	2	2	2	2	2	2	3	3	3	3

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	10 marks
Continuous Assessment	10 marks
Viva-Voce (Self Study)	10 marks
Test	15 marks
Lab Record	5 marks

End Semester Examination Pattern

The following guidelines should be followed regarding the award of marks:

Preliminary work	: 20 marks
Implementing the work / Conducting the experiment	: 20 marks
Performance, result and inference (usage of equipment and troubleshooting)	: 30 marks
Viva voce	: 30 marks

SYLLABUS

LIST OF EXPERIMENTS

No	Description
1	Tension test on mild steel/ TMT bar
2	Double shear test on mild steel rod.
3	Vicker's Hardness test on a given material (Brass / Steel)
4	Brinell Hardness test on a given material (Brass / Steel/ Aluminum)
5	Torsion Pendulum Test with given wire specimen (Brass & Steel)
6	Flexural rigidity of given steel I Beam.
7	Impact test of the given material using Izod and Charpy test.
8	Spring test on close coiled spring & open coiled spring.
9	Bending test on wooden beam
10	Verification of Clerk Maxwell's law of reciprocal theorem.
11	Torsion test on mild steel specimen

*Minimum Eight Experiments Are Mandatory

Reference Books:

1. G E Dieter. Mechanical Metallurgy, McGraw Hill, 2013 (3rd edition)
2. Dally J W, Railey W P, Experimental Stress analysis, McGraw Hill, 1991 S Timoshenko, D H Young, et al, "Engineering mechanics", McGraw Hill Education.
3. Timoshenko, S., & Young, D. (2021). Strength of Materials. (3rd edition)
4. Russell Hibbeler, "Engineering mechanics: Statics and Dynamics", Pearson Education, 2022 (15th edition).

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE2L06	CIVIL ENGINEERING DRAFTING LAB	0	0	3	2	2	2024

Preamble

The primary objectives of this course are to provide civil engineering students with the vital skills needed to create computer-aided engineering drawings understand the construction details of various building elements, and visualize the completed form of buildings along with the intricacies of construction based on engineering drawings. Through this comprehensive approach, students will gain a solid foundation in the principles and practices of architectural and engineering design.

Prerequisites: Graphics for Civil Engineers

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	To understand the fundamental AutoCAD commands essential for creating technical drawings.(Cognitive Knowledge Level: Apply)
CO 2	To illustrate the ability to organize technical drawings systematically and professionally.(Cognitive Knowledge Level: Apply)
CO 3	To demonstrate the ability to create and organize accurate sectional details, elevations, and plans for various building components. (Cognitive Knowledge Level: Apply)
CO 4	To prepare the floor plan, section, and elevation of the building from the layout in compliance with building rules.(Cognitive Knowledge Level: Apply)
CO 5	To prepare a complete document for the building permit to include all necessary information regarding the drawing. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	2	3	1	3	0	0	0	0	1	0
CO 2	2	2	3	0	2	0	0	1	1	3	1
CO 3	3	3	3	2	3	0	0	0	0	2	0
CO 4	3	3	3	2	3	2	1	1	0	2	1
CO 5	2	2	3	1	2	3	1	2	1	3	2

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	10 marks
Continuous Assessment	10 marks
Viva-Voce (Self Study)	10 marks
Test	15 marks
Lab Record	5 marks

End Semester Examination Pattern

The following guidelines should be followed regarding the award of marks:

Preliminary work	: 20 marks
Implementing the work / Conducting the experiment	: 20 marks
Performance, result and inference (usage of equipment and troubleshooting)	: 30 marks
Viva voce	: 30 marks

SYLLABUS

A. Introduction to AutoCAD

Basic Drawing Commands, Layers and Annotation, Blocks, Groups, and Hatching. Printing and Plotting — Setting up sheets and layouts, Applying scales and setting print preferences, Exporting drawings to different formats (PDF, DWG, DXF).

Detailed Drawings of:

1. Draw sectional details and elevation of panelled doors, glazed windows and ventilators in wood.
2. Draw elevation, section and detailing of connection between members, arrangement for fixing at the support for steel roof truss.

3. Draw plan, section, and elevation of dog-legged staircase.
4. Draw sectional details of a load-bearing wall over strip footing, RCC Column over isolated footing, and pile with pile cap.
5. Draw the sectional details, detailing of Septic Tank and Soak Pit drawings.
6. Develop the layout and design the floor plan, sectional view, and elevation for a single-story residential building featuring a flat roof.
7. Develop the layout and design the floor plan, section and elevation of two - storied residential building. Also include the site plan and service plan as per the latest building rules (KPBR or KMBR).
8. Draw plan, section and elevation of a public buildings — office complex, public health center, post office, bank etc.

B. Introduction to Revit Architecture

Create and modify basic building components—such as walls, floors, roofs, doors, and windows—within a 3D environment. The focus is on visualizing simple structural forms and developing accurate, well-coordinated 3D models.

Reference Books:

1. National Building Code of India
2. Kerala panchayat building rules, 2019
3. Kerala Municipality building rules, 2019
4. Dr. Balagopal T S Prabhu, Building Drawing and Detailing, Spades Publishers, 2007.
5. AutoCAD Essentials, Autodesk official Press, John Wiley & Sons, USA
6. Shah, M.G., Kale, C. M. and Patki, S.Y. Building Drawing With An Intergrated Approach to Built Environment, Tata McGraw Hill Publishing Company Limited, New Delhi
7. Elise Moss, Autodesk Revit 2024 Architecture Basics: From the Ground Up, SDC Publications, 2023

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CEM42	SOLID WASTE MANAGEMENT	3	1	0	5	4	2024

Preamble

This course offers a comprehensive exploration of solid waste management principles, practices, and emerging challenges.

Prerequisites: NIL

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Identify scope and regulations of solid waste management. (Cognitive Knowledge Level: Remember)
CO 2	Identify and explain the different types of solid waste and ensure effective and scientific management of municipal solid waste. (Cognitive Knowledge Level: Understand)
CO 3	Describe solid waste collection methods, transfer logistics, and on-site handling with relevant equipment and design considerations. (Cognitive Knowledge Level: Understand)
CO 4	Identify Methods and technologies used to manage waste, including recycling, composting, energy recovery, and landfilling. (Cognitive Knowledge Level: Understand)
CO 5	Identify various categories of special wastes and explain emerging environmental issues related to their management. (Cognitive Knowledge Level: Understand)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	1	0	0	0	0	2	1	0	0	0	1
CO 2	1	0	0	0	0	2	1	0	0	0	1
CO 3	1	0	0	0	0	2	1	0	0	0	1
CO 4	1	0	0	0	0	3	1	0	0	0	1
CO 5	1	0	0	0	0	3	1	0	0	0	1

Assessment Pattern

Solid Waste Management			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	40	40	40
Understand	60	60	60
Apply			
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course Project : 10 marks

Self Study : 5 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contains 10 questions carrying 3 marks each. Part B contains 2 questions from each module out of which any one is to be answered. Each question carries 14 marks and can have maximum 2 sub-divisions.

SYLLABUS

Module 1: Introduction to Solid Waste Management (9 hours)

Overview of solid waste management: definition, scope, and historical development, Legislations and regulations: national and international policies, Sources of solid waste: residential, commercial, industrial, institutional, and agricultural. Indian rules and guidelines for municipal solid waste, hazardous waste, electronic waste, construction and demolition waste and plastic waste and their amendments.

Module 2: Sources, Types, and Characteristics of Municipal Solid Waste (9 hours)

Types of solid waste: biodegradable, recyclable, inert, hazardous, and electronic waste; Physical and chemical characteristics: composition analysis, moisture content, density, calorific value, Waste generation rates: factors influencing generation and estimation methods. Integrated solid waste management: waste management hierarchy and sustainable practices; management of sanitary waste.

Module 3: Collection, Transfer, and Transport of Municipal Solid Waste (9 hours)

Collection systems: methods (curbside, block, community bins), equipment, and vehicles, Transfer and transport: transfer stations, transportation logistics, and route optimization, On-site handling and storage: segregation practices, storage containers, and design considerations.

Module 4: Processing and Disposal Methods (9 hours)

Site selection criteria; Processing techniques: mechanical (shredding, compaction), biological (composting, anaerobic digestion), thermal (incineration, pyrolysis), Resource recovery: material recovery facilities and energy recovery technologies, Disposal methods: landfills (site selection, design, operation, closure), leachate and gas management.

Module 5: Special Wastes and Emerging Issues (9 hours)

Hazardous waste management: definition, classification, treatment, and disposal methods, TSDF facility; Site selection criteria; Biomedical waste management: categories, handling protocols; bar code system for effective management of bio-medical waste, treatment, and disposal regulations, electronic waste management: sources, recycling, and disposal challenges, Recent trends and technologies: circular economy concepts, advances in waste processing, policy developments for sustainability.

Text books:

1. Handbook of Solid Waste Management, 2nd Edition, George Tchobanoglous and Frank Kreith, McGraw-Hill Education, 2002.
2. Introduction to Waste Management: A Textbook, Syed E. Hasan, Wiley, 2018.

3. Solid Waste Technology & Management, George Tchobanoglous, McGraw-Hill Education, 2011.
4. Waste Management: A Reference Handbook, Robert L. France, ABC-CLIO, 2011.

Reference books:

1. Environmental Pollution Control Engineering, S.K. Garg, Khanna Publishers, 2015.
2. Solid Waste Management, S.K. Garg, Khanna Publishers, 2015.
3. Elements of Environmental Engineering, Duggal K.N., S. Chand and Co. Ltd., 2014.
4. Environmental Engineering, B.C. Punmia, A.K. Jain, and A. Jain, Laxmi Publications, 2014.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Topic	No. of Lecture/ Tutorial Hours
1	Module 1	9 hours
1.1	Overview of solid waste management: definition, scope, and historical development,	3
1.2	Legislation and regulations: national and international policies, Municipal Solid Waste Management Rules	3
1.3	Integrated solid waste management: waste management hierarchy and sustainable practices	3
2	Module 2	9 hours
2.1	Sources of solid waste: residential, commercial, industrial, institutional, and agricultural	2
2.2	Types of solid waste: biodegradable, recyclable, inert, hazardous, and electronic waste	2
2.3	Physical and chemical characteristics: composition analysis, moisture content, density, calorific value.	3
2.4	Waste generation rates: factors influencing generation and estimation methods	3

3	Module 3	9 hours
3.1	Collection systems: methods (curbside, block, community bins), equipment, and vehicles,	3
3.2	Transfer and transport: transfer stations, transportation logistics, and route optimization	3
3.3	On-site handling and storage: segregation practices, storage containers, and design considerations	3
4	Module 4	9 hours
4.1	Processing techniques: mechanical (shredding, compaction), biological (composting, anaerobic digestion), thermal (incineration, pyrolysis),	3
4.2	Resource recovery: material recovery facilities and energy recovery technologies,	3
4.3	Disposal methods: landfills (site selection, design, operation, closure), leachate and gas management.	3
5	Module 5	9 hours
5.1	Hazardous waste management: classification, treatment, and disposal methods,	2
5.2	Biomedical waste management: categories, handling protocols, treatment, and disposal regulation.	2
5.3	Electronic waste management: sources, recycling, and disposal challenges,	2
5.4	Recent trends and technologies: circular economy concepts, advances in waste processing, policy developments	3
Total Hours		45 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1): To Identify scope and regulations of solid waste management

1. What are the historical roots of solid waste management, and how has it evolved over time?

2. What national policies and regulations govern solid waste management in your country?
3. How does solid waste management impact public health, the environment, and the economy?

Course Outcome 2 (CO 2): To Identify and explain the different types of solid waste and to ensure effective and scientific management of municipal solid waste.

1. What are the benefits and challenges of implementing integrated solid waste management systems?
2. How can sanitary waste management be integrated with other waste management systems?
3. How do physical and chemical characteristics influence waste management decisions?

Course Outcome 3 (CO 3):

1. What are the considerations for choosing a waste collection method, and how do they impact waste management operations?
2. How do collection vehicles contribute to greenhouse gas emissions, and what alternatives are available?
3. What technologies can be used to optimize transportation logistics and reduce costs?

Course Outcome 4 (CO 4):

1. What types of waste are suitable for anaerobic digestion, and what are the benefits of anaerobic digestion?
2. How does incineration affect the environmental impacts of waste, and what are the challenges associated with incineration?
3. What are the advantages and disadvantages of each processing technique, and how do they apply to different types of waste?

Course Outcome 5 (CO 5):

1. What are the different types of hazardous waste, and how are they managed?
2. What are the potential health impacts of hazardous waste, and how can they be prevented?
3. What are the proper procedures for handling and storing biomedical waste?

MODEL QUESTION PAPER

QP CODE:

Pages: 3

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

FOURTH SEMESTER B. TECH DEGREE EXAMINATION, MONTH YEAR

Course Code: B24CEM42

Course Name: SOLID WASTE MANAGEMENT

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. What sustainable practices can be adopted to reduce waste generation, increase recycling, and promote environmentally friendly waste disposal?
2. What is the purpose of a transfer station in waste management, and how does it operate?
3. How do route optimization algorithms work, and what data do they require?
4. How does shredding affect the physical characteristics of waste, and what are the benefits of shredding?
5. What are the proper procedures for handling and storing hazardous waste?
6. How is moisture content measured, and what is its impact on waste management?
7. How do route optimization algorithms work, and what data do they require?
8. What are the benefits of route optimization, and how can they be measured?
9. What national policies and regulations govern solid waste management in your country?
10. How do these policies and regulations address issues like waste generation, disposal, and recycling?

PART B

Answer any one question from each module. Each question carries 14 marks.

11. a) What are the responsibilities of local governments, waste generators, and other stakeholders under these rules? (7 marks)
b) What role can education, awareness, and community engagement play in promoting sustainable waste management practices? (7 marks)

OR

12. a) What sustainable practices can be adopted to reduce waste generation, increase recycling, and promote environmentally friendly waste disposal? (7 marks)
b) What is solid waste management, and what are its primary objectives? (7 marks)
13. a) How do transportation routes and schedules impact waste collection and disposal operations? (7 marks)
b) How do collection vehicles contribute to greenhouse gas emissions, and what alternatives are available? (7 marks)

OR

14. a) What is the purpose of a transfer station in waste management, and how does it operate? (7 marks)
b) What is block collection, and how is it used in urban areas? (7 marks)
15. a) What design considerations should be taken into account when planning on-site waste handling. (7 marks)
b) What safety features should be considered when designing or selecting waste collection equipment and vehicles? (7 marks)

OR

16. a) What are the key considerations for transportation logistics in waste management, and how do they impact costs and efficiency? (7 marks)
b) How can waste handling and storage facilities be designed to minimize environmental impacts and maximize efficiency? (7 marks)
17. a) How does composting affect the environmental impacts of waste, and what are the challenges associated with composting. (7 marks)
b) How does pyrolysis affect the environmental impacts of waste, and what are the challenges associated with pyrolysis. (7 marks)

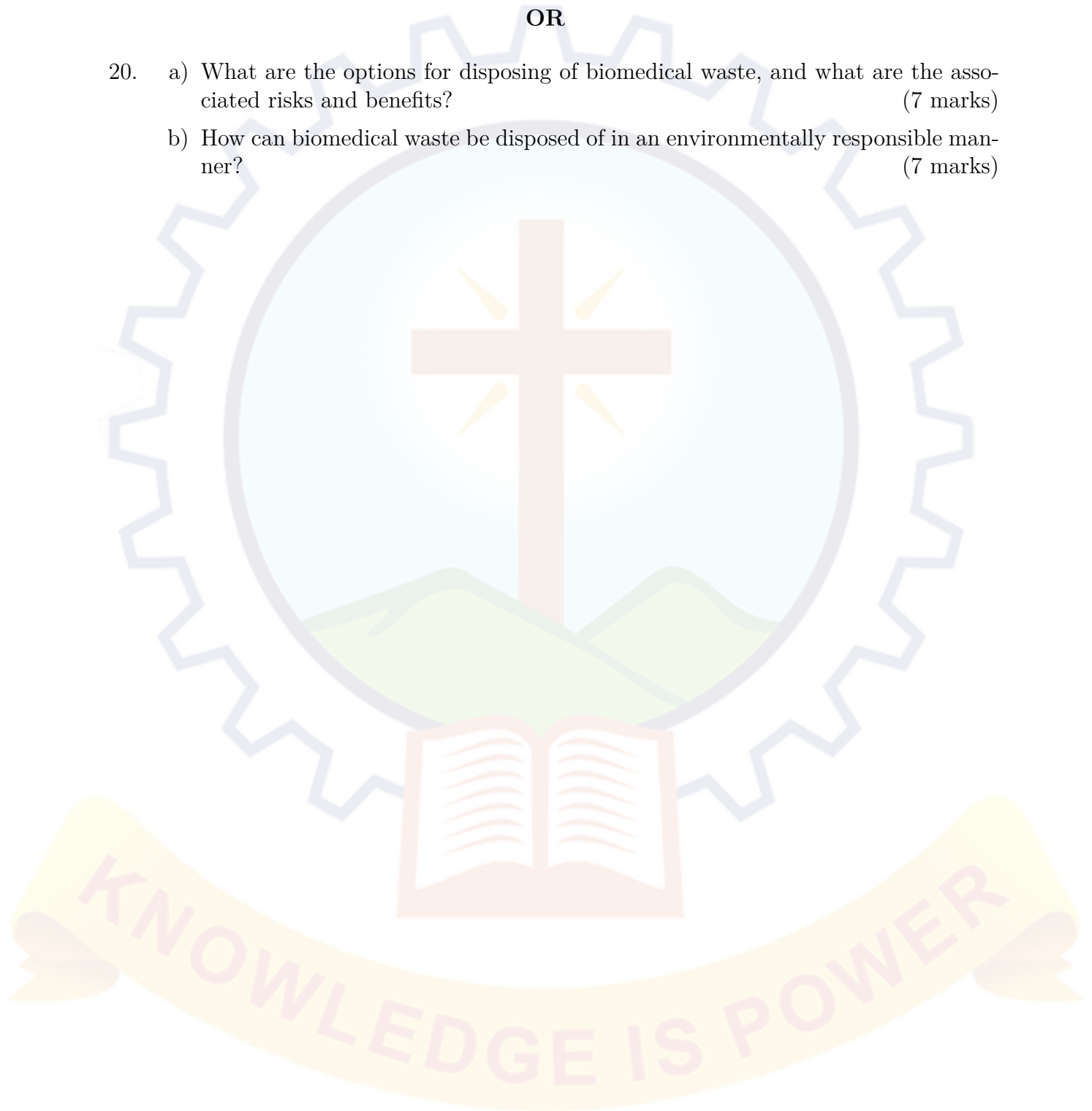
OR

18. a) How do mechanical, biological, and thermal processing techniques compare in terms of efficiency, cost, and environmental impacts? (7 marks)
b) What are the advantages and disadvantages of each processing technique, and how do they apply to different types of waste? (7 marks)

19. a) What are the common sources of hazardous waste generation, and how can they be minimized. (7 marks)
b) What are the proper procedures for handling and storing hazardous waste? (7 marks)

OR

20. a) What are the options for disposing of biomedical waste, and what are the associated risks and benefits? (7 marks)
b) How can biomedical waste be disposed of in an environmentally responsible manner? (7 marks)



CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CEM43	LAND USE AND URBAN PLANNING	3	1	0	5	4	2024

Preamble

This course provides a comprehensive introduction to land use and urban planning, emphasizing its role in shaping sustainable and livable cities. Students will explore the historical evolution of urban planning, and the foundational elements of urban design. The course also addresses critical issues such as urban growth, sprawl, and sustainability, with a focus on smart cities and green development. Legal frameworks, urban policies, and future challenges—including climate change and technological integration—are examined to prepare students for real-world planning scenarios in the Indian urban context.

Prerequisites: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Understand the fundamentals of urban planning and land use and Identify the challenges and goals of urban planning with a focus on sustainability. (Cognitive Knowledge Level: Understand)
CO 2	Understand the principles and practices of land use classification and zoning and gain knowledge of the regulatory and legal frameworks for zoning. (Cognitive Knowledge Level: Understand)
CO 3	Learn the principles and practices of urban design and understand the importance of infrastructure planning and its connection to urban development. (Cognitive Knowledge Level: Understand)
CO 4	Understand the factors that drive urban growth and their implications on land use and planning and Analyze the challenges of urban sprawl and discuss strategies to manage it. (Cognitive Knowledge Level: Understand)
CO 5	Understand the key urban planning policies and laws in India and gain insights into the legal and regulatory frameworks for urban planning. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	0	0	0	0	0	2	0	0	1	0	0
CO 2	0	0	0	0	0	2	0	0	1	0	0
CO 3	0	0	0	0	0	3	0	0	1	0	0
CO 4	0	0	0	0	0	2	0	0	1	0	0
CO 5	0	0	0	0	0	2	0	0	1	0	0

Assessment Pattern

Land Use and Urban Planning			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (% Marks)
	Test 1 (% Marks)	Test 2 (% Marks)	
Remember	40	40	40
Understand	50	50	50
Apply	10	10	10
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course Project : 10 marks

Self Study : 5 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contain 10 questions carrying 3 marks each. Part B contains 2 questions from each module out of which 1 to be answered. Each question carries 14 mark and can have maximum 2 sub - divisions.

SYLLABUS

MODULE 1 (9 hours)

Introduction to Land Use and Urban Planning : Definition of land use and urban planning, Historical evolution of urban planning, Importance of land use in urban development, Objectives of urban planning, Relationship between urban planning and sustainable development. Introduction to smart urban planning, Role of IoT and AI in modern urban planning.

MODULE 2 (9 hours)

Land Use Classification and Zoning : Land Use Classification, Importance of land use classification in urban planning, Case studies of land use patterns in Indian cities, Zoning Concepts and Types, Zoning regulations and their significance in urban planning, Challenges in Land Use and Zoning. Introduction to use of GIS and AI in Land use mapping and zoning.

MODULE 3 (9 hours)

Urban Design and Infrastructure Planning: Elements of urban design, The importance of aesthetics, functionality, and safety in urban design, The role of infrastructure in urban planning, Planning for transportation and mobility, Infrastructure challenges in urban areas, especially in Indian cities, Key principles of sustainable urban design, Case studies on sustainable urban design practices in India, Role of urban design in reducing environmental impacts of urbanization. AI in urban Infrastructure Management.

MODULE 4 (9 hours)

Urban Growth, Sprawl, and Sustainability: Factors Influencing Urban Growth, The role of urban policies and economic development in urban growth, Regional growth and the interaction between rural and urban areas, Urban sprawl and its causes and effects, Strategies for controlling sprawl, Planning for sustainable urban growth: Smart cities and green buildings, The role of urban planners in ensuring environmental sustainability, Case studies on sustainable urban development in India.

MODULE 5 (9 hours)

Urban Planning Policies, Legal Framework, and Future Challenges: Urban Planning Policies in India, The role of the National Urban Transport Policy, Master Plans, and Smart Cities Mission, Policies for affordable housing and urban renewal, Legal Framework in Urban Planning: The Town and Country Planning Acts:, The role of legal regulations in urban development, Future Challenges in Urban Planning, The future of smart cities and technological integration in urban planning. Ethical considerations and data privacy in smart urban planning.

Text Books:

1. P.K. Jain, "Urban Planning and Development", Vol I, CBS Publishers & Distributors Pvt. Ltd
2. S.P. Vyas, "Town Planning in India", Vol II, M/s Scientific Publishers
3. N.C.K.S.R.K. Rao, "Urban Land Use Planning", Vol II, CBS Publishers
4. C.S.V. Murthy, "Principles of Urban and Regional Planning", Revised Edition, CBS Publishers
5. R.K. Mishra, "Urban Planning and Development: Theory and Practice", Vol I, Atlantic Publishers
6. A.S. Rao, "Sustainable Development in Urban Planning", Vol I, Concept Publishing Company

Reference Books:

1. Ashok Kumar, Sanjeev Vidyarthi, and Poonam Prakash, "City Planning in India" (2021), Routledge India
2. S.K. Kulshrestha, "Urban and Regional Planning in India": A Handbook for Professional Practice (2012), SAGE Publications
3. Sameer Sharma, "A Textbook of Urban Planning and Geography", (2020), PHI Learning Pvt. Ltd.
4. Vidyadhar K. Phatak, "Planning for India's Urbanisation", (2024), CEPT University Press

COURSE CONTENTS AND LECTURE SCHEDULE

No	Topic	No. of Lecture/ Tutorial Hours
1	Module 1	9 hours
1.1	Introduction to Urban Planning: Definition, scope, and importance of urban planning, Overview of urban planning principles and concepts, Historical development of urban planning	2
1.2	Urbanization and Land Use :Growth of cities and the role of urban planning in managing land use, Urbanization trends in India and globally, The impact of urbanization on land use patterns	2

1.3	The Role of Urban Planning :Objectives of urban planning: Housing, transportation, infrastructure, and community development, The role of urban planning in shaping social, economic, and environmental outcomes.	2
1.4	Urban Planning and Sustainable Development: Relationship between urban planning and sustainability, Role of planners in promoting sustainable urban growth, Challenges in urban planning in India, focusing on sustainability issues. Introduction to smart urban planning, Role of AI and IoT in modern urban planning.	3
2	Module 2	9 hours
2.1	Land Use Classification : Different types of land use: Residential, commercial, industrial, recreational, and agricultural, Importance of land use classification in urban planning, Case studies of land use patterns in Indian cities.	3
2.2	Zoning Concepts and Types: Zoning regulations and their significance in urban planning, Different types of zoning: Residential, commercial, industrial, and mixed-use zones, Zoning ordinances and their role in controlling land use.	3
2.3	Challenges in Land Use and Zoning:Issues faced in land use planning: Land acquisition, land tenure, informal settlements, Challenges of implementing zoning regulations in rapidly growing cities. Introduction to use of AI and GIS in land use mapping and zoning.	3
3	Module 3	9 hours
3.1	Principles of Urban Design: The role of urban design in shaping cities, Elements of urban design: Street patterns, open spaces, and public spaces, The importance of aesthetics, functionality, and safety in urban design	3
3.2	Infrastructure Planning in Urban Areas : The role of infrastructure in urban planning: Roads, water supply, sanitation, and electricity, Planning for transportation and mobility: Public transport, road networks, and pedestrian pathways, Infrastructure challenges in urban areas, especially in Indian cities	3

3.3	Sustainable Urban Design: Key principles of sustainable urban design: Green spaces, energy-efficient buildings, and eco-friendly transport systems, Case studies on sustainable urban design practices in India, Role of urban design in reducing environmental impacts of urbanization. AI in urban infrastructure management.	3
4	Module 4	9 hours
4.1	Factors Influencing Urban Growth: Population growth, migration, and economic factors, The role of urban policies and economic development in urban growth, Regional growth and the interaction between rural and urban areas	3
4.2	Urban Sprawl: The concept of urban sprawl and its causes, Environmental, economic, and social consequences of urban sprawl, Strategies for controlling sprawl: Compact cities, transit-oriented development	3
4.3	Sustainable Urban Growth: Planning for sustainable urban growth: Smart cities and green buildings, The role of urban planners in ensuring environmental sustainability, Case studies on sustainable urban development in India.	3
5	Module 5	9 hours
5.1	Urban Planning Policies in India: Key urban planning policies and their evolution in India, The role of the National Urban Transport Policy, Master Plans, and Smart Cities Mission, Policies for affordable housing and urban renewal.	3
5.2	Legal Framework in Urban Planning: The Town and Country Planning Acts: Overview and impact on land use and urban planning, The role of legal regulations in urban development: Zoning laws, land acquisition, and property rights, Issues related to land tenure and informal settlements.	3
5.3	Future Challenges in Urban Planning: The impact of climate change, population pressure, and technological advancements on urban planning, The future of smart cities and technological integration in urban planning, Addressing issues like affordable housing, pollution, and inclusive urban development., Ethical considerations and Data privacy in smart urban planning.	3
Total Hours		45 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO1):

1. Compare traditional and modern urban planning principles with examples.
2. Explain how planning theories have evolved to suit contemporary urban issues.
3. Discuss how urban planning influences socio-economic outcomes.

Course Outcome 2 (CO2):

1. Define zoning ordinance and explain its purpose.
2. Differentiate between residential and industrial land uses in terms of infrastructure requirements.
3. How does mixed-use zoning differ from traditional single-use zoning?

Course Outcome 3 (CO3):

1. How should planners integrate utilities and services into urban planning from the start?
2. What is the significance of open and public spaces in urban environments?
3. Explain how sustainable urban design can be integrated into land use planning.

Course Outcome 4 (CO4):

1. Discuss the economic and social impacts of urban sprawl on infrastructure and community life.
2. Explain features of smart city and discuss how they contribute to sustainable urban living
3. Define the main drivers of urban growth. How do population growth and migration contribute to urban expansion?

Course Outcome 5 (CO5):

1. Explain the objectives and impact of the National Urban Transport Policy (NUTP).
2. Describe the role and structure of Master Plans in Indian cities
3. Discuss the urban planning challenges posed by informal settlements and slum development

MODEL QUESTION PAPER

QP CODE:

Pages: 2

Reg.No.:

Name:

**MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM**

FOURTH SEMESTER B. TECH DEGREE EXAMINATION, MONTH YEAR

Course Code: B24CEM43

Course Name: LAND USE AND URBAN PLANNING

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks

1. Define urban planning and explain its significance in modern urban development.
2. Explain the role of land use in urban planning with relevant examples.
3. What is zoning, and how does it influence urban planning?
4. Describe different land use classifications in urban areas and their significance.
5. Discuss the core principles of urban design and their role in shaping cities.
6. How does infrastructure planning contribute to the success of urban planning?
7. What are the key factors contributing to urban growth in India? Discuss their implications.
8. Explain the concept of urban sprawl and its negative effects on cities.
9. Explain the role of legal frameworks in urban planning.
10. How can smart city initiatives address urban planning challenges in India?

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE - 1

11. How does urban planning contribute to sustainability in urban development? Discuss its importance.

OR

12. Explain the historical evolution of urban planning with reference to major cities in India.

MODULE - 2

13. Explain the concept of mixed-use zoning and its advantages.

OR

14. How does land use classification affect urban infrastructure development?

MODULE - 3

15. Explain the concept of sustainable urban design. Provide examples from Indian cities.

OR

16. How do urban design and infrastructure planning influence economic activities in cities?

MODULE - 4

17. What is sustainable urban growth? How can it be achieved in Indian cities?

OR

18. Discuss strategies for managing urban growth and reducing urban sprawl in Indian cities.

MODULE - 5

19. Discuss the major urban planning policies in India. How have they impacted urban development?

OR

20. What are the future challenges in urban planning in India? Discuss how planners can address these challenges.

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CEH41	STRUCTURAL FORMS AND MATERIALS	3	1	0	5	4	2024

Preamble

This course introduces the fundamental structural forms and explores the behavior and efficiency of various structural systems. It examines the mechanical and physical properties of traditional and modern building materials including concrete, steel, timber, and composites.

Prerequisites: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Understand different structural forms and explain their behavior in terms of force distribution and structural efficiency. (Cognitive Knowledge Level- Understand)
CO 2	Understand the various mechanical and thermal properties. Understand the properties, types, and mix design of concrete as a structural material. (Cognitive Knowledge Level- Understand)
CO 3	Analyze the mechanical properties and types of structural steel, and assess the behavior and design considerations of steel structural systems. (Cognitive Knowledge Level- Analyze)
CO 4	Analyze the mechanical properties and structural behavior of timber, and understand its joinery techniques, durability, and maintenance strategies. (Cognitive Knowledge Level- Analyze)
CO 5	Understand the structural behavior of composite materials, and the characteristics of advanced construction materials such as high-performance concrete, self-healing concrete and smart materials (Cognitive Knowledge Level- Understand)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	1	1	0	0	0	1	0	0	0	2	1
CO 2	1	2	2	0	0	2	0	0	2	2	1
CO 3	1	2	2	0	0	2	0	0	2	2	1
CO 4	1	2	1	0	0	2	0	0	2	2	1
CO 5	1	1	2	0	0	2	0	0	0	2	1

Assessment Pattern

Structural Forms And Materials			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (Marks)
	Test 1 (Marks)	Test 2 (Marks)	
Remember			
Understand	50	40	50
Apply	30	40	30
Analyse	20	20	20
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course Project : 10 marks

Self Study : 5 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contain 10 questions carrying 3 marks each. Part B contains 2 questions from each module out of which only 1 to be answered. Each question carries 14 mark and can have maximum 2 sub- divisions.

SYLLABUS

MODULE 1 (9 hours)

Overview of Structural Forms: Definition and classification of structural forms - Types of structures: Frames, slabs, arches, shells and membranes. Force distribution in different structural forms: Beam, frame, arch, and shell - Structural efficiency: Strength-to-weight ratio, stiffness, and stability.

MODULE 2 (9 hours)

Building Materials: Mechanical Properties of Materials: Stress, strain, and their relationship - Tensile, compressive, shear, and bending stresses - Creep and fatigue behavior in materials - Modulus of elasticity, Poisson's ratio and thermal properties.

Concrete as a Structural Material: Basic properties – Mix design and factors affecting concrete quality – Concrete in reinforced and prestressed forms. Types of Concrete- Durability and degradation of concrete. Applications of concrete in structural systems.

MODULE 3 (9 hours)

Steel as a Structural Material: Properties of steel: Yield strength, tensile strength, and ductility, stiffness and fatigue behavior of steel – Types of steel: Carbon steel, alloy steel, stainless steel and high strength steel.

Steel Structural System: Structural shapes – I beams, channels, angles, hollow sections, and plates. Connections and joining techniques (bolted, welded, reveted) – Steel columns, beams, frames, and trusses. Design considerations for steel structures – buckling, torsional buckling, and stability of steel members.

MODULE 4 (9 hours)

Timber as a Structural Material: Properties of Timber – Mechanical properties of wood: Strength, modulus of elasticity, and moisture content - Timber's anisotropic nature and behavior under loads.

Timber Structural Systems: Beams, trusses, columns, and frames in timber structures – Joinery techniques and connections (nailing, bolting, gluing) - Glulam and laminated veneer lumber (LVL). Durability and Maintenance of Timber Structures - Timber decay, insect attack, and moisture content management - Treatment methods for timber.

MODULE 5 (9 hours)

Composites Materials: Introduction to composites in structural systems - Types of composites - uses and behaviour in structural systems - Applications of composites in strengthening and retrofitting structures.

Advanced Materials in Modern Construction -High-performance concrete (HPC), self-healing concrete, Smart materials.

Textbooks:

1. Allen Edward, Iano Joseph “Fundamentals of Building Construction: Materials and Methods”, John Wiley & Sons Inc, Seventh Edition 2019
2. Misra, Anil Kumar “Building Materials and Construction”, S. Chand Publishing, 2018
3. Ram S Gupta “ Principles of Structural Design – Wood, Steel, and Concrete”, Taylor and Francis Group, Second Edition 2014
4. S S Bhavikatti “Building Materials”, Vikas Publishing House 2012

COURSE CONTENTS AND LECTURE SCHEDULE

No	Topic	No. of Lecture/ Tutorial Hours
1	Module 1	9 hours
1.1	Overview of Structural Forms: Definition and classification of structural forms	2
1.2	Types of structures: Frames, slabs, arches, shells and membranes	2
1.3	Force distribution in different structural forms: Beam, frame, arch, and shell	3
1.4	Structural efficiency: Strength-to-weight ratio, stiffness, and stability	2
2	Module 2	9 hours
2.1	Building Materials: Mechanical Properties of Materials: Stress, strain, and their relationship -Tensile, compressive, shear, and bending stresses	1
2.2	Creep and fatigue behavior in materials	1
2.3	Modulus of elasticity, Poisson's ratio and thermal properties	2
2.4	Concrete as a Structural Material: Basic properties – Mix design and factors affecting concrete quality	2

2.5	Concrete in reinforced and prestressed forms. Types of Concrete- Durability and degradation of concrete.	2
2.6	Applications of concrete in structural systems	1
3	Module 3	9 hours
3.1	Steel as a Structural Material: Properties of steel: Yield strength, tensile strength, and ductility, stiffness and fatigue behavior of steel	2
3.2	Types of steel: Carbon steel, alloy steel, stainless steel and high strength steel.	2
3.3	Steel Structural System: Structural shapes – I beams, channels, angles, hollow sections, and plates.	1
3.4	Connections and joining techniques (bolted, welded, riveted) – Steel columns, beams, frames, and trusses.	2
3.5	Design considerations for steel structures – buckling, torsional buckling, and stability of steel members – Fire resistance of steel.	2
4	Module 4	9 hours
4.1	Timber as a Structural Material: Properties of Timber – Mechanical properties of wood: Strength, modulus of elasticity, and moisture content	1
4.2	Timber's anisotropic nature and behavior under loads.	2
4.3	Timber Structural Systems: Beams, trusses, columns, and frames in timber structures	2
4.4	Joinery techniques and connections (nailing, bolting, gluing) - Glulam and laminated veneer lumber (LVL).	2
4.5	Durability and Maintenance of Timber Structures - Timber decay, insect attack, and moisture content management - Treatment methods for timber	2
5	Module 5	9 hours
5.1	Composites Materials: Introduction to composites in structural systems - Types of composites-uses and behaviour in structural systems	3

5.2	Applications of composites in strengthening and retrofitting structures	3
5.3	Advanced Materials in Modern Construction -High-performance concrete (HPC), self-healing concrete and Smart materials.	3
Total Hours		45 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO1):

1. Classify the structural forms based on their structural efficiency.
2. Describe the behavior of membrane structures under load.
3. Explain the force distribution in an arch and slab.

Course Outcome 2 (CO2):

1. Discuss the influence of thermal properties in the selection of materials for modern commercial buildings.
2. What are the key factors that influence the quality of concrete?
3. Discuss the importance of durability in concrete used for marine or coastal structures.

Course Outcome 3 (CO3):

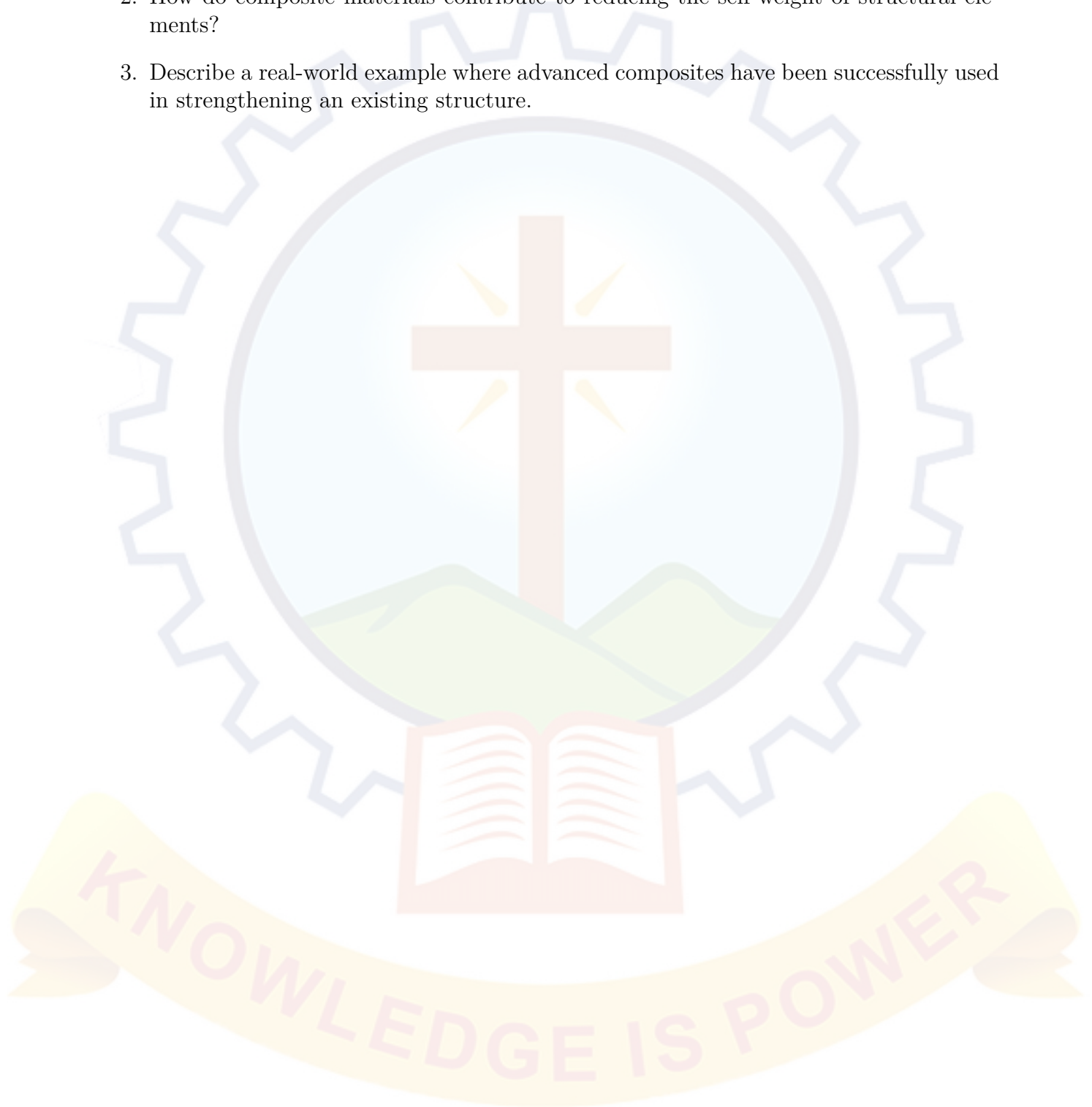
1. Why is ductility an important property in structural steel applications?
2. How does fatigue behavior influence the design of steel bridges?
3. Compare different types of steel based on their suitability for structural applications.

Course Outcome 4 (CO4):

1. Compare and contrast different timber joinery and connection techniques.
2. Analyze the mechanical behavior and structural applications of timber, considering its anisotropic nature and moisture sensitivity.
3. Propose methods to improve the durability of timber used in outdoor construction.

Course Outcome 5 (CO5):

1. Explain the commonly used types of composite materials in structural engineering.
2. How do composite materials contribute to reducing the self-weight of structural elements?
3. Describe a real-world example where advanced composites have been successfully used in strengthening an existing structure.



MODEL QUESTION PAPER

QP CODE:

Pages: 2

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

FOURTH SEMESTER B. TECH DEGREE EXAMINATION, MONTH YEAR

Course Code: B24CEH41

Course Name: STRUCTURAL FORMS AND MATERIALS

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks

1. Explain the importance of the strength-to-weight ratio in structural efficiency.
2. Define and classify structural forms with examples.
3. How does the structural behavior of a shell differ from that of a frame?
4. Explain the importance of the strength-to-weight ratio in structures? Give one practical implication.
5. What are the major factors affecting concrete mix quality?
6. Explain the significance of buckling in steel design.
7. Compare bolted and welded connections in steel structures.
8. Explain the anisotropic behavior of timber and its impact on structural design.
9. Describe two joinery techniques used in timber structures.
10. Define composite materials and give two examples used in structures.

PART B

Answer any one question from each module. Each question carries 14 marks

11. (a) Discuss various types of structural forms used in buildings.
(b) Explain how force is distributed in frames, arches, and shells.

OR

12. (a) Explain the criteria for evaluating the structural efficiency of a system.
(b) Compare strength-to-weight ratio and stiffness among beam, arch, and shell.
13. Compare reinforced and prestressed concrete systems with suitable diagrams. Mention their advantages and limitations.

OR

14. Explain the stress-strain behavior in concrete. How are creep and fatigue relevant in its long-term material performance?
15. Explain the design considerations for steel structures, including buckling, torsional buckling, and member stability.

OR

16. Compare different types of connections used in steel construction with neat sketches.
17. Discuss the causes of timber degradation and explain the treatment methods to improve durability.

OR

18. Explain the mechanical properties of timber and describe how its anisotropic nature affects design.
19. Write a detailed note on the role of composites in retrofitting and strengthening existing structures with examples.

OR

20. Explain the role of smart materials in adaptive and responsive structures.

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CEH42	NON DESTRUCTIVE TESTING	3	1	0	5	4	2024

Preamble

This course explores various Non Destructive Testing (NDT) methods, their principles, and applications that enhance modern engineering diagnostics. By integrating theoretical foundations with practical applications, students will develop expertise in using NDT techniques to evaluate civil engineering materials, detect defects, and ensure compliance with design standards.

Prerequisites: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Understand the principles, significance, and advantages of NDT in civil engineering, differentiating it from destructive testing methods (Cognitive knowledge level: Understand).
CO 2	Apply their knowledge to detect surface and subsurface defects in civil engineering materials (Cognitive knowledge level: Apply).
CO 3	Assess structural integrity with the help of various NDT techniques, ensuring safe and reliable construction practices (Cognitive knowledge level: Apply).
CO 4	Apply advanced NDT methods, to assess subsurface and material integrity in civil engineering structures (Cognitive knowledge level: Apply).
CO 5	Analyse real-world applications and case studies of NDT techniques while ensuring compliance with industry standards and codes (Cognitive knowledge level: Apply).

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	1	3	0	3	0	1	0	0	0	0	0
CO 2	2	3	0	3	2	1	0	0	0	0	0
CO 3	2	3	0	3	2	1	0	0	0	0	0
CO 4	2	3	0	3	2	1	0	0	0	0	1
CO 5	3	3	0	3	3	1	0	0	3	3	1

Assessment Pattern

Non Destructive Testing			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	20	20	20
Understand	40	40	40
Apply	40	40	40
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course Project : 10 marks

Self Study : 5 marks

End Semester Examination Pattern

There will be two parts: Part A and Part B. Part A contain 10 questions, with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module, of which students should answer any one. Each question carries 14 marks and can have a maximum of 2 sub-divisions.

SYLLABUS

MODULE 1: Introduction to Non-Destructive Testing (9 hours)

Overview of NDT: Definition, importance, and applications in civil engineering. Comparison with Destructive Testing: Advantages and limitations, Principles of NDT: Fundamental concepts and mechanics, Commonly Tested Materials: Concrete, steel, composites, and other civil engineering materials.

MODULE 2: Surface and Subsurface Inspection Techniques (9 hours)

Visual Inspection - Types of Distress and Identification, Visual Testing (VT): Methods, tools, and applications for detecting visible surface defects., Liquid Penetrant Testing (LPT): Techniques, steps, and applications for detecting surface cracks, Magnetic Particle Testing (MPT): Principles, equipment, and applications for ferromagnetic materials. Rebound hammer testing - Methods, correlation with compressive strength, calibration. Applications in Civil Engineering: Case studies of surface inspection in bridges, pavements, and structures.

MODULE 3: Ultrasonic Testing (UT) and Radiographic Testing (RT) (9 hours)

Ultrasonic Testing: Working principle (use of high-frequency sound waves), Types (pulse-echo, through-transmission). Applications in structural integrity assessment. Radiographic Testing : Principles (X-ray and gamma-ray techniques). Safety considerations, Applications for internal defect detection in large components.

MODULE 4: Electromagnetic and Advanced NDT Techniques (9 hours)

Ground Penetrating Radar (GPR): Principles, equipment, and applications in subsurface assessment, Eddy Current Testing (ECT): Working principles and use in identifying defects in conductive materials, Infrared Thermography: Techniques for thermal imaging and moisture detection, Emerging Technologies: Digital twins, AI-based inspection, and other innovations in civil engineering NDT.

MODULE 5: Practical Applications, Case Studies, and Standards (9 hours)

Field Applications: Real-life applications in inspecting various civil engineering structures, Case Studies: Analysis of NDT techniques used in major construction or failure investigations, Standards and Codes: Overview of codes used for NDT testing, Hands-on Training: Laboratory exercises and fieldwork using NDT equipment.

Text Books:

1. P. H. Emmons, Concrete Repair and Maintenance Illustrated. R.S. Means Company Inc, 2002.
2. C. Hellier, Handbook of Non-destructive Evaluation, 3rd ed. Mc-Graw Hill Education, 2020.

Reference Books:

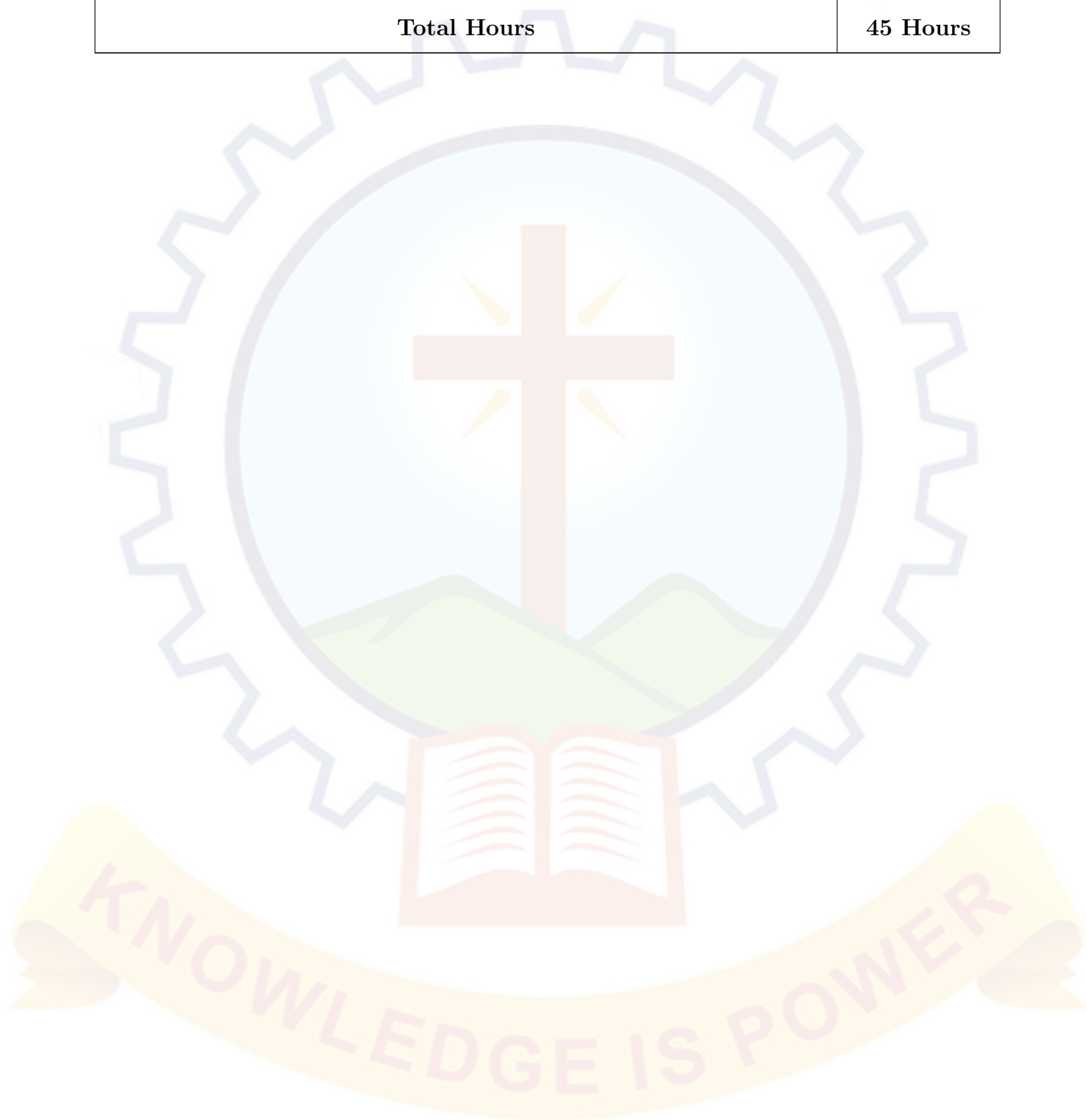
1. C. Maierhofer, H. Reinhardt, and G. Dobmann, Non-destructive Evaluation of Reinforced Concrete Structures: Volume 1: Deterioration Processes and Standard Test Methods. Woodhead Publishing, 2010.
2. Baldev Raj, T. Jayakumar, M. Thavasimuthu, "Practical Non-Destructive Testing", Narosa Publishing, London, 2012.
3. Paul E. Mix, "Introduction to Non Destructive Testing", A Training Guide, Wiley-Interscience, New Jersey, USA, June 2005.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Topic	No. of Lecture/ Tutorial Hours
1	Module 1	9 hours
1.1	Overview of NDT: Definition, importance, and applications in civil engineering.	2
1.2	Comparison with Destructive Testing: Advantages and limitations	1
1.3	Principles of NDT: Fundamental concepts and mechanics	3
1.4	Commonly Tested Materials: Concrete, steel, composites, and other civil engineering materials.	3
2	Module 2	9 hours
2.1	Visual Inspection - Types of Distress and Identification, and structures.	2
2.2	Visual Testing (VT): Methods, tools, and applications for detecting visible surface defects.	2
2.3	Liquid Penetrant Testing (LPT): Techniques, steps, and applications for detecting surface cracks	1

2.4	Magnetic Particle Testing (MPT): Principles, equipment, and applications for ferromagnetic materials. Rebound hammer testing - Methods, correlation with compressive strength, calibration.	2
2.5	Applications in Civil Engineering: Case studies of surface inspection in bridges, pavements	2
3	Module 3	9 hours
3.1	Ultrasonic Testing: Working principle (use of high-frequency sound waves), Types (pulse echo, through-transmission).	2
3.2	Applications in structural integrity assessment.	2
3.3	Radiographic Testing: Principles (X-ray and gamma-ray techniques).	2
3.4	Safety considerations, Applications for internal defect detection in large components.	3
4	Module 4	9 hours
4.1	Ground Penetrating Radar (GPR): Principles, equipment, and applications in subsurface assessment.	2
4.2	Eddy Current Testing (ECT): Working principles and use in identifying defects in conductive materials	2
4.3	Infrared Thermography: Techniques for thermal imaging and moisture detection.	2
4.4	Emerging Technologies: Digital twins, AI-based inspection, and other innovations in civil engineering NDT.	3
5	Module 5	9 hours
5.1	Field Applications: Real-life applications in inspecting various civil engineering structures	3
5.2	Case Studies: Analysis of NDT techniques used in major construction or failure investigations	2
5.3	Standards and Codes: Overview of codes used for NDT testing	2

5.4	Hands-on Training:Laboratory exercises and fieldwork using NDT equipment.	2
Total Hours		45 Hours



MODEL QUESTION PAPER

QP CODE:

Pages: 2

Reg.No.:

Name:

**MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM**

FOURTH SEMESTER B. TECH DEGREE EXAMINATION, MONTH YEAR

Course Code: B24CEH42

Course Name: NON DESTRUCTIVE TESTING

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks

1. Define Non-Destructive Testing (NDT) and mention two of its advantages over Destructive Testing.
2. List four materials commonly tested using NDT in civil engineering.
3. What are the basic steps involved in Liquid Penetrant Testing (LPT)?
4. Mention two applications of Magnetic Particle Testing (MPT) in civil engineering structures.
5. Differentiate between pulse-echo and through-transmission techniques in Ultrasonic Testing.
6. List two safety precautions that must be taken while performing Radiographic Testing.
7. State two applications of Ground Penetrating Radar (GPR) in civil engineering.
8. What is Eddy Current Testing and which materials is it most suitable for?
9. Mention two international standards used in Non-Destructive Testing.
10. Give an example of a civil engineering failure that was investigated using NDT

PART B

Answer any one question from each module. Each question carries 14 marks

11. Explain the differences between Destructive Testing and Non-Destructive Testing. Discuss the advantages and limitations of NDT in detail.

OR

12. Describe the principles of NDT and explain how it is applied to assess the integrity of civil engineering materials like concrete and steel.
13. Explain in detail the working principle, procedure, and applications of Visual Testing (VT) and Liquid Penetrant Testing (LPT).

OR

14. Describe Magnetic Particle Testing (MPT) and its significance in detecting subsurface flaws. Support your answer with examples from civil engineering structures like bridges or pavements.
15. Discuss the principle and methodology of Ultrasonic Testing. How is it applied to assess the structural integrity of civil engineering components?

OR

16. Explain Radiographic Testing with the help of diagrams. Discuss its principle, advantages, safety considerations, and applications in large civil components.
17. Explain the working principles and applications of Ground Penetrating Radar (GPR), Eddy Current Testing (ECT), and Infrared Thermography.

OR

18. Discuss emerging technologies in NDT such as digital twins and AI-based inspections. How are these technologies transforming the inspection of civil infrastructure?
19. Describe the real-life field applications of NDT techniques in civil engineering. Include case studies of bridges, dams, or buildings.

OR

20. Discuss the importance of standards and codes in NDT. Explain how hands-on training with NDT equipment supports better understanding and implementation of testing procedures.

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CEH43	CLIMATE CHANGE AND SUSTAINABILITY	3	1	0	5	4	2024

Preamble

This course introduces students to the fundamental concepts of climate, the factors influencing it, and the science behind climate change. It emphasizes the critical link between climate change and sustainability, aiming to build a strong foundation for understanding global environmental challenges. Through this course, students will explore the real-world impacts of climate change and examine effective adaptation and mitigation strategies.

Prerequisites: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Explain the fundamental concepts of climate and its influencing factors(Cognitive Knowledge Level: Understand)
CO 2	Explain the factors affecting climate change and the harmful impacts due to climate change (Cognitive Knowledge Level: Understand)
CO 3	Discuss the problems due to urbanization and the need for sustainable development (Cognitive Knowledge Level:Apply)
CO 4	Demonstrate the various adaptation and mitigation techniques for combating climate change (Cognitive Knowledge Level:Understand)
CO 5	Discuss multilateral agreements on climate change, Case studies on Climate change(Cognitive Knowledge Level:Understand)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	2	0	1	0	0	3	1	0	0	0	3
CO 2	2	2	1	2	0	3	1	0	0	0	3
CO 3	2	2	1	2	0	3	1	0	0	0	3
CO 4	2	0	1	0	0	3	1	0	0	0	3
CO 5	2	0	1	0	0	3	1	0	0	0	3

Assessment Pattern

Climate Change And Sustainability			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (% Marks)
	Test 1 (% Marks)	Test 2 (% Marks)	
Remember	40	40	40
Understand	40	40	40
Apply	20	20	20
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course Project : 10 marks

Self Study : 5 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contains 10 questions carrying 3 marks each. Part B contains 2 questions from each module out of which any one is to be answered. Each question carries 14 marks and can have maximum 2 sub-divisions.

SYLLABUS

MODULE 1 (9 hours)

Climate: Climate and weather, Meteorology and climatology, Composition and structure of atmosphere. Factors influencing climate-Insolation, Temperature, Humidity, Pressure, Wind, Precipitation, Topography. Atmospheric stability, Lapse rate, Inversions, Types of inversions. Cyclones and Anticyclones.

MODULE 2 (9 hours)

Climate change: Climate change, anthropogenic drivers of climate change, Global warming, Green house effect, Air pollution, carbon foot print, Impact of climate change on water cycle, agriculture, forest, water resources, urban areas, biodiversity, human health. Carbon sequestration, vulnerability index.

MODULE 3 (9 hours)

Urbanisation and Industrialization, Urbanisation, problems of urbanisation, Urban sprawl, Urban heat islands, causes, mitigation measures. Urban flooding, water conservation and ecological aspects. Urban Planning, Zoning of Land Use

Pillars of Sustainable development, Sustainability indicators, Life cycle analysis, Material flow analysis, Green energy, Waste management, 3R concepts, Sustainable cities, Sustainable Urbanisation.

MODULE 4 (9 hours)

Adaptation and mitigation strategies: Green Engineering, Design for Engineering, Green technologies, Circular economy. Planning of cities as climate resilient, Climate change and infrastructure planning, Climate resilient infrastructure, nature based solutions in disaster management, adaptation strategies for combating climate change

MODULE 5 (9 hours)

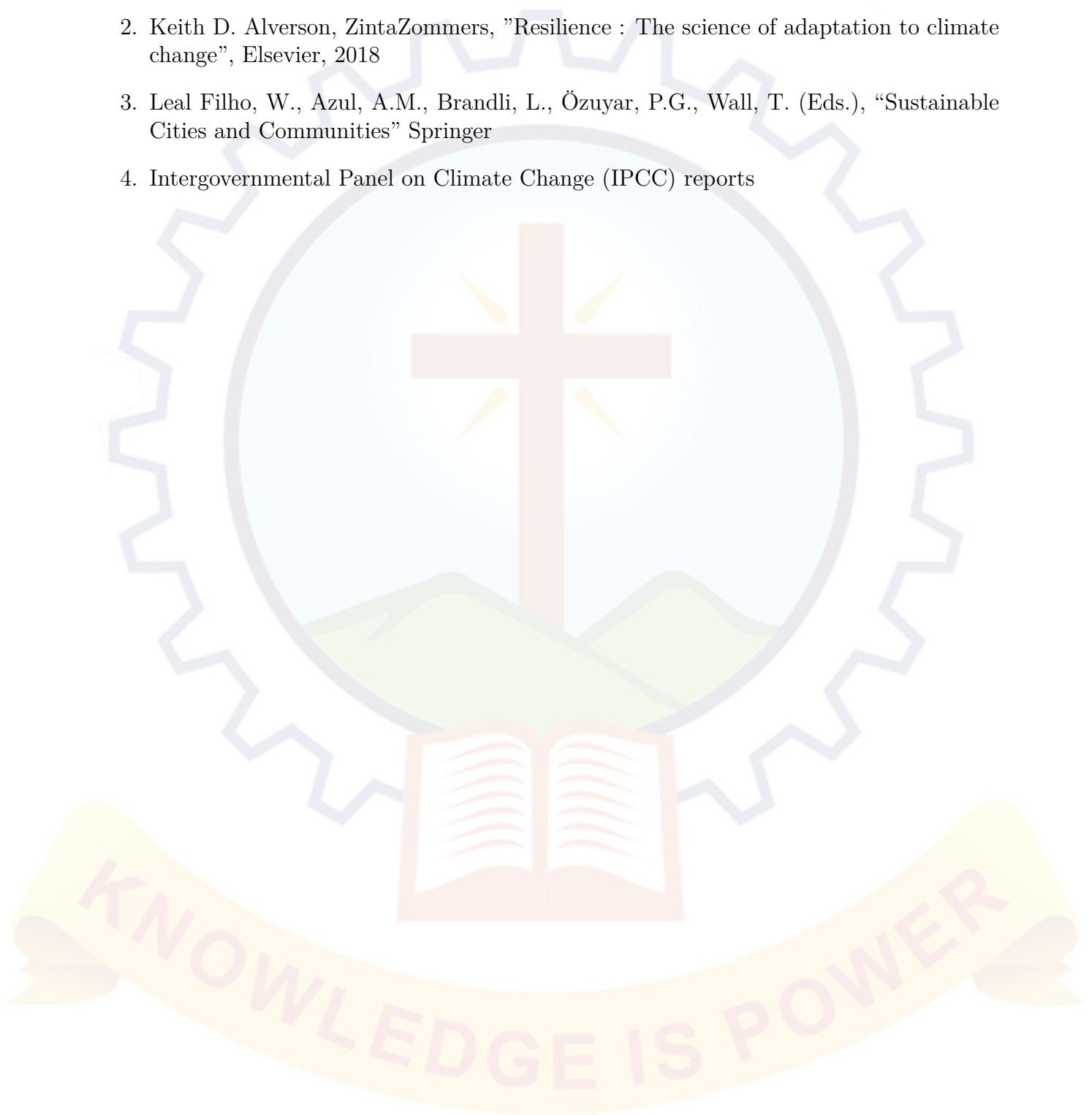
Climate and sustainability: Sustainability Engineering, Kyoto mechanisms to reduce GHG emission- Clean Development Mechanism, Joint Implementation, Emission trading, Case studies on Kyoto mechanism, Case studies on climate change and climate change risk reduction.

Text Books

1. Lal, DS, "Climatology", Published by Sharda Pustak Bhawan, ISBN8186204121
2. John T. Hardy, Jean Ponce, "Climate Change - Causes, Effects, and Solutions", Wiley Publications, 2003
3. Jonathan Tomkin, Tom Theis, "Sustainability - A Comprehensive Foundation", 12th Media Services, 2018

Reference Books

1. Karthik Karuppu, "Green Building Guidance: The Ultimate Guide for IGBC Accredited Professional Examination Book", NVICO Notion Press, 2019
2. Keith D. Alverson, ZintaZommers, "Resilience : The science of adaptation to climate change", Elsevier, 2018
3. Leal Filho, W., Azul, A.M., Brandli, L., Özuyar, P.G., Wall, T. (Eds.), "Sustainable Cities and Communities" Springer
4. Intergovernmental Panel on Climate Change (IPCC) reports



CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CEH44	CONSTRUCTION SCHEDULING AND PLANNING	3	1	0	5	4	2024

Preamble

This course offers students an in-depth understanding of construction scheduling techniques, project lifecycle stages, and advanced tools for monitoring progress and minimizing risks. The knowledge gained will enable students to tackle real-world challenges in the construction industry.

Prerequisites: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Understand the importance of construction planning and scheduling to identify key phases of a construction project. (Cognitive Level: Understand)
CO 2	Utilize the Critical Path Method (CPM) and Program Evaluation and Review Technique (PERT) for effective project scheduling. (Cognitive Level: Understand)
CO 3	Analyze resource allocation techniques and implement cost-time trade-off strategies to optimize project efficiency. (Cognitive Level: Apply)
CO 4	Apply scheduling tools like Gantt charts and network diagrams to monitor and manage project progress effectively. (Cognitive Level: Apply)
CO 5	Identify potential risks in construction scheduling and develop mitigation strategies using Lean construction principles. (Cognitive Level: Understand)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	1	3	2	1	2	0	1	0	0	0
CO 2	2	1	3	2	1	2	0	0	0	1	0
CO 3	2	1	3	2	1	2	0	0	0	0	0
CO 4	2	1	3	2	1	2	1	0	1	0	2
CO 5	3	1	3	2	1	2	0	1	0	0	0

Assessment Pattern

Construction Scheduling And Planning			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (% Marks)
	Test 1 (% Marks)	Test 2 (% Marks)	
Remember	20	20	20
Understand	50	50	50
Apply	30	30	30
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course Project : 10 marks

Self Study : 5 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contain 10 questions carrying 3 marks each. Part B contains 2 questions from each module out of which 1 to be answered. Each question carries 14 marks and can have a maximum of 2 sub - divisions.

SYLLABUS

MODULE 1 (9 hours)

Importance of Construction Planning and Scheduling, Need for effective scheduling in construction projects, Overview of project management in construction, Construction Project Lifecycle, Phases of a construction project (planning, design, procurement, construction, commissioning), Basic Concepts in Project Management, Project scope, objectives, and constraints (time, cost, quality), Types of Construction Projects-Residential, commercial, industrial, and infrastructure projects.

MODULE 2 (9 hours)

Critical Path Method (CPM), Introduction to CPM and its application in construction scheduling, Steps involved in CPM: Activity listing, sequencing, duration estimation, network diagram, critical path determination, Program Evaluation and Review Technique (PERT), Differences between PERT and CPM, Use of PERT for uncertain project durations, Float and Slack Time-Calculation and significance of float in scheduling.

MODULE 3 (9 hours)

Resource Planning in Construction Projects, Types of resources: Labor, materials, equipment., Resource levelling and resource smoothing techniques, Cost and Time Trade-offs, Managing cost vs. schedule balance, Techniques to optimize resources without delaying the project, Project Crashing, Definition and use of project crashing techniques to reduce project duration, Construction Project Constraints, Identifying and handling constraints related to resources, time, and budget.

MODULE 4 (9 hours)

Overview of commonly used construction scheduling tools, Activity scheduling, resource allocation, and cost estimation, Generating Gantt charts, network diagrams, and resource histograms, Scheduling and Monitoring Progress, Techniques for tracking project progress, Updating schedules in response to delays or changes, Real-time Project Management.

MODULE 5 (9 hours)

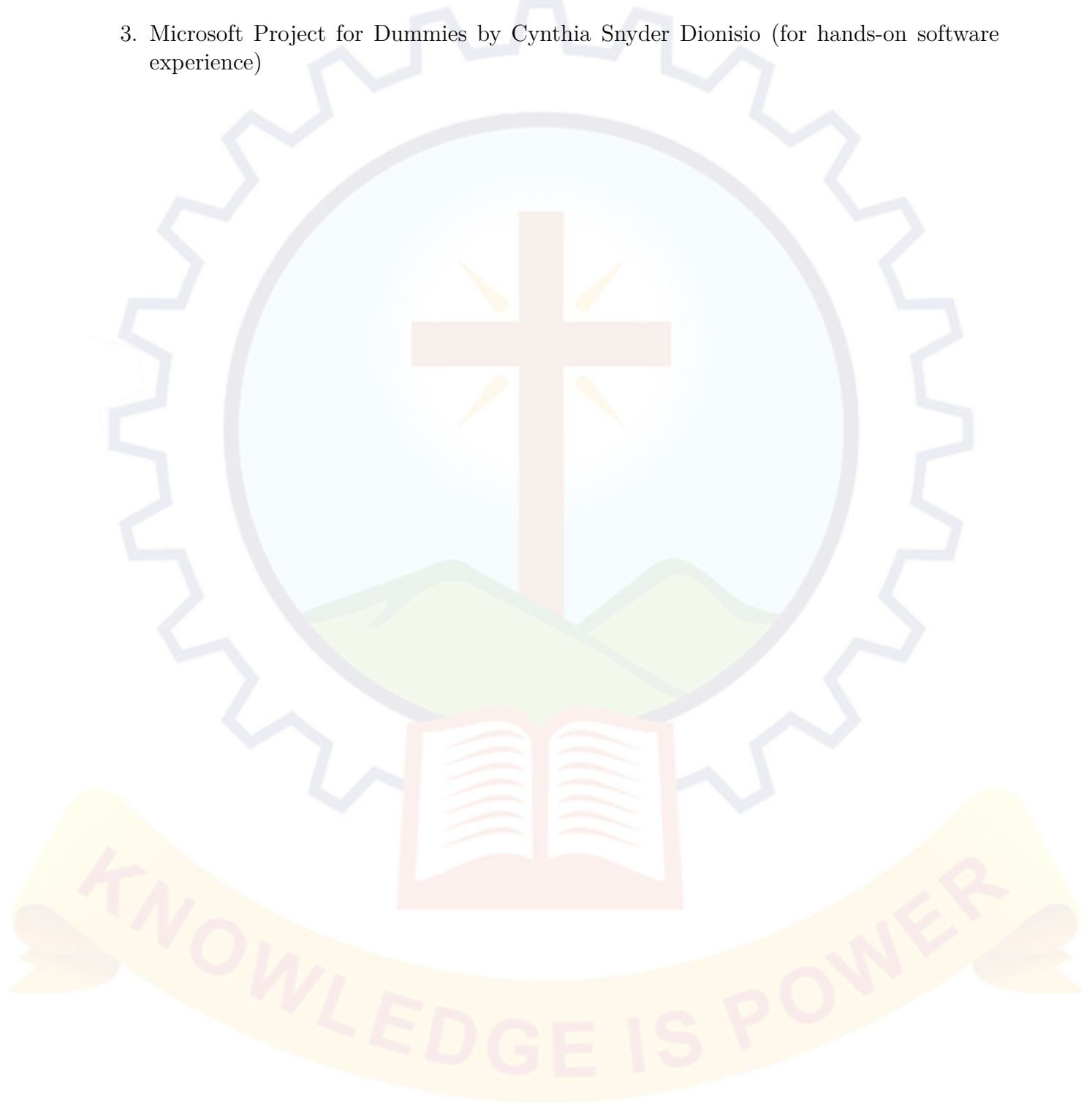
Risk Management in Construction Scheduling, identifying potential risks and their impact on the schedule, Techniques for mitigating scheduling risks, Lean Construction and Scheduling, Introduction to Lean principles in construction scheduling, Applying Lean concepts to reduce waste and optimize time, Contractor's Schedule vs. Owner's Schedule, Differences between contractor schedules and owner schedules, Managing the relationship and communication between stakeholders regarding schedules.

Text Books:

1. Project Management for Construction by Chris Hendrickson
2. Construction Scheduling: Principles and Practices by Jay S. Newell

Reference Books:

1. Project Management in Construction by Anthony Walker
2. Construction Project Management by Erik W. Howell and James J. P. Paulson
3. Microsoft Project for Dummies by Cynthia Snyder Dionisio (for hands-on software experience)



MODEL QUESTION PAPER

QP CODE:

Pages: 2

Reg.No.:

Name:

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

FOURTH SEMESTER B. TECH DEGREE EXAMINATION, MONTH YEAR

Course Code: B24CEH44

Course Name: CONSTRUCTION SCHEDULING AND PLANNING

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks

1. Explain the importance of construction planning and scheduling in the context of project management.
2. What are the key phases of a construction project lifecycle, and how does planning contribute to each phase?
3. What are the key types of resources in construction projects, and why is effective resource planning essential?
4. Explain the concept of project crashing and how it helps reduce project duration.
5. What is the significance of Gantt charts in construction scheduling, and how do they help track project progress?
6. List and briefly describe two commonly used construction scheduling tools and their features.
7. What are the primary techniques used in Lean Construction to optimize scheduling and reduce waste?
8. Define risk management in construction scheduling and discuss its significance.
9. Define the Critical Path Method (CPM) and explain its importance in construction scheduling.
10. How does float/slack time affect the overall project schedule in CPM?

PART B

Answer any one question from each module. Each question carries 14 marks

11. Discuss the role of effective scheduling in construction projects, addressing how it influences the project's time, cost, and quality. Provide examples of real-world projects where scheduling played a pivotal role.

OR

12. Describe the various types of construction projects (residential, commercial, industrial, and infrastructure) and explain how the scheduling needs and approaches differ across these types of projects.
13. Compare and contrast the Critical Path Method (CPM) and Program Evaluation and Review Technique (PERT). Discuss the advantages and disadvantages of each method in the context of construction scheduling.

OR

14. Explain the steps involved in CPM (activity listing, sequencing, duration estimation, network diagram, critical path determination) and apply these steps to a hypothetical construction project. Discuss how delays in non-critical activities affect project completion.
15. Discuss resource levelling and resource smoothing techniques. Explain how each technique is applied to minimize delays without increasing project costs.

OR

16. In a construction project, how can the balance between cost and time be optimized? Describe the strategies used to handle resource constraints and avoid project delays.
17. Explain the importance of real-time project management in construction scheduling. Discuss how real-time updates to the schedule can impact project outcomes.

OR

18. Describe how scheduling software tools assist in activity scheduling, resource allocation, and cost estimation. Discuss how such tools can help in managing delays and tracking progress in large construction projects.
19. Explain the process of identifying and mitigating risks in construction scheduling. Discuss various risks (e.g., delays, resource shortages, weather) and their potential impact on the project timeline.

OR

20. Discuss the differences between a contractor's schedule and an owner's schedule. Explain the importance of managing communication between contractors and owners to ensure successful project completion.

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CEH45	PUBLIC TRANSPORT SYSTEMS	3	1	0	5	4	2024

Preamble

Public transport systems are vital for urban mobility, providing efficient, affordable, and sustainable transportation. This course provides essential knowledge of public transport systems, focusing on efficiency, sustainability, and accessibility. Students learn transit planning, demand estimation, network design, and ITS, gaining skills to enhance operations. It also explores public transport's role in reducing congestion, supporting sustainability, and driving economic growth, preparing students for urban mobility planning.

Prerequisites: NIL

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Explain the role of public transport, its evolution, and the safety concerns associated with different transit modes. (Cognitive Level: Understand)
CO 2	Identify and describe the methods used for predicting transit usage and evaluating network accessibility. (Cognitive Level: Understand)
CO 3	Explain the data collection process, including manual data collection techniques and survey design for transit planning. (Cognitive Level: Understand)
CO 4	Analyze transit network planning, vehicle and crew scheduling, and fare structuring to improve operational efficiency. (Cognitive Level: Analyze)
CO 5	Analyze the impact of public transport systems on urban development, land use, environmental sustainability, and policy frameworks. (Cognitive Level: Analyze)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	2	0	0	0	3	0	0	0	0	1
CO 2	3	3	2	2	0	2	0	0	1	0	2
CO 3	3	3	2	2	0	0	0	0	1	1	2
CO 4	3	3	3	3	2	2	0	0	2	1	2
CO 5	3	3	2	2	3	3	2	2	3	0	3

Assessment Pattern

Public Transport Systems			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	20	20	20
Understand	30	30	30
Apply	30	30	30
Analyse	20	20	20
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course Project : 10 marks

Self Study : 5 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contain 10 questions carrying 3 marks each. Part B contains 2 questions from each module out of which 1 to be answered. Each question carries 14 mark and can have maximum 2 sub- divisions.

SYLLABUS

MODULE 1 (9 hours)

Introduction to Public Transport Systems and Transit Modes: Issues, safety, role of transit, evolution of urban transportation, Public transport travel characteristics, Modes of public transport and comparison - Modes; bus & coaches, Train (Commuter, intercity and high speed rail), tram and light rail, Rapid transit, personal rapid transit, cable-propelled transit, Ferry, Auto-Rickshaws, paratransit system, Feeder services—choice of transit technology

MODULE 2 (9 hours)

Transit Demand and Network Evaluation: Prediction of transit usage - Evaluation of network, accessibility considerations, estimating demand in transit planning studies, demand. Characteristics of transit travel riders, attitudes, modal splits special group of users, passenger load factor.

MODULE 3 (9 hours)

Data Collection and Survey Techniques for Transit Planning: Data Collection Program Design Process, Data Needs, Manual Data Collection Techniques, Sampling, Special Considerations for Surveying

MODULE 4 (9 hours)

Transit Network Planning and Operations : Transit Network Planning, Vehicle scheduling, Transit Network Planning, crew scheduling, Fare structure, Demand response to fare changes, Fare technology

MODULE 5 (9 hours)

Emerging Trends and Policy in Public Transport: Operational capability during disaster (introduction only), ITS in transit, Transit Oriented Development Impact on development, land use thereby, urban form, environmental impact, energy policy regulations, future policies, policy issues, public private partnership (PPP), Transit signal priority, integrated public transport planning

Textbooks:

1. Ceder, A., Public Transit Planning and Operation: Theory, Modeling and Practice, CRC Press, 2016.
2. Vuchic, V. R., Urban Transit: Systems and Technology, John Wiley & Sons, 2007.
3. Black, A., Urban Mass Transportation Planning, McGraw-Hill, 1995.
4. Kittelson & Associates, Transit Capacity and Quality of Service Manual, 3rd Edition, Transportation Research Board, 2013.
5. White, P., Public Transport: Its Planning, Management and Operation, Routledge, 2016.

Reference:

1. Vuchic, V. R., Transit Operations and Planning, John Wiley & Sons, 2005.
2. Gubbins, E. J., Managing Transport Operations, Kogan Page, 2003.
3. Gray, G. E., and Hoel, L. A., Public Transportation, Prentice Hall, 1992.
4. Meyer, M. and Miller, E., Urban Transportation Planning: A Decision-Oriented Approach, McGraw-Hill, 2001.
5. Currie, G., New Perspectives and Methods in Transport and Social Exclusion Research, Emerald Group Publishing, 2011.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Topic	No. of Lecture/ Tutorial Hours
1	Module 1	9 hours
1.1	Importance of public transport and role in urban mobility	2
1.2	Safety concerns and measures in different transit modes	2
1.3	Evolution of urban transportation and major developments	2
1.4	Overview of public transport modes and comparisons	3
2	Module 2	9 hours
2.1	Methods for predicting transit usage and network evaluation	3
2.2	Factors influencing transit demand and modal split	2
2.3	Passenger load factor and special user groups	2
2.4	Accessibility considerations and transit service quality	2
3	Module 3	9 hours
3.1	Data needs and collection methods in transit planning	2
3.2	Manual data collection techniques and survey design	2

3.3	Sampling methods and considerations in data collection	3
3.4	Case studies on data collection and analysis	2
4	Module 4	9 hours
4.1	Fundamentals of transit network planning and scheduling	3
4.2	Crew scheduling and fare structuring strategies	2
4.3	Demand response to fare changes and fare technology	2
4.4	Service reliability, performance indicators, and optimization	2
5	Module 5	9 hours
5.1	Role of ITS in public transport and its applications	3
5.2	Transit-oriented development (TOD) and land use impact	2
5.3	Public-private partnerships (PPP) in transit planning	2
5.4	Integrated transport planning and future policy trends	2
Total Hours		45 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Explain the evolution of urban transportation and its impact on public mobility.
2. Compare different public transport modes based on efficiency, capacity, and sustainability.
3. Discuss major safety concerns in public transport and suggest strategies to enhance passenger safety.

Course Outcome 2 (CO 2):

1. Explain how transit demand estimation is conducted in transport planning studies.
2. Discuss the factors influencing public transport ridership, including accessibility and user attitudes.
3. Analyze the role of passenger load factors in determining transit service efficiency.

Course Outcome 3 (CO 3):

1. Describe various data collection methods used in transit planning and their applications.
2. Explain the significance of sampling techniques in public transport surveys.
3. Discuss the challenges and special considerations involved in conducting transit surveys.

Course Outcome 4 (CO 4):

1. Analyze the key factors involved in designing an efficient transit network.
2. Explain the process of vehicle and crew scheduling in public transport operations.
3. Discuss the impact of fare policies on ridership and transit revenue.

Course Outcome 5 (CO 5):

1. Explain the role of Intelligent Transportation Systems (ITS) in improving public transport efficiency.
2. Analyze how Transit-Oriented Development (TOD) influences urban growth and land use.
3. Discuss the role of public-private partnerships (PPP) in enhancing public transport infrastructure.

MODEL QUESTION PAPER

QP CODE:

Pages: 2

Reg.No.:

Name:

**MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM**

FOURTH SEMESTER B. TECH DEGREE EXAMINATION, MONTH YEAR

Course Code: B24CEH45

Course Name: PUBLIC TRANSPORT SYSTEMS

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Explain the role of public transport in urban mobility.
2. What are the key characteristics of public transport travel demand?
3. What are the major factors influencing transit ridership?
4. Define modal split and its significance in transit planning.
5. What are the major challenges in collecting transit-related data?
6. Explain the importance of sampling in public transport surveys.
7. What are the key objectives of transit network planning?
8. Describe the role of fare structuring in public transport.
9. How does public transport contribute to environmental sustainability?
10. Discuss the significance of public-private partnerships (PPP) in transit planning.

PART B

Answer any one question from each module. Each question carries 14 marks.

11. a) Explain the evolution of urban transportation and its impact on modern public transit. (7 marks)
b) Discuss the advantages and limitations of various public transport modes. (7 marks)

OR

12. a) Compare and contrast different types of rail-based transit systems. (7 marks)
b) Discuss the role of feeder services in enhancing public transport accessibility. (7 marks)
13. a) Explain different methods used to predict transit demand. (7 marks)
b) Discuss the role of accessibility considerations in transit planning. (7 marks)

OR

14. a) Analyze the impact of passenger load factor on transit service efficiency. (7 marks)
b) Explain how rider attitudes influence modal choice in public transport. (7 marks)
15. a) Describe various manual data collection techniques used in transit planning. (7 marks)
b) Explain the challenges in conducting transit surveys and ensuring data accuracy. (7 marks)

OR

16. a) Discuss special considerations in designing surveys for public transport studies. (7 marks)
b) What are the key factors in ensuring effective sampling for transit data collection? (7 marks)
17. a) Explain the key principles of transit network planning. (7 marks)
b) Discuss how vehicle and crew scheduling affects transit efficiency. (7 marks)

OR

18. a) Describe the impact of fare structuring on ridership and revenue generation. (7 marks)
b) Analyze how public transport demand responds to fare changes. (7 marks)
19. a) How can public transport systems enhance operational capability during disasters? (7 marks)
b) Discuss the significance of transit signal priority in urban mobility. (7 marks)

OR

20. a) Explain the role of Intelligent Transportation Systems (ITS) in improving public transport operations. (7 marks)
b) Discuss key policy challenges in implementing integrated public transport planning. (7 marks)

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CEH46	REINFORCED SOIL AND GEOSYNTHETICS	3	1	0	5	4	2024

Preamble

This subject introduces the principles, materials, and applications of reinforced soil and geosynthetics in geotechnical engineering. It emphasizes design methods, performance evaluation, and practical applications, preparing students to apply innovative and sustainable solutions for soil stabilization, containment, and earth structure reinforcement.

Prerequisites: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Remember the types, functions, and basic principles of reinforced soil and geosynthetics used in geotechnical engineering. (Cognitive Level: Remember)
CO 2	Understand the properties, functions, and design considerations of geotextiles and geogrids in soil stabilization and reinforcement. (Cognitive Level: Understand)
CO 3	Apply design principles for geomembranes and geonets in containment and drainage systems based on material properties and site requirements. (Cognitive Level: Apply)
CO 4	Understand and analyze the design and construction of reinforced soil structures such as slopes, retaining walls, and foundations. (Cognitive Level : Understand)
CO 5	Apply knowledge of seismic behaviour, innovations, and practical applications of geosynthetics in real-world geotechnical projects. (Cognitive Level: Understand)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	1	0	1	1	0	0	0	1	0	1
CO 2	3	2	1	2	2	0	0	1	1	1	1
CO 3	3	2	3	2	2	1	0	1	1	1	2
CO 4	3	3	3	2	2	1	0	1	2	1	2
CO 5	3	2	2	2	3	2	1	2	2	2	2

Assessment Pattern

Reinforced Soil And Geosynthetics			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (% Marks)
	Test 1 (% Marks)	Test 2 (% Marks)	
Remember	40	20	30
Understand	40	40	40
Apply	20	40	30
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course Project : 10 marks

Self Study : 5 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contain 10 questions carrying 3 marks each. Part B contains 2 questions from each module out of which 1 to be answered. Each question carries 14 mark and can have maximum 2 sub- divisions.

SYLLABUS

MODULE 1 (9 hours)

Overview of Reinforced Soil: Definition and principles of reinforced soil, Types of reinforcement materials (geotextiles, geogrids, fibers), Applications and advantages of reinforced soil in construction

Introduction to Geosynthetics: Types of geosynthetics (geotextiles, geogrids, geomembranes, geonets), Functions and applications of geosynthetics in geotechnical engineering, Properties and selection criteria for geosynthetic materials.

Soil-Reinforcement Interaction: Mechanisms of interaction between soil and reinforcement, Factors affecting soil-reinforcement behavior, Design considerations for reinforced soil structures

MODULE 2 (9 hours)

Geotextiles: Types of geotextiles (woven, non-woven, knitted), Properties of geotextiles (filtering, drainage, separation), Design and applications of geotextiles in soil stabilization and erosion control

Geogrids: Types of geogrids (uniaxial, biaxial, triaxial), Properties of geogrids (tensile strength, stiffness), Applications of geogrids in soil reinforcement, retaining walls, and embankments

Design Considerations: Methods for determining the required properties of geotextiles and geogrids, Design guidelines for incorporating geosynthetics into soil structures, Quality control and performance evaluation of geosynthetics

MODULE 3 (9 hours)

Geomembranes: Types of geomembranes (HDPE, LLDPE, PVC, EPDM), Properties and applications (containment, waterproofing, liners), Installation techniques and performance testing

Geonets: Types of geonets and their properties, Applications in drainage systems and landfill liners, Design considerations for integrating geonets into geotechnical systems

Design and Performance: Design methods for geomembranes in containment and environmental applications, Assessment of geonets for drainage and filtration, Case studies and performance evaluation

MODULE 4 (9 hours)

Reinforced Soil Slopes and Embankments: Design principles for reinforced soil slopes and embankments, Stability analysis and reinforcement design methods, Case studies of reinforced soil slopes and embankments

Reinforced Soil Retaining Walls: Design and analysis of reinforced soil retaining walls, Types of retaining walls (segmental, wrapped-face, hybrid), Construction techniques and design considerations

Reinforced Soil Foundations: Applications of reinforced soil in foundation design, Load transfer mechanisms and design methods, Case studies of reinforced soil foundations

MODULE 5 (9 hours)

Seismic Design Considerations: Impact of seismic forces on reinforced soil structures, Design strategies for earthquake-resistant reinforced soil systems, Case studies of seismic performance of reinforced soil structures

Innovations in Geosynthetics: Recent advancements in geosynthetic materials and technologies, Emerging applications and trends in geosynthetics, Future directions for research and development in geosynthetics

Case Studies and Practical Applications: Review of real-world projects using reinforced soil and geosynthetics, Lessons learned from failures and successes in geosynthetic applications, Integration of geosynthetics into multidisciplinary engineering projects

Text Books:

1. Rao, S. A. S. Reinforced Soil and Its Engineering Applications. CRC Press, 2008.
2. Chien, L. S. M. Geosynthetics: Fundamentals, Testing, and Applications. CRC Press, 2014.
3. Koerner, R. M. Geosynthetics in Civil Engineering. CRC Press, 2013.

Reference Books:

1. Hegazy, T. Reinforced Soil Structures: Design and Construction. Taylor & Francis. 2014
2. Jones, C. J. F. P. Earth Reinforcement and Soil Structures. Spon Press. 1996
3. Leshchinsky, D. and Hsuan, Y. G. Geosynthetics in Civil Engineering. CRC Press. 2015
4. Berg, R. A., and Boulanger, R. W. Geosynthetics for Soil Improvement. Springer. 2013
5. Sharma, H. D., and R. K. Sharma. Geosynthetics in Civil Engineering. Wiley. 2014
6. Huang, H., and Zhang, L. Reinforced Soil and Geosynthetics. Springer. 2020

COURSE CONTENTS AND LECTURE SCHEDULE

No	Topic	No. of Lecture/ Tutorial Hours
1	Module 1	9 hours
1.1	Overview of Reinforced Soil: Definition and principles of reinforced soil, Types of reinforcement materials (geotextiles, geogrids, fibers), Applications and advantages of reinforced soil in construction.	2
1.2	Introduction to Geosynthetics: Types of geosynthetics (geotextiles, geogrids, geomembranes, geonets), Functions and applications of geosynthetics in geotechnical engineering, Properties and selection criteria for geosynthetic materials.	4
1.3	Soil-Reinforcement Interaction: Mechanisms of interaction between soil and reinforcement, Factors affecting soil-reinforcement behaviour, Design considerations for reinforced soil structures	3
2	Module 2	9 hours
2.1	Geotextiles: Types of geotextiles (woven, non-woven, knitted), Properties of geotextiles (filtering, drainage, separation), Design and applications of geotextiles in soil stabilization and erosion control	2
2.2	Geogrids: Types of geogrids (uniaxial, biaxial, triaxial), Properties of geogrids (tensile strength, stiffness), Applications of geogrids in soil reinforcement, retaining walls, and embankments	3
2.3	Design Considerations: Methods for determining the required properties of geotextiles and geogrids, Design guidelines for incorporating geosynthetics into soil structures, Quality control and performance evaluation of geosynthetics	4

3	Module 3	9 hours
3.1	Geomembranes: Types of geomembranes (HDPE, LLDPE, PVC, EPDM), Properties and applications (containment, waterproofing, liners), Installation techniques and performance testing	2
3.2	Geonets: Types of geonets and their properties, Applications in drainage systems and landfill liners, Design considerations for integrating geonets into geotechnical systems	3
3.3	Design and Performance: Design methods for geomembranes in containment and environmental applications, Assessment of geonets for drainage and filtration, Case studies and performance evaluation	4
4	Module 4	9 hours
4.1	Reinforced Soil Slopes and Embankments: Design principles for reinforced soil slopes and embankments, Stability analysis and reinforcement design methods, Case studies of reinforced soil slopes and embankments	3
4.2	Reinforced Soil Retaining Walls: Design and analysis of reinforced soil retaining walls, Types of retaining walls (segmental, wrapped-face, hybrid), Construction techniques and design considerations	3
4.3	Reinforced Soil Foundations: Applications of reinforced soil in foundation design, Load transfer mechanisms and design methods, Case studies of reinforced soil foundations	3
5	Module 5	9 hours
5.1	Seismic Design Considerations: Impact of seismic forces on reinforced soil structures, Design strategies for earthquake-resistant reinforced soil systems, Case studies of seismic performance of reinforced soil structures	3
5.2	Innovations in Geosynthetics: Recent advancements in geosynthetic materials and technologies, Emerging applications and trends in geosynthetics, Future directions for research and development in geosynthetics	3

5.3	Case Studies and Practical Applications: Review of real-world projects using reinforced soil and geosynthetics, Lessons learned from failures and successes in geosynthetic applications.	3
Total Hours		45 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO1): Remember the types, functions, and basic principles of reinforced soil and geosynthetics.

1. Define reinforced soil and explain its key components.
2. List different types of geosynthetic materials and their primary functions.
3. Describe the advantages of using reinforced soil in construction projects.

Course Outcome 2 (CO2): Understand the properties, functions, and design considerations of geotextiles and geogrids.

1. Explain the differences between woven and non-woven geotextiles.
2. Describe the role of geogrids in improving slope stability.
3. Illustrate how the tensile strength of geogrids influences soil performance.

Course Outcome 3 (CO3): Apply design principles for geomembranes and geonets in containment and drainage systems.

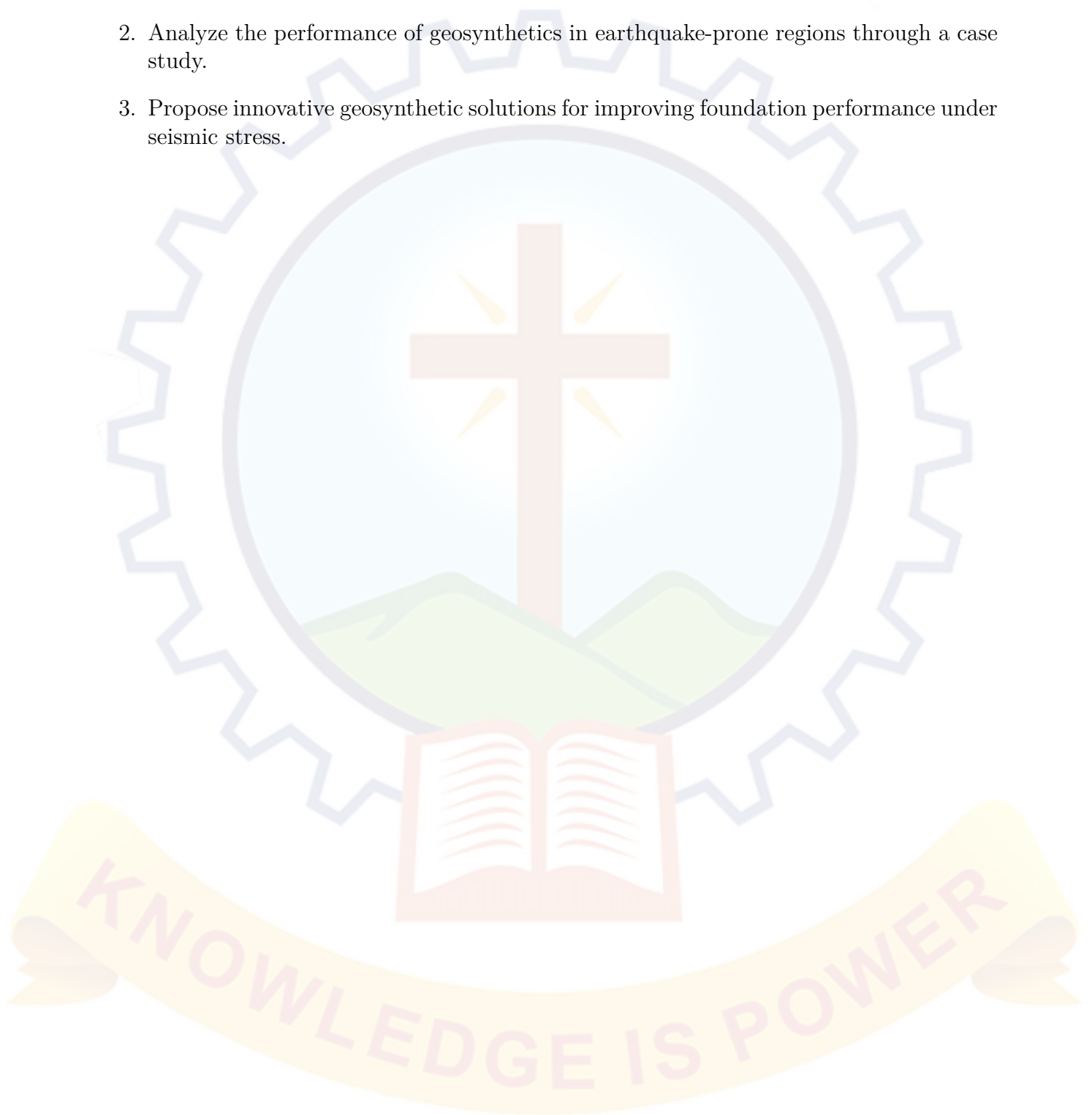
1. Select a suitable geomembrane for a landfill project and justify your choice.
2. Calculate the required thickness of a geomembrane liner based on given site parameters.
3. Apply appropriate design criteria for integrating geonets into a drainage layer.

Course Outcome 4 (CO4): Understand and analyze the design and construction of reinforced soil structures.

1. Explain the reinforcement mechanism in soil-retaining walls.
2. Discuss stability considerations in designing reinforced embankments.
3. Interpret a case study on the failure or success of a reinforced soil slope.

Course Outcome 5 (CO5): Apply knowledge of seismic behaviour, innovations, and practical applications of geosynthetics.

1. Design a reinforced soil retaining wall with considerations for seismic loads.
2. Analyze the performance of geosynthetics in earthquake-prone regions through a case study.
3. Propose innovative geosynthetic solutions for improving foundation performance under seismic stress.



MODEL QUESTION PAPER

QP CODE:

Pages: 3

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

FOURTH SEMESTER B. TECH DEGREE EXAMINATION, MONTH YEAR

Course Code: B24CEH46

Course Name: REINFORCED SOIL AND GEOSYNTHETICS

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks

1. Define reinforced soil and explain the basic principles behind its use in construction.
2. List the different types of reinforcement materials used in reinforced soil and briefly explain the characteristics of geotextiles and geogrids.
3. Explain the three types of geotextiles and briefly describe their primary characteristics.
4. Give any three applications of geogrids in soil reinforcement.
5. Briefly explain any 3 types of geomembranes and their primary characteristics.
6. What are the key applications of geomembranes in containment and waterproofing, and how do they perform as liners?
7. What are the key design principles for reinforced soil slopes and embankments, and how do they contribute to the stability of the structure?
8. List and briefly explain the different types of reinforced soil retaining walls and their applications.
9. Explain the impact of seismic forces on reinforced soil structures and how seismic events can affect their stability and performance.
10. What are the recent advancements in geosynthetic materials and technologies? Briefly describe one emerging application of geosynthetics.

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE - 1

11. (a) Explain the advantages and applications of reinforced soil in construction, including its use in retaining walls, embankments, and slopes. How does reinforced soil improve the stability of these structures?
(b) Describe the mechanisms of interaction between soil and reinforcement. What factors influence the soil-reinforcement behaviour, and how can these be accounted for in the design of reinforced soil structures?
12. (a) What are the key properties and selection criteria for geosynthetic materials in geotechnical engineering? Explain how the selection of geosynthetics impacts the performance of soil-reinforcement systems.
(b) Explain the different types of geosynthetics used in civil engineering, their functions and applications.

MODULE - 2

13. (a) Enumerate the properties of geogrids, including tensile strength and stiffness, and explain how these properties affect the performance of geogrid-based soil reinforcement systems.
(b) Describe the different types of geogrids and explain their respective applications in soil reinforcement stabilization.
14. (a) Explain the design considerations for incorporating geosynthetics, specifically geotextiles and geogrids, into soil structures. What are the methods used for determining the required properties of these materials?
(b) Enumerate the design guidelines for using geosynthetics in soil stabilization and erosion control. How do quality control and performance evaluation ensure the long-term effectiveness of geosynthetics in these applications?

MODULE - 3

15. (a) Describe the different types of geonets and their properties. How are geonets used in drainage systems and landfill liners, and what are the design considerations when integrating geonets into geotechnical systems?
(b) Explain the installation techniques for geomembranes and detail the performance testing methods used to ensure their effectiveness in containment and environmental applications.
16. (a) What are the design methods for geomembranes in containment and environmental applications? Enumerate the key considerations and challenges involved in designing geomembranes for long-term performance.
(b) Explain the role of geonets in drainage and filtration systems. How do you evaluate the performance of geonets in real-world applications?

MODULE - 4

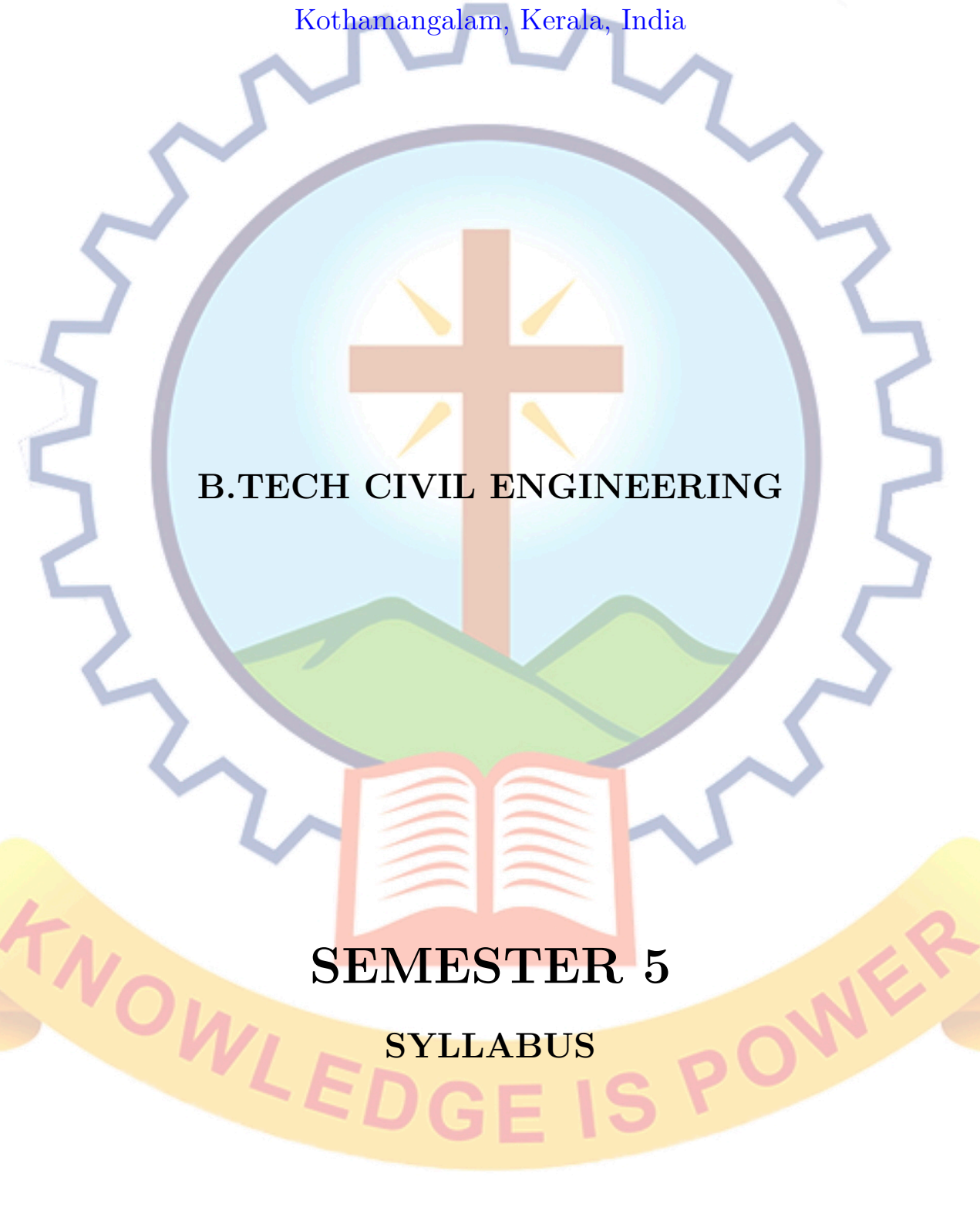
17. (a) Describe the design and analysis methods for reinforced soil retaining walls. What are the advantages and challenges of using segmental, wrapped-face, and hybrid retaining walls in construction.
(b) Explain the stability analysis and reinforcement design methods for reinforced soil slopes and embankments. How do these methods help in determining the safety and performance of such structures?
18. (a) There are various applications of reinforced soil in foundation design. Justify the statement.
(b) By enumerating a case study of reinforced soil slopes, embankments, or foundations, explain how these real-world examples highlight the effectiveness of reinforced soil in improving the stability and performance of geotechnical structures.

MODULE - 5

19. (a) Explain the design strategies for earthquake-resistant reinforced soil systems. How do these strategies help in mitigating the effects of seismic forces on reinforced soil structures?
(b) Enumerate a case study of reinforced soil structures during seismic events. How did these structures perform, and what lessons were learned regarding their design and stability in seismic conditions?
20. (a) Explain the emerging trends and future directions for research and development in geosynthetics. How are these advancements shaping the future of civil and geotechnical engineering?
(b) Enumerate both the successes and failures, and highlight the key lessons learned from a real-world project which used reinforced soil and geosynthetics.

MAR ATHANASIOUS COLLEGE OF ENGINEERING

Government Aided, Autonomous Institution
Kothamangalam, Kerala, India



B.TECH CIVIL ENGINEERING

SEMESTER 5

SYLLABUS

KNOWLEDGE IS POWER

SEMESTER 5

SLOT	COURSE NO.	COURSES	L-T-P-S	HOURS	CREDIT
A	B24CE3T01	DESIGN OF CONCRETE STRUCTURES	3-1-0-5	4	4
B	B24CE3T02	ADVANCED ANALYSIS OF STRUCTURES	3-1-0-5	4	4
C	B24CE3T03	WATER RESOURCES ENGINEERING	3-1-0-5	4	4
D	B24CE3T04	CONCRETE TECHNOLOGY	2-1-0-4	3	3
E	B24CE3T05	ENVIRONMENTAL ENGINEERING	3-1-0-5	4	4
F	B24CE3P1x	PROGRAM ELECTIVE I	2-1-0-4	3	3
G	B24CE3L07	SOIL MECHANICS LABORATORY	0-0-3-2	3	2
H	B24CE3L08	TRANSPORTATION ENGINEERING LABORATORY	0-0-3-2	3	2
M	B24CEM5x	MINOR	3-1-0-5	4	4
N	B24CEH5x	HONOURS	3-1-0-5	4	4
			TOTAL	36	26

PROGRAMME ELECTIVE I

COURSE NO.	COURSES
B24CE3P11	REMOTE SENSING & GIS
B24CE3P12	MODERN CONSTRUCTION MATERIALS
B24CE3P13	GEO-ENVIRONMENTAL ENGINEERING
B24CE3P14	SAFETY IN CONSTRUCTION
B24CE3P15	ENGINEERING GEOLOGY
B24CE3P16	HIGHWAY MATERIALS AND DESIGN

MINOR COURSES

COURSE NO.	COURSES
B24CEM52	RENEWABLE ENERGY
B24CEM53	SUSTAINABLE TRANSPORTATION

HONOURS COURSES

COURSE NO.	COURSES
B24CEH51	FUNDAMENTALS OF EARTHQUAKE ENGINEERING
B24CEH52	STRUCTURAL FORENSIC ANALYSIS
B24CEH53	ECO-FRIENDLY MATERIALS AND GREEN BUILDINGS
B24CEH54	CONSTRUCTION CONTRACTS, METHODS AND EQUIPMENTS
B24CEH55	TRANSPORTATION SAFETY ENGINEERING
B24CEH56	GROUND MONITORING TECHNIQUES

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE3T01	DESIGN OF CONCRETE STRUCTURES	3	1	0	5	4	2024

Preamble

This course provides a comprehensive introduction to the limit state design of reinforced concrete (RC) elements in accordance with the Indian Standard IS 456:2000 and allied codes. Emphasizing the philosophy of limit states—collapse and serviceability—the syllabus equips students with the theoretical foundations, codal provisions, and practical design skills required for safe and economical RC structures.

Prerequisites: Mechanics of Solids

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Apply the principles of limit state design, including characteristic loads, partial safety factors, and material stress-strain behavior, to analyze and design reinforced concrete members for safety and serviceability. (Cognitive Knowledge Level: Apply)
CO 2	Design singly and doubly reinforced rectangular beams, T-beams, and cantilever beams for flexure, shear, torsion, and bond, ensuring compliance with IS 456 provisions and proper reinforcement detailing. (Cognitive Knowledge Level: Apply)
CO 3	Analyze load distribution in slabs and design one-way and two-way slabs (simply supported and restrained) using IS code coefficients, along with the design and detailing of dog-legged staircases (Cognitive Knowledge Level: Apply)
CO 4	Classify and design short RC columns under axial compression, uniaxial, and biaxial bending using SP-16 design charts, incorporating helical reinforcement where applicable, as per codal specifications. (Cognitive Knowledge Level: Apply)
CO 5	Design isolated and combined footings based on soil-bearing capacity and structural requirements, and evaluate serviceability limit states such as deflection and cracking in accordance with IS 456 recommendations. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	3	2	1	2	1	1				1
CO 2	3	3	3	2	3	2	1		1	1	1
CO 3	3	3	3	2	3	2	1		1	1	1
CO 4	3	3	3	2	3	2	1		1	1	1
CO 5	3	3	3	2	3	3	1		1	1	1

Assessment Pattern

DESIGN OF CONCRETE STRUCTURES			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	10	10	10
Understand	40	40	40
Apply	50	50	50
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course Project	: 10 marks
Self Study	: 5 marks

End Semester Examination Pattern

There will be two parts: Part A and Part B. Part A contain 10 questions, with 2 questions

from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module, of which students should answer any one. Each question carries 14 marks and can have a maximum of 2 sub-divisions.

SYLLABUS

Module 1: Limit State Design and Flexural Design of Beams (9 hours)

Introduction - Principles of Limit state method of design, Introduction to BIS code - Types of limit states - characteristic and design values - partial safety factors - types of loads and their factors. Limit State of Collapse by flexure - assumptions - stress - strain relationship of steel and concrete. Calculation of moment of resistance. Design of singly reinforced rectangular beams - basic rules for design. Design example of simply supported beam - design of cantilever beam - detailing

Module 2: Doubly Reinforced Beams, T-Beams, Shear, Bond and Torsion (9 hours)

Fundamentals of doubly reinforced beams. Design of doubly reinforced beams - detailing, T-beams - terminology and understanding of design methods. Limit state of collapse in shear, shear stresses in beams - types of reinforcement - shear strength of RC beam - IS code recommendations for shear design - Design of shear reinforcement - examples. Bond and development length - code recommendations. Curtailment of reinforcement. Torsion in beams-IS code provisions.

Module 3: Design of Slabs and Staircases (11 Hours)

Design of slabs - introduction - one-way and two-way action of slabs - load distribution in a slab - IS recommendations for design of slabs - design of one-way slab- numerical problems - concepts of detailing of continuous slab - code coefficients. Two-way slabs - simply supported design using IS Code coefficients Reinforcement detailing. Stair cases - Types-proportioning-loads- distribution of loads - code provisions - Design and detailing of dog legged stair.

Module 4: Design of Columns under Axial Load and Bending (9 Hours)

Columns - introduction -classification - effective length - short column - long column - reinforcement - IS specifications regarding columns - limit state of collapse: compression - Design of axially loaded short columns - design examples. Design of short columns subjected to axial load and uniaxial bending, axial load and biaxial bending - code procedure for design - design using SP16 charts for limit state.

Module 5: Design of Footings and Serviceability Requirements (7 Hours)

Foundations - classification - IS code provisions for design of isolated footings - Design principles of rectangular footings- detailing. Combined footings (design principles only). Limit state of serviceability - limit state of deflection - short term and long-term deflection (con-

cept only) Limit state of serviceability - IS code recommendations - limit state of cracking (concept only).

Text Books:

1. Bhavikatti, S.S. Design of R.C.C. Structural Elements Vol. I. New Age International, 2007.
2. Punmia, B. C, Jain A.K and, Jain A.K , R C C Designs, Laxmi Publications Ltd., 10e, 2015
3. Varghese P.C, Limit State Design of Reinforced Concrete, Prentice Hall of India Pvt Ltd, 2008

Reference Books:

1. Pillai S.U & Menon D – Reinforced Concrete Design, Tata McGraw Hill Book Co., 2009
2. Relevant IS codes (IS 456, IS 875, SP 16, SP 34)

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	9 hours
1.1	Introduction - Principles of Limit state method of design, Introduction to BIS code	1
1.2	Types of limit states - characteristic and design values - partial safety factors - types of loads and their factors	1
1.3	Limit State of Collapse by flexure - assumptions - stress - strain relationship of steel and concrete	1
1.4	Calculation of moment of resistance. Design of singly reinforced rectangular beams - basic rules for design	2
1.5	Design example of simply supported beam	2
1.6	Design of cantilever beam - detailing	2

2	Module 2	9 hours
2.1	Fundamentals of doubly reinforced beams. Design of doubly reinforced beams - detailing, T-beams - terminology and understanding of design methods	3
2.2	Limit state of collapse in shear, shear stresses in beams - types of reinforcement - shear strength of RC beam - IS code recommendations for shear design	2
2.3	Design of shear reinforcement - examples	2
2.4	Bond and development length - code recommendations	1
2.5	Curtailment of reinforcement. Torsion in beams - IS code provisions	1
3	Module 3	11 hours
3.1	Design of slabs - introduction - one-way and two-way action of slabs - load distribution in a slab - IS recommendations for design of slabs	1
3.2	Design of one-way slab - numerical problems, concepts of detailing of continuous slab - code coefficients	2
3.3	Two-way slabs - simply supported design using IS Code coefficients Reinforcement detailing	2
3.4	Two-way slabs - restrained slabs - design using IS Code coefficients Reinforcement detailing	2
3.5	Stair cases - Types-proportioning - loads - distribution of loads - codal provisions	1
3.6	Design and detailing of dog legged stair	3
4	Module 4	9 hours
4.1	Columns - introduction - classification - effective length - short column - long column - reinforcement - IS specifications regarding columns	1
4.2	Design of axially loaded short columns - design examples	2
4.3	Design of axially loaded short columns with helical reinforcement - design examples	1

4.4	Analysis and design of short columns subjected to compression and uniaxial bending - design using SP16 charts for limit state	2
4.5	Analysis and design of short columns subjected to combined axial load and biaxial bending moments - code procedure for design - design using SP16 charts for limit state	3
5	Module 5	7 hours
5.1	Foundations - classification - IS code provisions for design of isolated footings	1
5.2	Design principles of rectangular footings - detailing	3
5.3	Combined footings (design principles only)	1
5.4	Limit state of serviceability - limit state of deflection - short term and long term deflection (concept only)	1
5.5	Limit state of serviceability - IS code recommendations - limit state of cracking (concept only)	1
Total		45 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. A simply supported RC beam has a span of 5 m and carries a characteristic live load of 20 kN/m (uniformly distributed) in addition to its self-weight. Using IS 456, (a) Determine the design load (factored UDL) considering partial safety factors. (b) If the beam is made of M25 concrete and Fe415 steel, calculate the limiting moment of resistance for a singly reinforced rectangular section of width 300 mm and effective depth 450 mm. (c) Check whether the section is under-reinforced if the actual factored moment is 180 kNm.
2. Explain the stress-strain curve for concrete (as per IS 456 Clause 38.1) and steel (Clause 36.4). A rectangular beam section ($b = 250$ mm, $d = 500$ mm) is subjected to a factored moment of 220 kNm. Using M30 concrete and Fe500 steel: (a) Calculate the depth of neutral axis using equilibrium equations. (b) Determine the area of tension steel required. (c) Verify if the section satisfies the limit state of collapse in flexure.

Course Outcome 2 (CO 2):

3. Design a doubly reinforced rectangular beam of size 300 mm $\times$ 600 mm (overall depth) to resist a factored moment of 350 kNm and factored shear of 180 kN. Use M25 concrete and Fe415 steel. (a) Calculate A_{st} and A_{sc} using limit state method. (b) Design shear reinforcement (2-legged 8 mm stirrups). (c) Check development length at support and provide proper anchorage.
4. A T-beam has flange width 1500 mm, flange thickness 120 mm, web width 300 mm, and effective depth 580 mm. It is subjected to a factored moment of 480 kNm. Use M30 and Fe500. (a) Determine if neutral axis is in flange or web. (b) Design tension reinforcement. (c) Provide detailing of flange and web reinforcement as per IS 456.

Course Outcome 3 (CO 3):

5. A two-way slab (6 m $\times$ 4 m) is simply supported on all four sides with corners free to lift. Live load = 5 kN/m², floor finish = 0.8 kN/m². Use M30 and Fe500. (a) Use IS 456 Table 26 to determine bending moments in short and long spans. (b) Design reinforcement in both directions. (c) Sketch the reinforcement layout with bar bending schedule.
6. Design a dog-legged staircase for a residential building with: Floor to floor height = 3.3 m, Tread = 300 mm, Riser = 150 mm, Width of flight = 1.2 m, Live load = 5 kN/m². Use M25 and Fe415. (a) Calculate effective span and loads (including self-weight). (b) Design waist slab and main reinforcement. (c) Design distribution steel and provide landing reinforcement details.

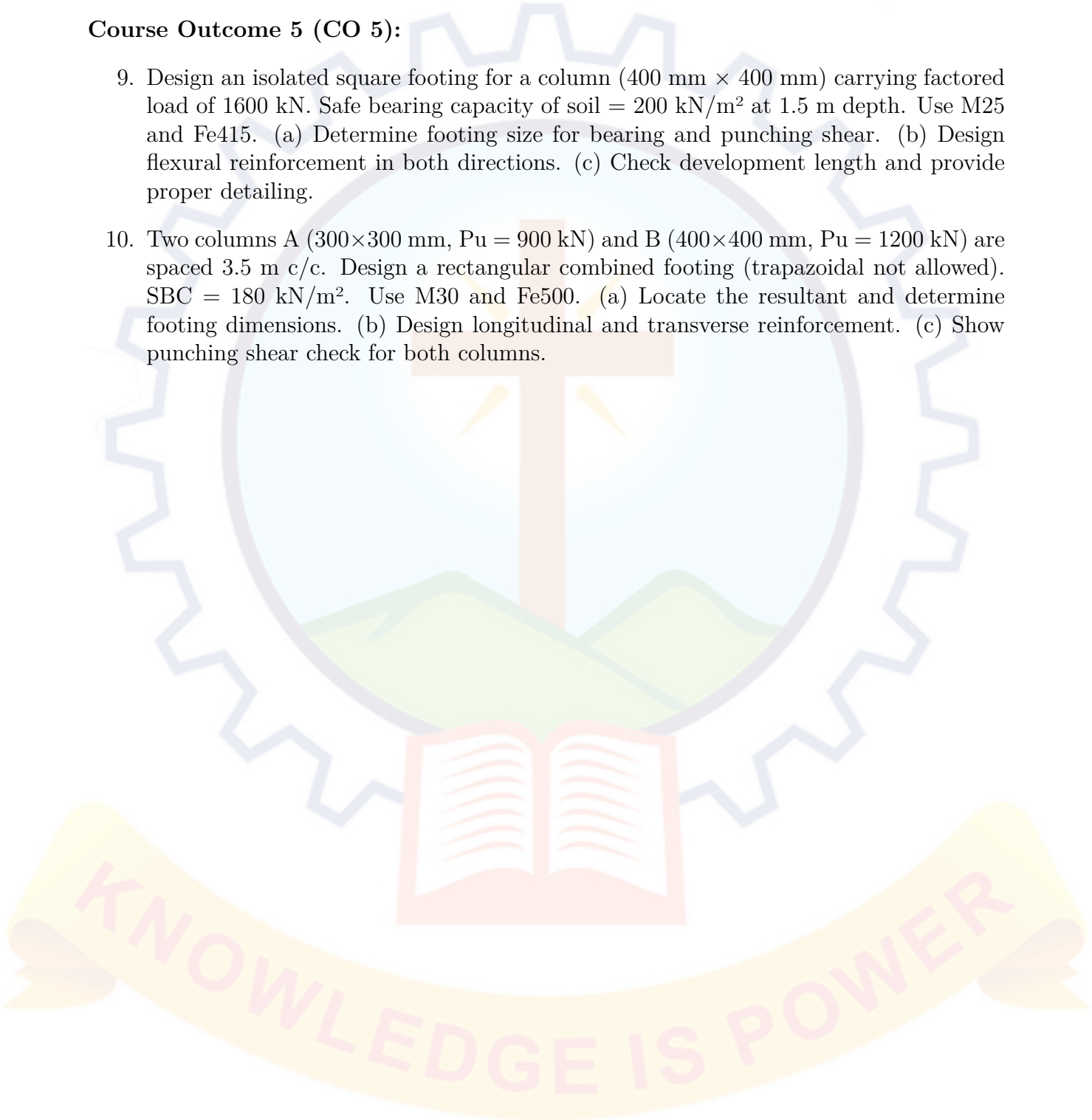
Course Outcome 4 (CO 4):

7. Design a short square column (tied) to carry a factored axial load of 1400 kN. Use M25 and Fe415. Assume 1.5% steel. (a) Determine the minimum size of column using IS 456 Clause 25.4. (b) Design longitudinal and lateral ties with proper spacing and diameter. (c) Check minimum eccentricity condition.

8. A short rectangular column ($400 \text{ mm} \times 600 \text{ mm}$) is subjected to factored axial load $P_u = 1800 \text{ kN}$ and uniaxial moment $M_u = 240 \text{ kNm}$ about the major axis. Use M30 and Fe500. (a) Use SP-16 Chart 27 to find required p/f_{ck} . (b) Calculate total longitudinal steel. (c) Provide detailing of bars and lateral ties.

Course Outcome 5 (CO 5):

9. Design an isolated square footing for a column ($400 \text{ mm} \times 400 \text{ mm}$) carrying factored load of 1600 kN . Safe bearing capacity of soil $= 200 \text{ kN/m}^2$ at 1.5 m depth. Use M25 and Fe415. (a) Determine footing size for bearing and punching shear. (b) Design flexural reinforcement in both directions. (c) Check development length and provide proper detailing.
10. Two columns A ($300 \times 300 \text{ mm}$, $P_u = 900 \text{ kN}$) and B ($400 \times 400 \text{ mm}$, $P_u = 1200 \text{ kN}$) are spaced 3.5 m c/c. Design a rectangular combined footing (trapezoidal not allowed). $SBC = 180 \text{ kN/m}^2$. Use M30 and Fe500. (a) Locate the resultant and determine footing dimensions. (b) Design longitudinal and transverse reinforcement. (c) Show punching shear check for both columns.



KNOWLEDGE IS POWER

MODEL QUESTION PAPER

QP CODE:

Pages: 3

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

FIFTH SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CE3T01

DESIGN OF CONCRETE STRUCTURES

Use of IS 456:2000 & Relevant pages of SP:16 are permitted.

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Distinguish between balanced, over-reinforced and under-reinforced sections in limit state design.
2. Explain how design loads are estimated in limit state design?
3. Enumerate the situations in which a doubly reinforced section become necessary.
4. What are the different types of shear reinforcement in beams?
5. Differentiate between one way and two-way slabs.
6. List the different types of staircases based on its geometrical shapes.
7. Differentiate between long columns and short columns.
8. List the functions of transverse reinforcement in column.
9. Explain at what situations a combined footing is recommended.
10. Explain the procedure of limiting deflection in two-way slabs.

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. a Find the moment of resistance of a singly reinforced concrete beam of 300 mm width and 600 mm effective depth, reinforced with 4 bars of 16 mm diameter of Fe 415 steel. Take M 25 concrete. (6)
- b Design a simply supported singly reinforced rectangular beam of span 3 metres to withstand a factored load of 10 kN/m. (8)

OR

12. a Define limit state. What are the objectives of limit state design? (4)
- b A singly reinforced beam 200mm wide has as an effective depth of 400mm. It is reinforced with 3 bars of 16mm diameter HYSD bars of Fe415 grade. Determine the moment of resistance of the section, if M20 concrete is used. (10)

MODULE 2

13. a Explain why and how shear reinforcement is provided in beams. (4)
- b Design a simply supported rectangular beam to carry a superimposed load of 30kN/m over a span of 5.5m. Assume support width as 300mm. Maximum overall depth is restricted to 550mm. Use M20 concrete and Fe 415 grade steel. (10)

OR

14. a What are the various modes of shear failure in beams? (4)
- b Determine the moment of resistance of a T beam with effective width of flange 740mm, depth of flange 80mm, web width 240mm and effective depth 400mm. The tensile steel reinforcement provided is 520mm diameter bars. Use M15 concrete and Fe 415 grade steel. (10)

MODULE 3

15. a Explain the behaviour of restrained and unrestrained two-way slabs. (4)
- b Design a reinforced concrete slab for a room of inside dimensions 3m x 7m. The thickness of supporting wall is 300mm. The live load on slab is taken as 2 kN/m² and floor finish is 1.5 kN/m². Use M20 concrete and Fe415 grade steel. (10)

OR

16. a Define the terms: (i) Flight (ii) Landing. (4)
- b Design a dog legged stair case for a residential building hall measuring 2.2m x 4.7m. The width of the landing is 1 m which spans in same direction as the stair slab. The distance between floor to floor is 3.3m. The rise and tread may be taken as 150mm and 270mm respectively. The weight of floor finish is 1 kN/m². The materials used are M20 grade concrete and Fe415 grade steel. (10)

MODULE 4

17. a Explain how interaction curves are used in the design of column. (4)
b Design a circular column to carry an axial load of 1000 kN. Use M 20 concrete and Fe 415 steel. Draw a longitudinal section and a cross section showing the reinforcement. (10)

OR

18. a Define slenderness ratio. What are its implications in the design of RC compression members? (4)
b Design a short square column to carry a factored axial load of 3000 kN, using M20 concrete and Fe 415 steel. (10)

MODULE 5

19. Design a reinforced concrete footing for a rectangular column 400mm x 600mm bearing a load of 600kN. Safe bearing capacity of the soil is 120 kN/m^2 . Adopt M20 concrete and Fe415 grade steel.

OR

20. a How is crack width determined for RC sections? (4)
b Design a square footing for an axially loaded column of 450 mm x 450 mm size. Load on column is 800kN. The safe bearing capacity of soil is 190 kN/m^2 . Use M20 concrete and Fe415 steel. (10)

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE3T02	ADVANCED ANALYSIS OF STRUCTURES	3	1	0	5	4	2024

Preamble

This course equips students with the skills to analyze various types of structures using suitable analytical methods. It covers both force and displacement methods for evaluating framed structures and introduces the fundamentals of plastic theory and its practical applications. Additionally, students are exposed to the dynamic analysis of structures undergoing deformation, applying principles of structural dynamics. The course also emphasizes the development of mathematical models and enhances analytical thinking, providing a solid foundation for advanced topics such as the finite element method.

Prerequisites: Structural Analysis

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Understand the principles of plastic theory and its applications in structural analysis. (Cognitive knowledge level: Apply).
CO 2	Apply physical approach of stiffness method to analyse beams and frames. (Cognitive knowledge level: Analyse).
CO 3	Apply elemental approach of stiffness methods to analyse structures. (Cognitive knowledge level: Analyse).
CO 4	Apply Direct stiffness method to analyse beams, frames and trusses. (Cognitive knowledge level: Apply).
CO 5	Understand the basic principles of structural dynamics and apply the same to simple structures. (Cognitive knowledge level: Apply).

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	2	3	2	3	1	1		1	1	2	1
CO 2	3	3	2	2	1	1		1	1	2	1
CO 3	3	3	2	2		1	1	1	1	2	2
CO 4	3	3	2	2	1	1	1	1	1	2	1
CO 5	2	3	2	3	1	1	1	1	1	2	1

Assessment Pattern

ADVANCED ANALYSIS OF STRUCTURES			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	10	10	10
Understand	20	20	20
Apply	70	70	70
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 10 marks
Self Study	: 5 marks

End Semester Examination Pattern

The question paper shall contain two questions from each module. Student has to answer any one question from each module. Each question carries 20 marks and can have maximum 3 sub-divisions.

SYLLABUS

Module 1: Plastic Theory (9 hours)

Introduction - plastic hinge concepts - plastic modulus - shape factor - redistribution of moments - collapse mechanisms - Plastic analysis of beams and portal frames by equilibrium and mechanism methods (single storey and single bay frames only).

Module 2: Introduction to Kani's method and matrix method (10 hours)

Introduction to Kani's method (concepts only)

Matrix analysis of structures: Introduction to matrix methods of analysis of structures: Concepts of stiffness method, nodal loads and element loads. Stiffness method: Concepts of physical approach. Development of stiffness matrices by physical approach-stiffness matrices for beams, frames and truss. Problems on beams and frames.

Module 3: Matrix analysis of structures (9 Hours)

Elemental approach of stiffness method- displacement transformation matrix, analysis of simple structures (Beams, frames and trusses).

Flexibility method (Concept only): Introduction to flexibility matrix method for the analysis of beams, truss and frame elements.

Module 4: Direct stiffness method (9 Hours)

Introduction to direct stiffness method - Rotation of axes in two dimensions, stiffness matrix of elements in global co - ordinates from element co - ordinates - assembly of load vector and stiffness matrix, solution of two span continuous beam - single bay single storey portal frame and plane truss.

Module 5: Introduction to Structural Dynamics (8 Hours)

Dynamic systems and loads - Free or natural vibrations-Natural Frequency - Inertia force - D'Alembert's principle - Mathematical modelling of single degree of freedom systems - equivalent spring stiffness of combination of springs. Free response of damped and undamped systems - logarithmic decrement.

Text Books:

1. James M Gere & William Weaver, Matrix Analysis of Framed Structures, CBS Publishers, 1990

2. Mechanics of Structures Vol I & II, Junnarkar S.B., Charotar Publishing House, 2015
3. Devdas Menon, Structural Analysis, Narosa Publications, Third Edition, 2017
4. Wang C.K., Intermediate Structural Analysis, McGraw Hill, 2017
5. Mario Paz, Structural Dynamics, Sixth Edition, 2004

References:

1. Pandit and Gupta, Structural Analysis – A Matrix Approach, Second Edition, 2008
2. Reddy C. S., Basic Structural Analysis, Tata McGraw Hill, Third Edition, 2017
3. Norris and Wilbur, Elementary Structural Analysis, Tata McGraw Hill, Fourth Edition, 1991
4. Punmia B. C., Strength of Materials and Mechanics of Structures, Laxmi Publications, Tenth Edition, 2018
5. RC Hibbeler, Structural Analysis, Eleventh Edition, 2023
6. Wang C K, Matrix Method of Structural Analysis, Second Edition, 1970
7. Anil. K. Chopra, Dynamics of structures, Pearson Education/ Prentice Hall India, Sixth Edition, 2023
8. Clough R.W. and Penzein, J., Dynamics of structures - Tata McGraw Hill, Second Edition, 1993
9. Rajasekharan & Sankara Subramanian, Computational Structural Mechanics, First Edition, 2008

COURSE CONTENTS AND LECTURE SCHEDULE

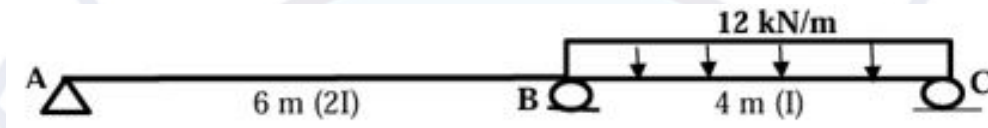
No	Topic	No. of Lecture/ Tutorial Hours
1	Module 1	9 hours
1.1	Plastic Theory: Introduction – plastic hinge concepts	1
1.2	plastic modulus – shape factor	1
1.3	redistribution of moments – collapse mechanisms	1
1.4	Plastic analysis of beams and portal frames by equilibrium method (single storey and single bay frames only)	3
1.5	Plastic analysis of beams and portal frames by mechanism method (single storey and single bay frames only)	3
2	Module 2	10 hours
2.1	Introduction to various methods; Kani's method (concepts only)	1
2.2	Introduction to matrix methods of analysis of structures: Concepts of stiffness method	1
2.3	Nodal loads and element loads	1
2.4	Stiffness method: Concepts of physical approach. Development of stiffness matrices by physical approach-stiffness matrices for beams, frames and truss.	3
2.5	Problems on beams and frames	4
3	Module 3	9 hours
3.1	Elemental approach of stiffness method- displacement transformation matrix,	2
3.2	Analysis of simple structures (Beams).	2
3.3	Analysis of simple structures (frames and trusses).	3

3.4	Flexibility method (Concept only): Introduction to flexibility matrix method for the analysis of beams, truss and frame elements.	2
4	Module 4	9 hours
4.1	Direct stiffness method: Introduction to direct stiffness method	1
4.2	Rotation of axes in two dimensions, stiffness matrix of elements in global co-ordinates from element co-ordinates- assembly of load vector and stiffness matrix	2
4.3	Solution of two span continuous beam	3
4.4	Surface mapping, interpolation	3
4.5	Single bay single storey portal frame and plane truss.	1
5	Module 5	8 hours
5.1	Introduction to Structural Dynamics - Dynamic systems and loads - Free or natural vibrations-Natural Frequency	1
5.2	Inertia force - D'Alembert's principle - Mathematical modelling of single degree of freedom systems	2
5.3	Equivalent spring stiffness of combination of springs.	1
5.4	Free response of undamped systems	2
5.5	Free response of damped systems - logarithmic decrement.	2
Total		45 Hours

CO ASSESSMENT QUESTIONS

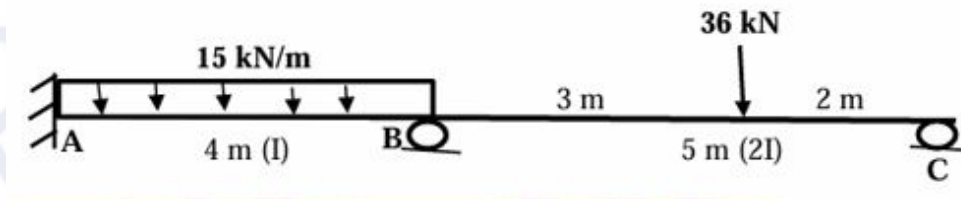
Course Outcome 1 (CO 1):

1. Explain the terms 'design plastic moment capacity of a member' and 'collapse load of a structure'.
2. Define the terms shape factor and load factor.
3. Find the plastic moment capacity of the beam shown in figure.



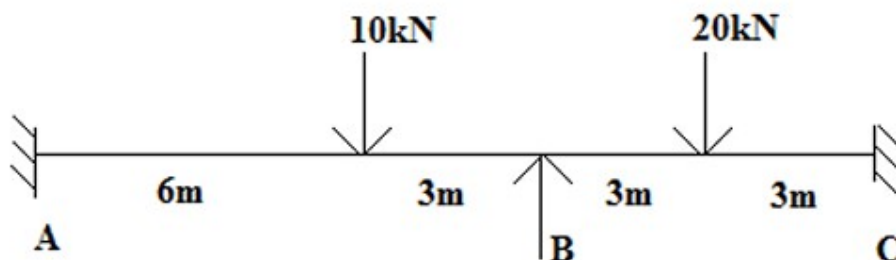
Course Outcome 2 (CO 2):

1. Outline the steps involved in the analysis of beam using physical approach of stiffness.
2. Derive stiffness matrix for a cantilever beam with point load W at the free end.
3. Analyse the continuous beam shown in Figure using physical approach of stiffness method. Draw BMD also. Assume EI as constant throughout.



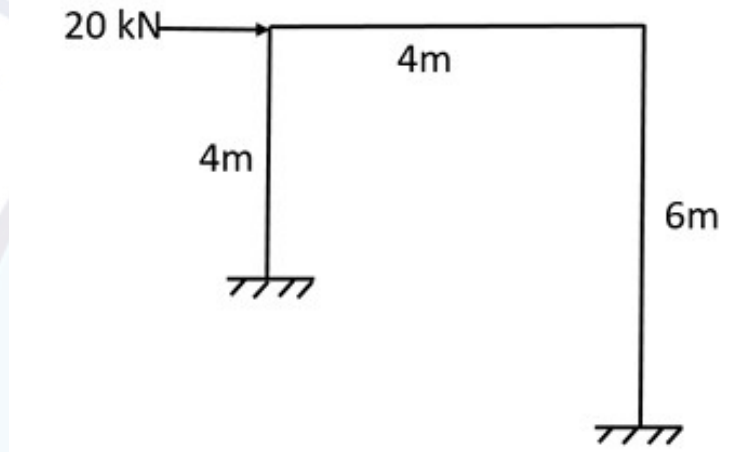
Course Outcome 3 (CO 3):

1. Outline the steps involved in the analysis of beam using elemental approach of stiffness method.
2. Differentiate between force and displacement methods of analysis of framed structures.
3. Analyse the continuous beam shown in figure using elemental approach of stiffness method. Draw BMD also. Assume EI as constant throughout.



Course Outcome 4 (CO 4):

1. How is direct stiffness matrix method different from stiffness method of analysis?
2. Obtain the transformation matrix for the linear displacements of the ends of a truss element in local and global coordinates; the member makes angle with the global x-direction.
3. Analyse and draw bending moment diagram for the frame shown in figure using direct stiffness method. Assume constant EI for all the members.



Course Outcome 5 (CO 5):

1. Explain the components of a basic dynamic system.
2. Derive the equation of motion of a SDOF system subjected to un-damped free vibration and subsequently the displacement (motion) form.
3. A vibrating system consisting of a mass 5kg and a spring of stiffness $k = 120 \text{ N/m}$ is viscously damped with damping coefficient 5 Ns/m. Determine a) damping ratio b) the natural frequency of damped vibration c) logarithmic decrement d) ratio of two successive amplitudes e) no of cycles after which the amplitude reduces to 25 percentage.

MODEL QUESTION PAPER

QP CODE:

Pages: 4

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

FIFTH SEMESTER B.TECH DEGREE EXAMINATION, YEAR

Course Code: B24CE3T02

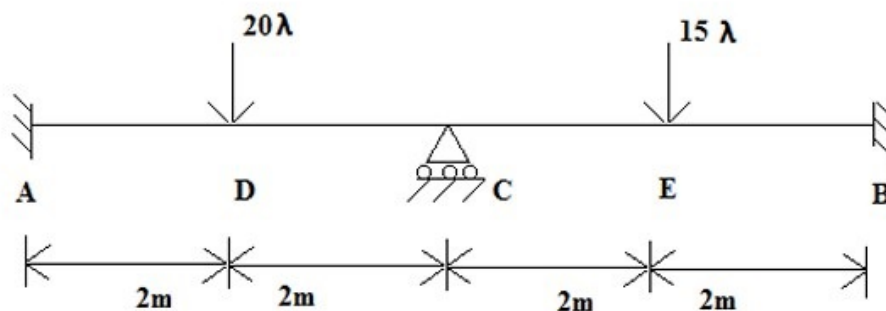
ADVANCED ANALYSIS OF STRUCTURES

Max. Marks: 100

Duration: 3 hours

Answer all questions. Each question carries 20 marks.

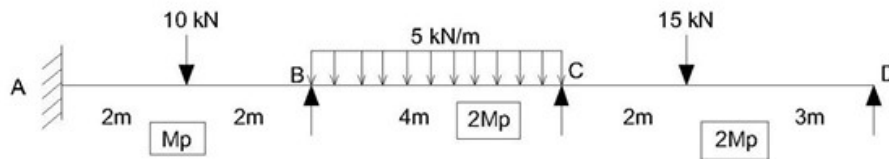
1. a Explain the term collapse load of a structure. (4)
- b Derive an expression for shape factor for rectangular cross section. (4)
- c Determine the Plastic moment, M_p required in the continuous beam shown in Figure, so as to ensure a minimum load factor of 1.7. (12)



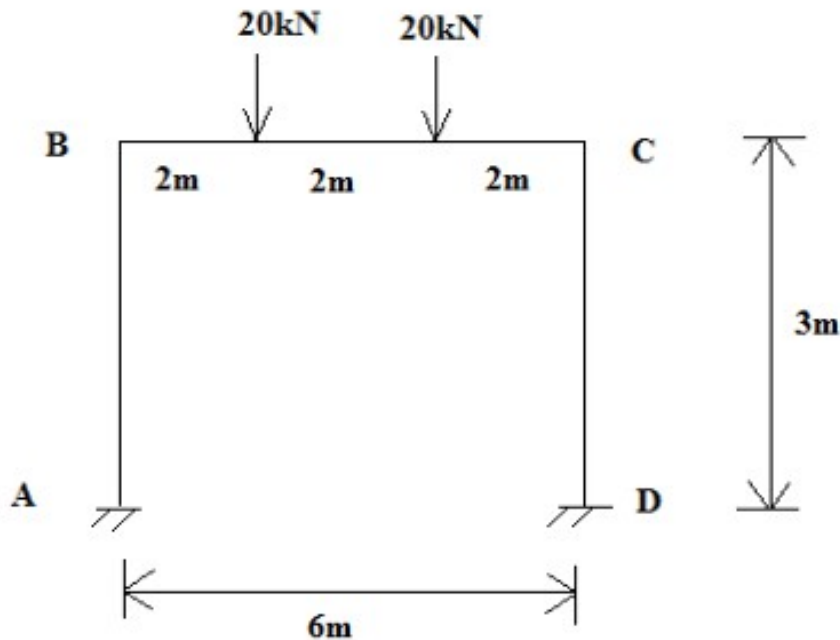
OR

2. a Explain the different methods for plastic analysis. (6)

- b Calculate the plastic moment of the given beam. (14)

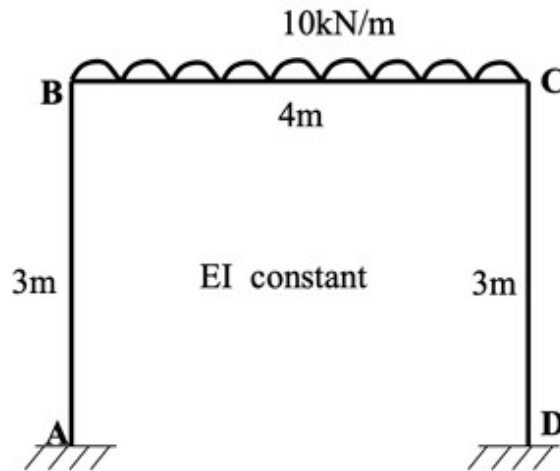


3. a Explain the features of stiffness matrix with an example. (6)
b Analyse the frame shown in figure using physical approach of stiffness. (14)

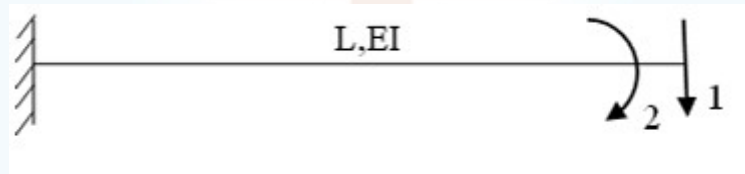


OR

4. a Derive stiffness matrix for a portal frame ABCD, where columns $AB = CD = 5\text{m}$, and beam length $BC = 2\text{m}$, A and D are fixed ends of the column AB and CD. EI is constant throughout. (6)
b Analyse the frame shown in figure using physical approach of stiffness method. (14)

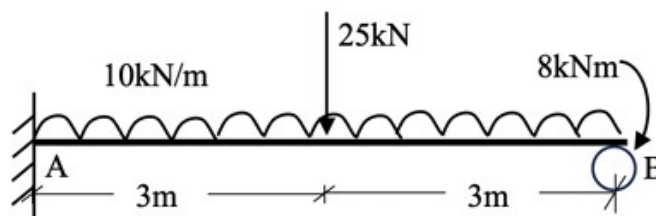


5. a Derive displacement transformation matrix using elemental approach for the coordinates marked in Figure.



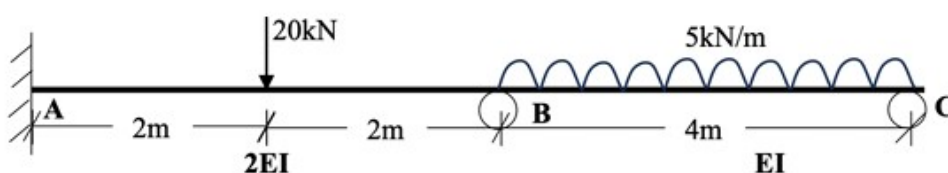
(6)

- b Analyse the beam shown in Figure using elemental approach of stiffness method and draw the bending moment diagram. Flexural rigidity is EI. (14)

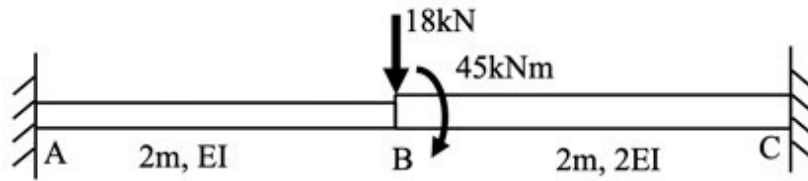


OR

6. a Differentiate between force and displacement methods of analysis of framed structures. (4)
- b Analyse the beam in Figure by elemental approach of stiffness method and draw the bending moment diagram. Flexural rigidity of AB is twice that of BC. (16)

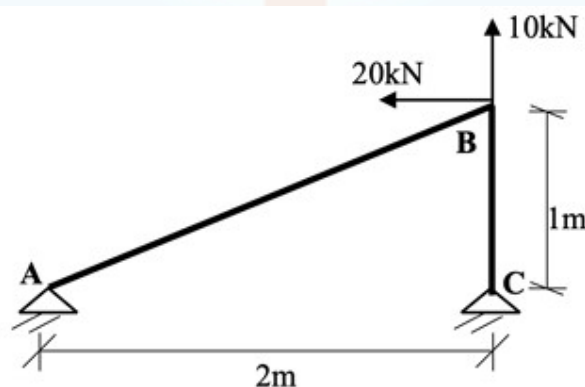


7. a Explain global coordinate and local coordinate system used in matrix method of analysis. (4)
- b Analyse the beam shown Figure by direct stiffness method and get the displacements at point B. (16)



OR

8. a How element stiffness matrix in global coordinates is derived from the local co-ordinate system for a truss element? (6)
- b Analyse the pin jointed truss shown in Figure by direct stiffness method and get the displacements at joint B. Cross sectional area of the members = 500mm^2 , $E = 200\text{GPa}$. (14)



9. a Define logarithmic decrement and elaborate on its significance. (4)
- b Derive an expression for the free vibration response of a damped SDOF system (under damped case). Draw the displacement response diagram. (16)

OR

10. a Explain the components of a basic dynamic system. (4)
- b State and explain D'Alembert's principle. (4)
- c Calculate the natural frequency of transverse vibrations of a cantilever beam 40mm diameter circular cross-section, carrying a load of 500N at the free end. Span of the cantilever beam is 800mm. $E = 200\text{ kN/mm}^2$. If a spring of stiffness 52.75kN/m is introduced between the mass and the beam. Calculate the change in natural frequency. (12)

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE3T03	WATER RESOURCES ENGINEERING	3	1	0	5	4	2024

Preamble

The primary objective of this course is to introduce students to the fundamental concepts of surface and groundwater hydrology, forming the foundation of water resources engineering. It aims to highlight the importance of sustainable water resource management and development. The course provides knowledge on the distribution and availability of water within the hydrosphere, methods for its quantification, and scientific techniques for computing irrigation water requirements. Additionally, it covers essential topics in reservoir and river engineering, equipping students with the skills necessary for effective water resource planning and utilisation.

Prerequisites: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Describe and estimate the components of the hydrologic cycle by processing hydro-meteorological data (Cognitive Knowledge Level: Understand).
CO 2	Analyse runoff processes, apply unit hydrograph theory for flood estimation, and assess streamflow, flood, and drought risks (Cognitive Level: Apply).
CO 3	Determine the crop water requirements for the design of irrigation canals by recollecting the principles of irrigation engineering (Cognitive Level: Apply).
CO 4	Describe and apply the principles of reservoir engineering to estimate the capacity of reservoirs and their useful life (Cognitive Level: Apply).
CO 5	Demonstrate the principles of groundwater engineering and apply them for computing the yield of aquifers and wells, and promote awareness on sustainable management and recharge strategies (Cognitive Level: Apply).

Mapping of Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	2					2	1				
CO 2	2					2	2				
CO 3	2					2	3				
CO 4	1					1	1				
CO 5	1	2	1			2	3	1			

Assessment Pattern

WATER RESOURCES ENGINEERING			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	20	20	20
Understand	30	20	30
Apply	50	60	50
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 10 marks
Self Study	: 5 marks

End Semester Examination Pattern

There will be two parts: Part A and Part B. Part A contain 10 questions, with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module, of which students should answer any one. Each question carries 14 marks and can have a maximum of 2 sub-divisions.

SYLLABUS

Module 1: Precipitation & Abstractions (8 hours)

Hydrology: Hydrologic cycle - precipitation - mechanism, types and forms. Measurement of rainfall using rain gauges - optimum number of rain gauges. Estimation of missing precipitation - Arithmetic mean method, Normal ratio method and Inverse distance method. Representation of rainfall data - mass curve and hyetograph. Computation of mean precipitation over a catchment-Spatial analysis - Arithmetic mean, Thiessen & isohyetal methods, Design rainfall - probable maximum rainfall.

Infiltration: Horton's equation, infiltration indices, double-ring infiltrometer - Evaporation-measurement by IMD land pan, control of evaporation.

Module 2: Runoff (12 hours)

Hydrograph Analysis and Runoff Estimation in Watersheds: Watersheds, catchment characteristics, components of runoff, Factors affecting runoff, methods of estimation of runoff-Hydrograph analysis- Derivation of Hydrograph from isolated storm-Base flow separation, Unit hydrograph – Applications. Assumptions and limitations of unit hydrograph theory. Computation of storm/flood hydrograph of different duration by method of superposition and by development of S – Hydrograph.

River flow: Stream flow measurement- methods, estimation of stream flow (area velocity method only), stage discharge relationships. Introduction to flood control and Drought Prone Areas Programme (DPAP)

Module 3: Irrigation Engineering (10 Hours)

Irrigation: Necessity, benefits and ill effects. Types: flow and lift irrigation - perennial and inundation irrigation. Methods: flooding, furrow, sprinkler and drip irrigation (concepts only). Soil water plant relationships, soil moisture constants, Computation of crop water requirement: depth and frequency of Irrigation, Duty and delta, relationship, variation of duty, factors affecting duty. Computation of design discharge of conveyance channels, Irrigation efficiencies. Consumptive use of water- simple problems, concept of Evapotranspiration.

Module 4: Surface Water systems (8 Hours)

River training works: Objectives, classification, examples for river training works.

Diversion and storage systems: Necessity, structures (basic concepts only).

Reservoirs: Types of reservoirs, flow duration curve, firm yield, storage zones of reservoir.

Reservoir planning: storage capacity and yield of reservoirs - analytical method and mass curve method. Reservoir sedimentation: Trap efficiency, methods for control of sedimentation. Computation of useful life of reservoir

Module 5: Groundwater & Management (7 Hours)

Ground water: Origin, classification, types of aquifers, Aquifer properties, Porosity, Specific yield, specific retention, Darcy's law, co-efficient of permeability, Transmissibility. Wells-Types, Steady radial flow into a fully penetrating well in Confined and Unconfined aquifers. Estimation of yield of an open well, pumping and recuperation tests. Tube wells – types.

Text Books:

1. Modi P. N. Irrigation, Water Resources and Water Power Engineering, S.B.H Publishers and Distributors New Delhi, 2020.
2. Punmia B.C. Ashok K Jain, Arun K Jain, B. B. L Pande, Irrigation and Water Power Engineering, Laxmi Publications (P) Ltd, 2016.

References:

1. Subramanya, Engineering Hydrology, McGraw Hill, 2024
2. Garg S. K., Irrigation Engineering and Hydraulic Structures Khanna Publishers New Delhi 2009.
3. Todd, Groundwater Hydrology, Wiley, 2007
4. Chow, Maidment & Mays, Applied Hydrology, McGraw Hill, 1998
5. Raghunath, Hydrology, Wiley Eastern, 1998 (eeeonline.org)
6. Linsley & Franzini, Water Resources Engineering, McGraw Hill, 1995 .
7. NPTEL Videos on Water Resources Engineering: <https://www.nptelprep.in/courses/105104103/ma>
8. NPTEL Videos on Watershed Management: [nptel.ac.in/courses/105101010](https://www.nptel.ac.in/courses/105101010)

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	8 hours
1.1	Hydrology - Hydrologic cycle, Precipitation - mechanism, types and forms	1
1.2	Measurement of rainfall using rain gauges - optimum number of rain gauges	1
1.3	Estimation of missing precipitation - Arithmetic mean method, Normal ratio method and Inverse distance method	1
1.4	Representation of rainfall data - mass curve and hyetograph	1
1.5	Computation of mean precipitation over a catchment - Spatial analysis - Arithmetic mean, Thiessen & isohyetal methods	1
1.6	Design rainfall - probable maximum rainfall	1
1.7	. Infiltration: Horton's equation, infiltration indices, double - ring infiltrometer	1
1.8	Evaporation - measurement by IMD land pan, control of evaporation	1
2	Module 2	12 hours
2.1	Watersheds, catchment characteristics	1
2.2	Components of runoff, Factors affecting runoff, methods of estimation of runoff	2
2.3	Hydrograph analysis- Derivation of Hydrograph from isolated storm-Base flow separation	1
2.4	Unit hydrograph –Applications. Assumptions and limitations of unit hydrograph theory	2
2.5	Computation of storm/flood hydrograph of different duration by method of superposition and by development of S– Hydrograph	2

2.6	River flow: Stream flow measurement- methods, estimation of stream flow (area velocity method only), stage discharge relationships	2
2.7	Introduction to flood control and Drought Prone Areas Programme (DPAP)	2
3	Module 3	10 hours
3.1	Irrigation- Necessity, benefits and ill effects	1
3.2	Types: flow and lift irrigation - perennial and inundation irrigation	1
3.3	Methods: flooding, furrow, sprinkler and drip irrigation (concepts only)	1
3.4	Soil water plant relationships, soil moisture constants	1
3.5	Computation of crop water requirement	1
3.6	Depth and frequency of irrigation	1
3.7	Duty and delta, relationship, variation of duty	1
3.8	Factors affecting duty	1
3.9	Computation of design discharge of conveyance channels, Irrigation efficiencies	1
3.10	Consumptive use of water - simple problems, concept of Evapotranspiration	1
4	Module 4	8 hours
4.1	River training works – objectives, classification	1
4.2	Examples for river training works	1
4.3	Diversion and storage systems: Necessity, structures (basic concepts only)	1
4.4	Reservoirs: Types of reservoirs, flow duration Curve, firm yield, storage zones of reservoir	1
4.5	Reservoir planning: storage capacity and yield of reservoirs - analytical method	1

4.6	Reservoir planning: storage capacity and yield of reservoirs - mass curve method	1
4.7	Reservoir sedimentation: Trap efficiency, methods for control of sedimentation	1
4.8	Computation of useful life of reservoir	1
5	Module 5	7 hours
5.1	Ground water: Origin, classification, types of aquifers, Aquifer properties, Porosity, Specific yield, specific retention Ground water: Origin, classification, types of aquifers, Aquifer properties, Porosity, Specific yield, specific retention, Darcy's law, co-efficient of permeability, Transmissibility	1
5.2	Darcy's law, co-efficient of permeability, Transmissibility	2
5.3	Wells- Types, Steady radial flow into a fully penetrating well in Confined aquifers	1
5.4	Steady radial flow into a fully penetrating well in an Unconfined aquifers	1
5.5	Estimation of yield of an open well, pumping and recuperation tests	1
5.6	Tube wells – types	1
Total		45 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Differentiate between the types and forms of precipitation.
2. The annual rainfall at five stations in a catchment are 120 cm, 95 cm, 110 cm, 85 cm, and 105 cm. If the allowable error in mean rainfall estimation is 8%, determine the optimum number of rain gauges required.

Course Outcome 2 (CO 2):

1. Explain the components of runoff and factors affecting it.
2. The ordinates of a 3 - hour unit hydrograph are: Time (h): 0, 3, 6, 9, 12, 15, 18, 21, 24; Discharge (cumecs): 0, 50, 150, 220, 180, 120, 70, 20, 0. Derive the ordinates of a 6 - hour unit hydrograph using the S-hydrograph method.

Course Outcome 3 (CO 3):

1. Describe methods of irrigation such as sprinkler and drip irrigation.
2. The following data for a crop: Root zone depth = 80 cm, Field capacity = 25%, Wilting point = 10%, Dry density of soil = 1400 kg/m³, Daily consumptive use = 12 mm. Assuming 75% depletion of available moisture for irrigation timing, determine the frequency of irrigation.

Course Outcome 4 (CO 4):

1. Explain the objectives and types of river training works.
2. Define trap efficiency and methods for controlling reservoir sedimentation.

Course Outcome 5 (CO 5):

1. Explain steady radial flow to a well in confined and unconfined aquifers.
2. Describe the various types of tube wells with neat sketches.

MODEL QUESTION PAPER

QP CODE:

Pages: 4

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

FIFTH SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CE3T03

WATER RESOURCES ENGINEERING

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Elucidate the steps involved in the determination of optimum number of rain gauges in catchment along with the equations involved.
2. Explain the significance of mass curve and hyetograph with sketch.
3. With neat sketches discuss the methods of base flow separation.
4. Distinguish between storm hydrograph and unit hydrograph with the help of sketches.
5. Derive the relationship between Duty and Delta. Explain their relevance in irrigation engineering.
6. "Computation of design discharge of conveyance channels is related to Irrigation efficiencies". Justify the statement.
7. Explain the importance of river training works with examples.
8. Why we need to control sedimentation in reservoir and what are the methods to control reservoir sedimentation?
9. State Darcy's law and its limitations.
10. Describe the various divisions of subsurface water.

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. a Rainfall data for Kothamangalam on August 5th of 2025 is given below. Represent it in different forms. What is the total rainfall obtained? (7)

Time	8 - 10 AM	10 - 11 AM	11 AM - 2 PM	2 - 3 PM	3 - 4 PM
Rainfall (cm)	2	1.0	6.0	0.0	2.0

- b Explain the working of Tipping bucket type rain gauge with a neat sketch. (7)

OR

12. a Explain the terms probable maximum rainfall, Infiltration and estimation of average rainfall in a river basin? (7)
- b If the value of k in Horton's equation is 2 and maximum and minimum infiltration rates observed are 2 cm/hr and 0.5 cm/hr respectively, find the infiltration rates at 30 minutes interval and plot the infiltration rate curve. (7)

MODULE 2

13. a What is Unit Hydrograph? Stating the assumptions, explain the derivation of a unit hydrograph from a storm hydrograph. (7)
- b Ordinates of 4 hr unit hydrograph are given below. Derive the ordinates of a 12 hr unit hydrograph. (7)

Time (hrs)	0	4	8	12	16	20	24	28	32	36	40	44
Ordinates of 4 hr UH (cumecs)	0	20	80	130	150	130	90	52	27	15	5	0

OR

14. a What is S Hydrograph? How is it used to construct a longer or shorter period unit hydrograph from a longer period unit hydrograph? (4)
- b A 2 hr unit hydrograph ordinates for a basin are given below. Derive the ordinates of 6 hr unit hydrograph using S - curve method. (10)

Time (hrs)	0	2	4	6	8	10	12	14	16	18	20	22
Ordinates of 2 hr UH (cumecs)	0	25	100	160	200	170	110	70	30	20	8	0

MODULE 3

15. a A water course has culturable command area of 2600 hectares, out of which the intensities of irrigation for perennial sugarcane and rice crops are 20% and 40% respectively. The duty for these crops at the head of the water course are 750 hectares per cumec and 1800 hectares per cumec respectively. Find the discharge required at the head of water course if the peak demand is 120% of the average requirement. (7)
- b After how many days will you provide irrigation to ensure healthy growth of crops. (i) Field capacity of soil – 29%, Permanent wilting percentage – 11%, Density of soil – 1300 kg/m³, Effective depth of root zone – 700 mm, Daily consumptive use of water for the given crop – 12 mm. Do remember that for healthy growth, moisture content must not fall below 25% of the water holding capacity between field capacity and permanent wilting point. (7)

OR

16. a A stream of 119 litres/sec was diverted from a canal and 99 litres/sec were delivered in the field. An area of 4094 acres was irrigated in 9.5 hours. The runoff loss in the field was 421m³. Determine the water conveyance efficiency. (4)
- b Explain the various methods of surface irrigation. (10)

MODULE 4

17. a The following information is available regarding the relationship between trap efficiency and capacity-inflow ratio for a reservoir. Find the probable life of the reservoir with an initial reservoir capacity of 30 million cubic meters, if the annual flood inflow is 60 million cubic metres and the average annual sediment inflow is 36,00,000 kN. Assume a specific weight of sediment equal to 12 kN/m³. The useful life of reservoir will terminate when 80% of initial capacity is filled with sediment. (10)

Capacity/Inflow ratio	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
Trap efficiency (η %)	87	93	95	95.5	96	96.5	97	97.2	97.3	97.5

- b Explain the types of reservoirs. (4)

OR

18. a Explain Guide Banks and Groynes with neat sketches. (7)
b Describe the step by step procedure for determining reservoir capacity from mass inflow curve. (7)

MODULE 5

19. a Derive an expression for steady radial flow in an unconfined aquifer. (7)
b A 30 cm diameter well penetrates 20 m below the static water table. After 24 hours of pumping at the rate of 4000 litres/minute, water level in a test well 85 m away from the main well is lowered by 0.48 m, and in a test well 35 m away from the main well, the drawdown is 1 m. a) What is the Transmissibility of the aquifer b) Determine the drawdown in the main well. (7)

OR

20. a A tube well penetrates fully an unconfined aquifer. Calculate the discharge from the tube well under the following conditions:
Diameter of well = 30 cm
Drawdown = 2 m
Effective length of strainer under the above drawdown = 10 m
Coefficient of permeability of aquifer = 0.05 cm/sec
Radius of zero drawdown = 300 m (7)
b Differentiate among aquifer, aquiclude, aquitard and aquifuge with suitable examples. (7)

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE3T04	CONCRETE TECHNOLOGY	2	1	0	4	3	2024

Preamble

This course explores the properties of concrete's constituent materials and their influence on its performance, with a particular emphasis on mix design. It aims to develop a strong understanding of both fundamental mechanisms and the latest advancements in concrete technology, enabling learners to apply modern practices effectively in the field.

Prerequisites: Introduction to Civil Engineering

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Explain the properties, production methods, and applications of special concretes and select suitable types for specific construction requirements (Understand)
CO 2	Conceive the manufacturing process, composition, and properties of cement, aggregates, and mixing water, and relate these to concrete performance. (Understand)
CO 3	Select and justify the use of chemical and mineral admixtures based on their mechanisms and effects on workability, strength, and durability (Apply)
CO 4	Design concrete mixes using IS 10262:2019 and other proportioning methods, considering strength, workability, durability, and special requirements (Design)
CO 5	Evaluate fresh and hardened concrete properties, durability aspects, and the influence of water-cement ratio on concrete performance. (Analyze)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	2	1	1	2	1			1		1
CO 2	3	3	2	2	2	2			1		2
CO 3	3	3	2	2	3	2		1	2	2	2
CO 4	3	3	2	3	2	3		1	1	1	2
CO 5	3	3	3	2	2	3	1		1	2	2

Assessment Pattern

CONCRETE TECHNOLOGY			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	30	10	20
Understand	40	50	40
Apply	20	30	30
Analyse	10	10	10
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 10 marks
Self Study	: 5 marks

End Semester Examination Pattern

There will be two parts: Part A and Part B. Part A contain 10 questions, with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module, of which students should answer any one. Each question carries 14 marks and can have a maximum of 2 sub-divisions.

SYLLABUS

Module 1: Special concrete (7 hours)

High-strength concrete, Self-compacting concrete, Fibre-reinforced concrete, High-density concrete, Lightweight concrete, Mass concreting, 3D printed concrete-application and properties

Module 2:Cement Components (9 hours)

Cement -introduction to manufacturing process- chemical composition, Cement hydration, test on cements- Aggregates-Classification-Mechanical properties and tests -Water- Quality of water for use in concrete

Module 3:Admixtures (7 Hours)

Chemical Admixtures: Accelerators-Retarders- Plasticisers- corrosion inhibitors- Air entrainers – Mineral Admixtures- Fly Ash, Silica Fume, Ground Granulated Blast Furnace Slag and Metakaoline -Mechanism and effects on concrete properties.

Module 4: Mix design (7 Hours)

Nominal mix- design mix – concept of mix design - variables of proportioning - general considerations - factors considered in the design of concrete mix- as per IS 10262-2019. Properties of fresh concrete- workability factors affecting workability - slump test, compaction factor test

Module 5:Properties of hardened concrete (6 Hours)

Modulus of elasticity, compressive strength, split tensile strength, flexural strength- effect of water cement ratio – Introduction to Creep and Shrinkage- Durability of concrete- Factors affecting durability – deterioration mechanisms.

Text Books:

1. Mehta and Monteiro, Concrete - Micro structure, Properties and Materials, McGraw Hill Professional 2017
2. Neville A. M. and Brooks J. J., Concrete Technology, Pearson Education, 2019
3. Lea, Chemistry of Cement and Concrete , Butterworth - Heinemann Ltd, 5e, 2017

Reference Books:

1. The Contractor's Guide to Quality Concrete Construction ACI & American Society of Concrete Contractors, 4th Edition (2018)

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	7 hours
1.1	High-strength concrete	1
1.2	Self-compacting concrete	1
1.3	Fibre-reinforced concrete	1
1.4	High-density concrete, Lightweight concrete	1
1.5	Mass concreting	1
1.6	3D printed concrete	1
1.7	Application and properties	1
2	Module 2	9 hours
2.1	Introduction to manufacturing process	2
2.2	chemical composition	1
2.3	Cement hydration, test on cements	2
2.4	Aggregates-Classification-Mechanical properties and tests	2
2.5	Water- Quality of water for use in concrete	2
3	Module 3	7 hours
3.1	Chemical Admixtures: Accelerators-Retarders- Plasticisers-corrosion inhibitors- Air entrainers	3

3.2	Mineral Admixtures- Fly Ash, Silica Fume, Ground Granulated Blast Furnace Slag and Metakaoline	3
3.3	Mechanism and effects on concrete properties	1
4	Module 4	7 hours
4.1	Nominal mix- design mix – concept of mix design	1
4.2	Variables of proportioning - general considerations	2
4.3	Factors considered in the design of concrete mix- as per IS 10262-2019.	2
4.4	Properties of fresh concrete- workability factors affecting workability	1
4.5	Slump test, compaction factor test	1
5	Module 5	6 hours
5.1	Modulus of elasticity, compressive strength, split tensile strength,	1
5.2	Flexural strength- effect of water cement ratio	1
5.3	Introduction to Creep and Shrinkage	1
5.4	Durability of concrete- Factors affecting durability	2
5.5	Deterioration mechanisms	1
Total		36 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Describe the manufacturing process of Portland cement with the help of neat sketches, and explain how its chemical composition influences the properties of cement.
2. Explain the various tests performed on aggregates to assess their suitability for use in concrete.

Course Outcome 2 (CO 2):

1. Explain the mechanisms and effects of chemical admixtures on the workability and strength characteristics of concrete.
2. Describe the role and advantages of mineral admixtures such as fly ash, ground granulated blast furnace slag (GGBS), and metakaolin in enhancing the durability and sustainability of concrete.

Course Outcome 3 (CO 3):

1. Explain the principles and procedure of concrete mix design as per IS 10262:2019, detailing all the parameters considered in the design process
2. Using IS 10262:2019 guidelines, design a concrete mix for M30 grade by assuming appropriate data and justify the chosen parameters

Course Outcome 4 (CO 4):

1. Explain the properties of hardened concrete with reference to compressive, tensile, and flexural strength, and the factors affecting them.
2. Discuss statistical quality control in concrete, highlighting mean strength, standard deviation, coefficient of variation, and acceptance criteria.

Course Outcome 5 (CO 5):

1. Discuss the causes and mechanisms of reinforcement corrosion in concrete and outline methods to prevent it for enhanced durability.
2. Describe sulphate attack, acid attack, and alkali-silica reaction in concrete, highlighting their impact on its long-term durability.

MODEL QUESTION PAPER

QP CODE:

Pages: 2

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

FIFTH SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CE3T04

CONCRETE TECHNOLOGY

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Define Self-Compacting Concrete and mention any two of its important properties.
2. List any three applications of Fibre Reinforced Concrete.
3. Briefly explain the manufacturing process of cement.
4. What are the requirements of quality of water used for concrete mixing?
5. What are plasticisers? State two advantages of their use in concrete.
6. List any three mineral admixtures and mention one benefit of each.
7. Define nominal mix and design mix.
8. What is workability of concrete? Mention any two factors affecting it.
9. Define creep and shrinkage in concrete.
10. Mention any three factors affecting durability of concrete

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. Explain the properties, advantages, and applications of High-Strength Concrete and Lightweight Concrete.

OR

12. Discuss in detail 3D printed concrete, highlighting its construction challenges and applications.

MODULE 2

13. Describe in detail the manufacturing process of cement, explaining the significance of major chemical compounds.

OR

14. Explain the classification, mechanical properties, and tests on aggregates used in concrete.

MODULE 3

15. Discuss the mechanisms and effects of chemical admixtures such as plasticizers, retarders, and accelerators on workability and strength of concrete.

OR

16. Explain the role and benefits of mineral admixtures like fly ash, GGBS, and metakaolin in improving the durability and sustainability of concrete.

MODULE 4

17. Discuss the principles and steps involved in mix design as per IS 10262:2019, including all required parameters.

OR

18. Design an M30 grade concrete mix as per IS 10262:2019, assuming suitable data and justify your selection of parameters.

MODULE 5

19. Explain in detail the properties of hardened concrete, including compressive, tensile, and flexural strength, and their influencing factors.

OR

20. Describe the various deterioration mechanisms such as sulphate attack, acid attack, and alkali-silica reaction, and explain their impact on long-term concrete performance.

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE3T05	ENVIRONMENTAL ENGINEERING	3	1	0	5	4	2024

Preamble

The course delves into water treatment technologies for drinking water and wastewater, emphasizing the environmental engineer's role in public health and enhancing environmental quality. The course also addresses air and noise pollution, as well as solid waste management.

Prerequisites: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Comprehend the importance of water supply engineering. (Cognitive Knowledge Level: Understand)
CO 2	Acquire fundamental understanding of wastewater engineering. (Cognitive Knowledge Level: Apply)
CO 3	Gain a foundational understanding of air and noise pollution. (Cognitive Knowledge Level: Understand)
CO 4	Comprehend the various elements involved in municipal solid waste management. (Cognitive Knowledge Level: Apply)
CO 5	Identify key aspects of electronic waste, hazardous waste, and biomedical waste. (Cognitive Knowledge Level: Understand)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	1				1					1
CO 2	3	1				1					1
CO 3	3	1				1					1
CO 4	3	1				1					1
CO 5	3	1				1					1

Assessment Pattern

ENVIRONMENTAL ENGINEERING			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	30	30	30
Understand	40	40	40
Apply	30	30	30
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course project : 10 marks

Self Study : 5 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contains 10 questions carrying 3 marks each. Part B contains 2 questions from each module out of which any one is to be answered. Each question carries 14 marks and can have maximum 2 sub-divisions.

SYLLABUS

Module 1: Water Supply Engineering (9 hours)

Sources of water - Physical, chemical and biological characteristics of water - Drinking Water quality standards - Layout plan of a conventional water treatment plant - Screening - types of screens - aeration - aerator types - Theory and principles of sedimentation - Stoke's law - Types of settling - Mechanisms of coagulation and flocculation - popular coagulants - Filtration of water-theory of filtration - types of filters - Disinfection of water - various methods - advantages and limitations - Lay out of water distribution network - types - methods of distribution.

Module 2: Wastewater Engineering (9 hours)

Sewage Treatment - Characteristics and composition of sewage - primary treatment of sewage - screens - grit chamber - Detritus chamber- Flow equalization tank - primary sedimentation tanks - secondary treatment of sewage - Activated Sludge Process - Extended aeration systems - Rotating biological contactors - Trickling filters - Waste Stabilization Ponds - advances in sewage treatment - Sequencing Batch Reactor - Moving bed biofilm reactor- Membrane Bioreactor - UASB - Sludge treatment (concepts only) - thickening- digestion - dewatering - drying - composting - Onsite waste treatment systems - septic tank - soak pit.

Module 3: Air and Noise Pollution (9 Hours)

Air pollutants - Sources - Classification of air pollutants - Particulates and gaseous pollutants - Effects of air pollutants on human health, vegetation and property - Ambient air quality and emission standards - Air pollution indices - Monitoring of Air Pollutants - Sampling of particulate and gaseous pollutants - Control of Air Pollutants - Particulate emission control methods - Scrubbing - Cyclones - Filtration - Electrostatic Precipitation - Gaseous emission control methods - adsorption, absorption, thermal methods.

Noise Pollution: Sources of Noise - Ill effects of Noise - Noise Measuring & Control - Permissible Noise Limits - Noise indices.

Module 4: Municipal Solid Waste (9 Hours)

Sources and types of municipal solid waste (MSW) - Waste generation rates - composition and characteristics - Methods of sampling - Effects of improper disposal of solid wastes - Elements of solid waste management - Objectives of waste processing - Processing technologies - Biological and chemical conversion technologies - Thermal processing options - Land disposal of solid waste - Sanitary landfills - site selection and operation of sanitary landfills - Landfill liners - Management of leachate and landfill gas.

Module 5: Electronic, Hazardous and Biomedical Waste (9 Hours)

Electronic Waste: Composition - Characteristics - Environmental and Health Implications - Storage and On-site Handling - Recycling E-Waste - Extended Producer Responsibility (EPR) - Treatment and Disposal.

Hazardous Waste: Sources - Characteristics - Classification - Impact on Human Health and Environment - Environmental Regulations - Waste Minimization and Resource Recovery - Storage and Transportation - Treatment.

Biomedical waste: Source - Classifications - Health Hazards - Waste Collection - Segregation and Labelling - Handling - Onsite/Off Site Transportation - Treatment and Disposal of Biomedical Waste.

Text Books:

1. Howard S Peavy, Donald R Rowe and George Tchobanoglous, Environmental Engineering, Mc Graw Hill Education, 2013.
2. Mackenzie L Davis, David A Cornwell, Introduction to Environmental Engineering, Mc Graw Hill Education, 2014.
3. S.K.Garg, Water Supply Engineering, Khanna Publishers. 2010.
4. G S Birdie, Water Supply and Engineering, Dhanapat Rai Publishing Company, 2014.
5. J. Arceivala, Shyam R. Asolekar, Wastewater Treatment for Pollution Control and Reuse, McGrawhill Education, 2007
6. S.K. Garg, Sewage disposal and air pollution engineering, Khanna Publishers. 2008.
7. Metcalf & Eddy Inc., George Tchobanoglous, H. David Stensel, Ryujiro Tsuchihashi, Franklin L. Burton , Wastewater Engineering: Treatment and Resource Recovery, New York, USA: McGraw-Hill Education, 2014.
8. Clair Sawyer, Perry McCarty and Gene Parkin, Chemistry for Environmental Engineering and Science, New York, USA: McGraw-Hill Education, 2003.
9. Duggal K.N., "Elements of Environmental Engineering" S.Chand and Co. Ltd., New Delhi, 2014.
10. Punmia, B.C., Jain, A.K., and Jain.A.K., Environmental Engineering, Vol.II, Laxmi Publications, 2010.

References:

1. Davis M. L. and Cornwell D. A., Introduction to Environmental Engineering, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2010.
2. The Central Public Health and Environmental Engineering Organisation(CPHEEO), Manual on Sewerage and Sewage Treatment, Ministry of Urban Development, Government of India.
3. The Central Public Health and Environmental Engineering Organisation(CPHEEO), Manual on Water Supply and Treatment, Ministry of Urban Development, Government of India.

4. Gilbert M. Masters, Wendell P. Ela, Introduction to Environmental Engineering and Science, Noida, India: Pearson India Education Services Pvt. Ltd., 2015.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	9 hours
1.1	Water supply engineering: Sources of water - Physical, chemical and biological characteristics of water - Drinking Water quality standards	2
1.2	Layout plan of a conventional water treatment plant - Screening-types of screens - aeration - aerator types	1
1.3	Layout plan of a conventional water treatment plant - concept of unit operations and unit processes - Screening - types of screens - aeration - aerator types	2
1.4	Theory and principles of sedimentation - Stoke's law - Types of settling	1
1.5	Mechanisms of coagulation and flocculation - popular coagulants - Filtration of water - theory of filtration	2
1.6	Disinfection of water - various methods - advantages and limitations.	1
2	Module 2	9 hours
2.1	Waste water engineering:Sewage Treatment - Characteristics and composition of sewage	1
2.2	Primary treatment of sewage - screens - grit chamber - Detritus chamber - Flow equalization tank - primary sedimentation tanks	2
2.3	Secondary treatment of sewage - Activated Sludge Process - Extended aeration systems - Rotating biological contactors - Trickling filters - Waste Stabilization Ponds	3

2.4	Advances in sewage treatment - Sequencing Batch Reactor – Moving bed biofilm reactor - Membrane Bioreactor - UASB	2
2.5	Sludge treatment (concepts only) - thickening - digestion - dewatering - drying - composting	1
3	Module 3	9 hours
3.1	Air pollutants - Sources - Classification of air pollutants - Particulates and gaseous pollutants - Effects of air pollutants on human health, vegetation and property	2
3.2	Ambient air quality and emission standards - Air pollution indices - Monitoring of Air Pollutants: Sampling of particulate and gaseous pollutants	1
3.3	Control of Air Pollutants - Particulate emission control - methods, Scrubbing - Cyclones - Filtration - Electrostatic Precipitation	2
3.4	Gaseous emission control - adsorption, absorption, thermal methods	2
3.5	Noise Pollution: Sources of Noise - Ill effects of Noise - Noise Measuring and Control - Permissible Noise Limits - Noise indices.	2
4	Module 4	9 hours
4.1	Municipal Solid Waste (MSW): Sources and types of municipal solid waste - Waste generation rates - composition and characteristics	2
4.2	Methods of sampling – Effects of improper disposal of solid wastes – Elements of solid waste management	2
4.3	Objectives of waste processing – Processing technologies – Biological and chemical conversion technologies –Thermal processing options.	3
4.4	Land disposal of solid waste - Sanitary landfills – site selection, operation of sanitary landfills– Landfill liners – Management of leachate and landfill gas	2

5	Module 5	9 hours
5.1	Electronic Waste: Composition – Characteristics – Environmental and Health Implications – Storage and On-site Handling - Recycling E-Waste - Extended Producer Responsibility (EPR) - Treatment and Disposal	3
5.2	Hazardous Waste: Sources - Characteristics - Classification - Impact on Human Health and Environment - Environmental Regulations - Waste Minimization and Resource Recovery - Storage and Transportation – Treatment	3
5.3	Biomedical waste: Source – Classifications - Health Hazards – Waste Collection - Segregation and Labelling – Handling – Onsite/Off Site Transportation – Treatment and Disposal of Biomedical Waste	3
Total		45 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Outline Drinking Water quality standards.
2. Enumerate theory of filtration.
3. Discuss different types of settling.

Course Outcome 2 (CO 2):

1. Problems on design of septic tank.
2. Outline various methods for sludge treatment.
3. Enumerate the working principle of trickling filters.

Course Outcome 3 (CO 3):

1. Briefly discuss various gaseous emission control methods.
2. Discuss effects of air pollutants on human health, vegetation and property.
3. Write a note on Air pollution indices and noise indices.

Course Outcome 4 (CO 4):

1. Discuss various elements of solid waste management.
2. Outline various waste processing technologies.

Course Outcome 5 (CO 5):

1. Enumerate the importance of biomedical waste treatment.
2. Discuss environmental and health implications of electronic waste.

MODEL QUESTION PAPER

QP CODE:

Pages: 2

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

FIFTH SEMESTER B TECH DEGREE EXAMINATION, MONTH YEAR

Course Code: B24CE3T05
ENVIRONMENTAL ENGINEERING

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Discuss the objectives of providing aeration in water treatment process.
2. Discuss about theory of filtration.
3. What are the advantages of providing a flow equalization tank in a sewage treatment plant?
4. Explain the advantages of a septic tank?
5. Distinguish between primary and secondary air pollutants.
6. Describe the effects of air pollution on vegetation.
7. What is the role of transfer station in solid waste management.
8. Explain the composition of municipal solid wastes.
9. Write a note on identification and classification of hazardous waste.
10. Discuss recycling of e-waste.

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. (a) Outline physical and chemical characteristics of drinking water. (10)
(b) State the objectives of disinfection in water treatment. (4)

OR

12. (a) Compare the various water distribution layouts practiced in the field. (9)
(b) Distinguish between coagulant aided sedimentation and plain sedimentation. (5)

MODULE 2

13. Assess the working of ASP with flow diagram. (14)

OR

14. (a) Analyze various stages of sludge digestion process and explain disposal of digested sludge. (5)
(b) Illustrate the working of trickling filters with its merits and demerits. (9)

MODULE 3

15. (a) List the various measures to control gaseous air pollutants. Discuss any two in detail. (7)
(b) Describe the principles of operation and advantages of electrostatic precipitators for particulate emission control. (7)

OR

16. (a) Describe the effects of air pollution on materials and infrastructure. (7)
(b) Explain briefly the various sources and their effects of noise pollution. (7)

MODULE 4

17. (a) Explain the procedure adopted for chemical and biological conversion of solid-waste. (10)
(b) Enumerate various elements of solid waste management. (4)

OR

18. (a) Classify solid waste based on source and define each. (7)
(b) Summarize the effects of improper disposal of solid wastes. (7)

MODULE 5

19. (a) What is E-waste? What are the impacts of E-Waste on the environment? (7)
(b) Enumerate the various methods of treating bio-medical waste. (7)

OR

20. Describe the various techniques of hazardous waste processing and methods of disposal. (14)

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE3P11	REMOTE SENSING & GIS	2	1	0	4	3	2024

Preamble

The Remote Sensing & GIS course provides a comprehensive understanding of the theoretical foundations of remote sensing, digital image processing, and Geographic Information Systems (GIS). It covers key concepts in spatial data analysis and modeling techniques, equipping students with practical skills for interpreting satellite imagery and conducting GIS-based spatial analysis. The course emphasizes real-world applications in areas such as urban planning, environmental monitoring, water resource management, and disaster resilience.

Prerequisites: Surveying & Geomatics

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Understand the fundamentals of Remote Sensing, including its principles and laws, remote sensing platforms, satellite missions, and sensor types, along with their corresponding spatial, spectral, temporal, and radiometric resolutions. (Cognitive Knowledge Level: Understand)
CO 2	Understand image interpretation, pre-processing, classification, and change detection, and use Google Earth Engine for satellite data processing. (Cognitive Level: Understand)
CO 3	Apply GIS concepts and tools to perform spatial and attribute data management, vector and raster analysis, and utilize GPS data for real-world applications. (Cognitive Level: Understand)
CO 4	Perform spatial data analysis and modeling using statistical, overlay, proximity, multicriteria, and terrain-based methods. (Cognitive Level: Apply)
CO 5	Apply Remote Sensing and GIS techniques for land use/land cover analysis, watershed and water resource management, urban planning, environmental monitoring, and disaster resilience. (Cognitive Level: Analyse)

Mapping of Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	2										
CO 2	2				1						
CO 3	2			1	1						
CO 4	2		1	3	3	1	2		1	2	
CO 5	2		2	3	3		2		2	2	

Assessment Pattern

REMOTE SENSING & GIS			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	40	20	20
Understand	60	40	40
Apply		40	40
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 10 marks
Self Study	: 5 marks

End Semester Examination Pattern

There will be two parts: Part A and Part B. Part A contains 10 questions, with 2 questions

from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module, of which students should answer any one. Each question carries 14 marks and can have a maximum of 2 sub-divisions.

SYLLABUS

Module 1: Fundamentals of Remote Sensing (7 hours)

Introduction to Remote sensing - Scope, Application overview, Evolution of remote sensing, Principles of Remote Sensing, Laws of remote sensing, Electromagnetic Spectrum and energy interactions. Remote Sensing Platforms: Aerial and Satellite Platforms, Satellite Data Products. Sensors: passive and active sensors, Optical, Thermal, and Microwave Remote Sensing, LiDAR (concepts only), Resolutions: spatial, spectral, temporal, and radiometric.

Module 2: Image Interpretation and Digital Image Processing (7 hours)

Elements of image interpretation, Visual interpretation, Image pre-processing methods- Data formats, image enhancement and its methods, Principal Component Analysis (PCA). Image classification: supervised and unsupervised, change detection, accuracy assessment, error matrix. Google Earth Engine platform for processing satellite data.

Module 3: GIS Concepts and Data Models (7 Hours)

Introduction, Principle, Definition, Components of GIS, Application, coordinate systems and map projections, GIS data types, data input, geometric transformation, spatial data editing, attribute data input and management, data exploration, vector and raster data analysis, GPS - components, working principle, applications.

Module 4: GIS Data Analysis and Modeling (7 Hours)

Statistical analysis, Measurement, Proximity analysis (buffering), Overlay analysis, Multicriteria analysis, site suitability analysis, Nearest neighbour analysis, Surface mapping, interpolation, Network analysis, and terrain analysis (DEM/DTM)

Module 5: Applications of Remote Sensing and GIS (8 Hours)

Introduction to RS & GIS software, Land use/Land cover Analysis - Change detection in Land use/ Land cover, NDVI, Introduction to Building Information Modelling (BIM) and the concept of Digital Twin, with applications in smart cities, infrastructure monitoring, and disaster resilience. Watershed Management - Evaluation of surface and ground water resources, flood inundation modelling and mapping, Urban planning and infrastructure development - Site suitability analysis for Urban and Regional planning, Environmental monitoring and disaster management.

Course Project

- Land Use and Land Cover Mapping
- Watershed Delineation

- Road Network Extraction and Analysis
- Spatio-Temporal Change Detection Analysis using Satellite Images
- Urban Expansion Monitoring and Risk Assessment

Text Books:

1. Thomas Lillesand, Ralph W. Kiefer, Jonathan Chipman, “Remote Sensing and Image Interpretation”, Wiley Publications, 2015.
2. George Joseph, “Fundamentals of Remote Sensing”, University Press, 2003
3. Kang-tsung Chang, “Introduction to Geographic Information Systems”, McGraw-Hill Education, 2017.

References:

1. M. Anji Reddy, “Remote Sensing and Geographical Information Systems”, B S Publications, 2024
2. C.P. Lo & Albert Yeung, “Concepts and Techniques of Geographic Information Systems”, Prentice Hall, 2008
3. Satheesh Gopi, “Advanced Surveying: Total Station, GIS and Remote Sensing”, Pearson Education, 2006.
4. Burrough P , “Principles of Geographical Information Systems”, Oxford University Press, 1998.
5. <https://developers.google.com/earth-engine>
6. [National Geospatial Policy PDF](#)

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	7 hours
1.1	Introduction to Remote sensing: Scope, Application overview, Evolution of remote sensing	1
1.2	Principles of Remote Sensing, Laws of remote sensing	1
1.3	Electromagnetic Spectrum and energy interactions	1
1.4	Remote Sensing Platforms: Aerial and Satellite Platforms, Satellite Data Products Sensors: passive and active sensors	2
1.5	Optical, Thermal, and Microwave Remote Sensing, LiDAR (concepts only)	1
1.6	Resolutions: spatial, spectral, temporal, and radiometric	1
2	Module 2	7 hours
2.1	Elements of image interpretation, Visual interpretation	1
2.2	Image pre-processing methods - Data formats, image enhancement, and its methods	1
2.3	Principal Component Analysis	1
2.4	Image classification: supervised and unsupervised, change detection, accuracy assessment, error matrix	2
2.5	Google Earth Engine platform for processing satellite data	2
3	Module 3	7 hours
3.1	Introduction, Principle, Definition, Components of GIS.	1
3.2	Application, coordinate systems and map projections GIS data types, data input, geometric transformation,	2
3.3	Spatial data editing, attribute data input and management, data exploration	2

3.4	Vector and raster data analysis, GPS - components, working principle, applications	2
4	Module 4	7 hours
4.1	Statistical analysis, Measurement, Proximity analysis (buffering)	1
4.2	Overlay analysis, Multicriteria analysis	2
4.3	Site suitability analysis, Nearest neighbour analysis	1
4.4	Surface mapping, interpolation	2
4.5	Network analysis, and terrain analysis (DEM/DTM)	1
5	Module 5	8 hours
5.1	Introduction to RS & GIS software	1
5.2	Land use/Land cover Analysis - Change detection in Land use/ Land cover, NDVI	2
5.3	Introduction to Building Information Modelling (BIM) and the concept of Digital Twin, with applications in smart cities, infrastructure monitoring, and disaster resilience	2
5.4	Watershed Management - Evaluation of surface and ground water resources, flood inundation modelling and mapping	2
5.5	Urban planning and infrastructure development - Site suitability analysis for Urban and Regional planning, Environmental monitoring and disaster management	1
Total		36 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Describe in detail the stages involved in the remote sensing process.
2. Compare aerial and satellite remote sensing platforms. Explain their advantages and limitations.

Course Outcome 2 (CO 2):

3. Discuss the importance of visual interpretation in remote sensing.
4. Discuss the role of PCA in data compression and information extraction from multi-spectral images.

Course Outcome 3 (CO 3):

5. Define GIS and explain its basic principles.
6. Describe the components of GPS and its major applications in surveying and mapping.

Course Outcome 4 (CO 4):

7. Define proximity analysis and explain the process of buffering in GIS with suitable examples.
8. Explain the role of overlay analysis in decision-making and resource management.

Course Outcome 5 (CO 5):

9. Explain Land Use and Land Cover (LULC) analysis using remote sensing.
10. Explain the process of watershed management using GIS and remote sensing.

MODEL QUESTION PAPER

QP CODE:

Pages: 3

Reg.No.:

Name:

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

FIFTH SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CE3P11

REMOTE SENSING & GIS

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Differentiate between active and passive remote sensing systems.
2. Name any three major remote sensing satellite missions and their purposes.
3. How are false colour composites useful in visual interpretation?
4. Explain the term “noise” in satellite imagery.
5. State the basic principle of GIS.
6. Differentiate between geographic and projected coordinate systems.
7. What is the importance of buffer zones in environmental planning?
8. What are the applications of DEM in civil engineering and planning?
9. How is remote sensing used in LULC classification?
10. Mention any three GIS-based applications in watershed studies.

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. Describe in detail the stages involved in the remote sensing process.

OR

12. a) What is a spectral signature? Why are the spectral responses of different surface materials (vegetation, soil, and water) are unique ? (7)
b) Compare aerial and satellite remote sensing platforms. Explain their advantages and limitations. (7)

MODULE 2

13. a) What are the common sources of errors in satellite imagery? Explain how image pre-processing methods correct these errors. (7)
b) Discuss the role of PCA in data compression and information extraction from multispectral images. (7)

OR

14. a) Explain how different sources of errors affect classification results and accuracy assessment. Suggest measures to minimize these errors. (8)
b) Discuss the advantages and applications of Google Earth Engine in remote sensing and environmental monitoring. (6)

MODULE 3

15. a) Discuss the applications of GIS in civil engineering and environmental management. (8)
b) What are coordinate systems and map projections? Explain their types and importance in GIS. (6)

OR

16. a) Describe the components of GPS and its major applications in surveying and mapping. (7)
b) Explain the process of data exploration and visualization in GIS. (7)

MODULE 4

17. a) Explain how overlay, buffering, and multicriteria analysis are integrated in GIS for site suitability assessment. (7)
b) Discuss the applications of DEM/DTM in hydrological and civil engineering studies. (7)

OR

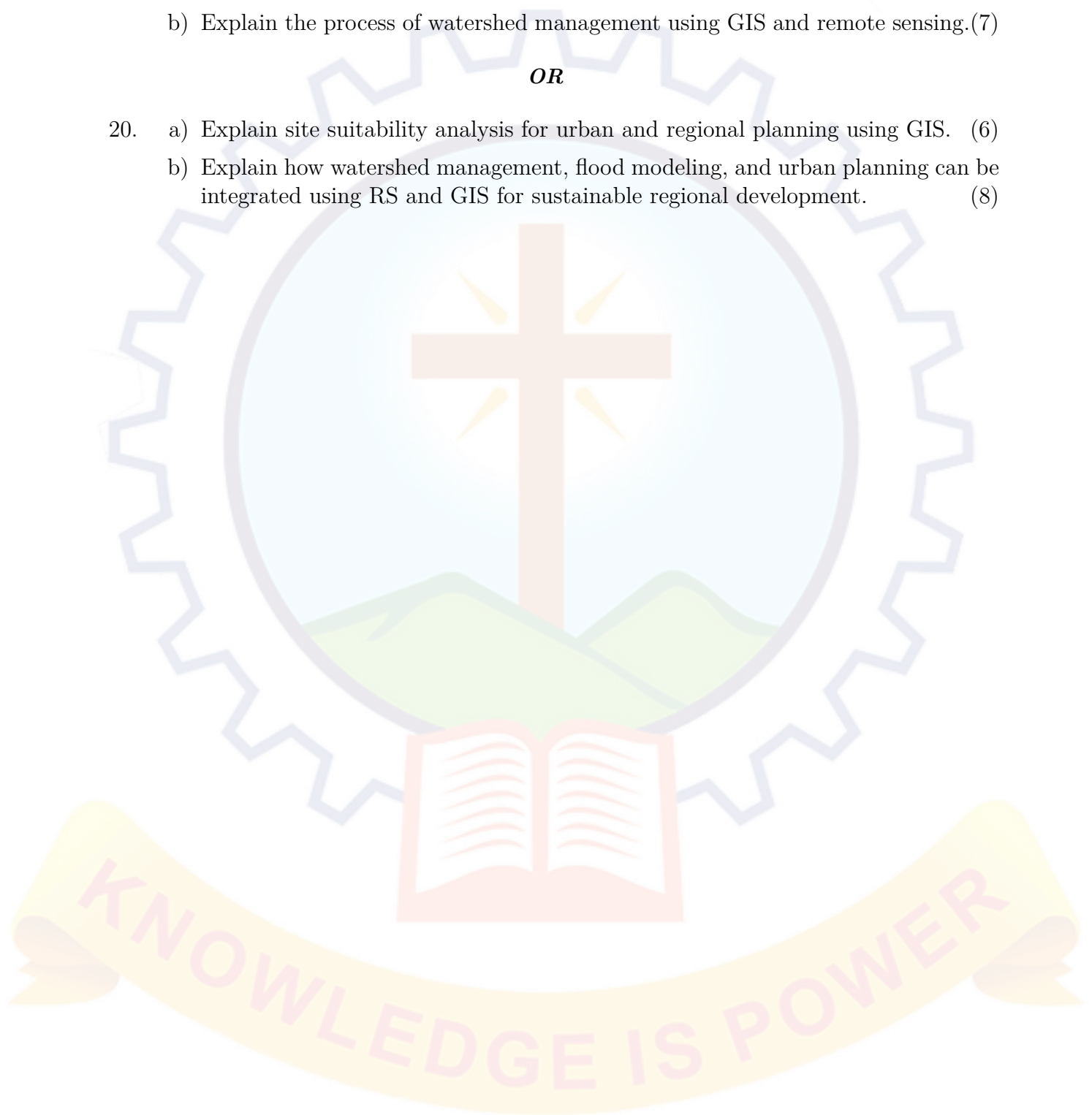
18. a) Explain the concept of surface mapping and interpolation in GIS. (6)
b) Explain the concept of Multi Criteria Analysis (MCA) in GIS. Describe the steps involved in conducting an MCA for spatial decision-making. (8)

MODULE 5

19. a) Explain NDVI (Normalized Difference Vegetation Index) and its applications in environmental monitoring and vegetation studies. (7)
b) Explain the process of watershed management using GIS and remote sensing. (7)

OR

20. a) Explain site suitability analysis for urban and regional planning using GIS. (6)
b) Explain how watershed management, flood modeling, and urban planning can be integrated using RS and GIS for sustainable regional development. (8)



CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE3P12	MODERN CONSTRUCTION MATERIALS	2	1	0	4	3	2024

Preamble

The course covers the properties of the ingredients of concrete and its influence on the performance of concrete. The course also focus to develop a strong understanding about the latest developments in the area of concrete technology with a clear knowledge about the fundamental mechanisms.

Prerequisites: Basics of Civil Engineering, Concrete Technology

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Explain the properties, manufacturing processes, and applications of modern engineered timber products and hybrid timber construction systems. (Cognitive Knowledge Level: Understand).
CO 2	Apply knowledge of modern masonry and modular walling materials to select appropriate sustainable masonry systems for construction applications. (Cognitive Level: Apply)
CO 3	Analyse the strength, deformation behaviour, durability, and corrosion protection performance of advanced metallic materials used in structural and architectural construction. (Cognitive Level: Analyze)
CO 4	Evaluate the suitability and performance of polymeric, composite, FRP strengthening, and protective systems for repair, retrofitting, and durability enhancement in construction. (Cognitive Level: Evaluate).
CO 5	Explain the characteristics, functional behavior, and potential civil engineering applications of smart, responsive, and advanced functional materials for intelligent and sustainable infrastructure. (Cognitive Level: Understand).

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	2	1	2	2	1	1	1	2	1	2
CO 2	3	3	2	2	3	2	1	1	2	2	2
CO 3	2	3	3	3	3	2	1	1	2	2	2
CO 4	2	3	2	3	3	3	2	2	2	2	3
CO 5	3	2	1	2	3	2	1	1	2	1	2

Assessment Pattern

MODERN CONSTRUCTION MATERIALS			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	30	20	10
Understand	40	30	40
Apply	20	30	30
Analyse	10	10	10
Evaluate		10	10
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	40	60	3 hours

Continuous Internal Evaluation Pattern

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course project : 10 marks

Self Study : 5 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question carries 14 marks and can have maximum 2 sub-divisions.

SYLLABUS

Module 1: Modern Timber-Based Construction Materials (7 hours)

Modern timber in construction-Evolution of engineered timber products-Cross Laminated Timber (CLT):-Laminated Veneer Lumber (LVL-Glued Laminated Timber-Plywood--Structural Composite Lumber (SCL)-Wood-Plastic Composites (WPC)- Hybrid timber (timber-steel, timber-concrete) systems (timber-steel, timber-concrete)-Fire resistance, durability, and serviceability properties.

Module 2: Masonry and Modular Walling Materials (7 hours)

Modern masonry concepts in construction-reinforced masonry -Autoclaved Aerated Concrete (AAC) blocks-Fly ash blocks-Calcium silicate blocks-Dry stack and thin joint masonry systems-Compressed Earth Blocks (CSEB)-Hollow and cellular concrete blocks-Interlocking masonry units-Dry stack and thin joint masonry systems.

Module 3: Metallic Materials for Modern Construction(7 Hours)

High-strength and high-performance steels-Cold-formed steel sections-Stainless steels for structural and architectural applications-Aluminium alloys for construction-Titanium alloys (specialised structural and façade applications)-Corrosion-resistant coated materials (galvanised, aluminised, Zn-Al-Mg coatings)

Module 4: Polymeric and Composite Construction Materials(8 Hours)

Classification of polymers (thermoplastics, thermosets, elastomers)-Fibre Reinforced Polymer (FRP) composites -FRP strengthening systems -Polymer matrix composites (PMC) and hybrid composites-Sandwich panels and composite structural panels-Advanced construction chemicals (admixtures, sealants, adhesives, grouts, coatings)-Polymer-modified mortars and concretes-Protective coatings and corrosion protection systems-Laminates and surface finishes.

Module 5: Smart and Advanced Functional Materials(7 Hours)

Introduction to smart materials in construction-Shape Memory Alloys (SMA): temperature-responsive behavior-Piezoelectric materials: sensing and actuation properties- Magnetostrictive materials- Electrochromic and photochromic materials-Adaptive and vibration control materials-Functional material properties and performance characteristics.

Course Project: Each student should inspect their house to identify the materials used in construction. They need to study the properties of these materials and explain why each material was chosen for its specific purpose in the building.

Text Books:

1. V. Raghavan, “Materials Science and Engineering: A first course”, Prentice Hall, 2004
2. R.A. Higgins, “Properties of Engineering Materials”, Industrial Press, 1994
3. J.M. Gere, “Mechanics of Materials”, Nelson Thornes, 2001
4. T.L. Anderson, “Fracture Mechanics: Fundamentals and applications”, CRC Press, 1991
5. M.F. Ashby and D.R.H. Jones, “Engineering Materials 1”, Elsevier, 2005
6. P.C. Varghese, “Building Materials”, Prentice-Hall India, 2005.

References:

1. J.F. Young, S. Mindess, R.J. Gray and A. Bentur, “The Science and Technology of Civil Engineering Materials”, Prentice Hall, 1998
2. W.D. Callister, “Materials Science and Engineering: An introduction”, John Wiley, 1994
3. J.M. Illston and P.L.J. Domone, “Construction Materials: Their nature and behaviour”, Spon Press, 2001
4. P. Kumar Mehta and Paulo J. M. Monteiro, “Concrete, Microstructure, Properties and Materials”, Indian Concrete Institute, Chennai.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	7 hours
1.1	Modern timber in construction-Evolution of engineered timber products-Cross Laminated Timber (CLT):-Laminated Veneer Lumber (LVL-Glued Laminated Timber-Plywood-Structural Composite Lumber (SCL)	4
1.2	Wood-Plastic Composites (WPC)- Hybrid timber (timber-steel, timber-concrete) systems (timber-steel, timber-concrete)-	2
1.3	Fire resistance, durability, and serviceability properties	1
2	Module 2	7 hours
2.1	Modern masonry concepts in construction-reinforced masonry -Autoclaved Aerated Concrete (AAC) blocks	2
2.2	Fly ash blocks-Calcium silicate blocks-Dry stack and thin joint masonry systems-Compressed Earth Blocks (CSEB)	2
2.3	Hollow and cellular concrete blocks-Interlocking masonry units-Dry stack and thin joint masonry systems	3
3	Module 3	7 hours
3.1	High-strength and high-performance steels-Cold-formed steel sections-Stainless steels for structural and architectural applications	3
3.2	Aluminium alloys for construction-Titanium alloys (specialised structural and façade applications)	3
3.3	Corrosion-resistant coated materials (galvanised, aluminised, Zn-Al-Mg coatings)	1

4	Module 4	8 hours
4.1	Classification of polymers (thermoplastics, thermosets, elastomers)–Fibre Reinforced Polymer (FRP) composites – FRP strengthening systems –Polymer matrix composites (PMC) and hybrid composites–Sandwich panels and composite structural panels	3
4.2	Advanced construction chemicals (admixtures, sealants, adhesives, grouts, coatings)	2
4.3	Polymer-modified mortars and concretes–Protective coatings and corrosion protection systems–Laminates and surface finishes	3
5	Module 5	7 hours
5.1	Introduction to smart materials in construction-Shape Memory Alloys (SMA): temperature-responsive behavior	2
5.2	Piezoelectric materials: sensing and actuation properties-Magnetostrictive materials	3
5.3	Electrochromic and photochromic materials-Adaptive and vibration control materials-Functional material properties and performance characteristics	2
Total		36 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Explain the concept of engineered timber products. Discuss the composition, structural behaviour, and applications of Cross Laminated Timber (CLT).
2. Describe hybrid timber construction systems. Explain timber–steel and timber–concrete systems with advantages and typical applications.

Course Outcome 2 (CO 2):

1. Explain Autoclaved Aerated Concrete (AAC) blocks and fly ash blocks. Compare their properties and advantages in modern construction.
2. Describe dry stack masonry and thin-joint masonry systems. Explain their construction method and advantages over conventional masonry.

Course Outcome 3 (CO 3):

1. Explain high-strength steels used in construction. Discuss their mechanical properties and structural applications.
2. Describe cold-formed steel sections. Explain their manufacturing process, advantages, and uses in building construction.

Course Outcome 4 (CO 4):

1. Explain Fibre Reinforced Polymer (FRP) composites. Discuss types of fibres, properties, and applications in civil engineering.
2. Describe polymer-modified mortars and construction chemicals. Explain their role in improving durability and performance of structures.

Course Outcome 5 (CO 5):

1. Explain smart materials used in construction. Describe the working principle and applications of Shape Memory Alloys (SMA).
2. Explain piezoelectric and electrochromic materials. Discuss their applications in sensing, vibration control, and adaptive building systems.

MODEL QUESTION PAPER

QP CODE:

Pages: 2

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

FIFTH SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CE3P12

MODERN CONSTRUCTION MATERIALS

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. What is Cross Laminated Timber (CLT)? List two advantages of CLT over conventional timber.
2. Briefly explain hybrid timber–concrete construction systems with one application.
3. What are Autoclaved Aerated Concrete (AAC) blocks? Mention two key properties.
4. State the principle of dry stack masonry and list two advantages over conventional masonry.
5. What are cold-formed steel sections? Mention two structural applications.
6. List the advantages of Zn–Al–Mg coated steel over conventional galvanised steel.
7. Define Fibre Reinforced Polymer (FRP) composites and mention two types of fibres used.
8. What are polymer-modified mortars? State two performance benefits.
9. What is the shape memory effect in Shape Memory Alloys (SMA)?
10. State the working principle of piezoelectric materials used in civil engineering structures.

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. Discuss the evolution of engineered timber products. Explain the manufacturing process, structural behavior, fire resistance, and applications of CLT and Glued Laminated Timber. (14)

OR

12. Explain Wood–Plastic Composites (WPC) and Structural Composite Lumber (SCL). Compare their properties, durability, and applications in modern construction. (14)

MODULE 2

13. Describe modern masonry systems including AAC blocks, fly ash blocks, and calcium silicate blocks. Compare their mechanical and durability properties. (14)

OR

14. Explain reinforced masonry, interlocking masonry units, and thin-joint masonry systems with sketches and construction advantages. (14)

MODULE 3

15. Discuss high-strength steels and cold-formed steel sections used in construction. Explain their mechanical behavior, advantages, and typical applications. (14)

OR

16. Explain corrosion mechanisms in metallic structures. Discuss galvanised, aluminised, and Zn–Al–Mg coating systems for corrosion resistance. (14)

MODULE 4

17. Explain FRP composites and FRP strengthening systems. Describe their role in repair, retrofitting, and durability enhancement of concrete structures. (14)

OR

18. Describe the role of construction chemicals in building construction. Explain the applications and performance criteria of admixtures, adhesives, sealants, grouts, and protective coatings. (14)

MODULE 5

19. Explain the classification and working principles of smart materials used in construction. Discuss Shape Memory Alloys and their civil engineering applications. (14)

OR

20. Describe piezoelectric, magnetostrictive, electrochromic, and photochromic materials. Explain their applications in vibration control, sensing, and adaptive building systems. (14)

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE3P13	GEO-ENVIRONMENTAL ENGINEERING	2	1	0	4	3	2024

Preamble

The course introduces environmental challenges in geotechnical engineering with emphasis on waste containment, contaminant transport, and site remediation. It integrates geotechnical and environmental principles to address engineering problems related to landfill design, liner systems, soil-pollutant interaction, and geosynthetics. The course aims to develop the ability to design safe, sustainable waste management systems and select appropriate remediation strategies for contaminated sites.

Prerequisites: Soil Mechanics, Environmental Engineering.

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Identify waste characteristics, soil-pollutant interaction, and regulatory requirements relevant to the basic design of containment systems.
CO 2	Explain contaminant transport mechanisms and attenuation concepts to evaluate the performance of liners and barrier systems.
CO 3	Develop design concepts for engineered landfill systems by considering waste properties, liner systems, leachate control, and stability requirements.
CO 4	Recognize types and functions of geosynthetics and apply their use in the design, installation, and performance evaluation of containment and liner systems.
CO 5	Examine contaminated site conditions and apply appropriate investigation, risk assessment, and remediation strategies based on engineering and constructability considerations.

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	2	2	1	-	-	2	2	-	-	-	-
CO 2	2	3	1	2	2	-	1	-	-	-	-
CO 3	3	2	3	-	2	2	3	-	-	-	1
CO 4	3	2	3	-	3	-	2	-	-	-	-
CO 5	2	3	2	3	2	2	3	-	-	-	1

Assessment Pattern

GEO-ENVIRONMENTAL ENGINEERING			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	20	20	20
Understand	40	40	30
Apply	40	40	50
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 10 marks
Self Study	: 5 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question carries 14 marks and can have maximum 2 sub-divisions.

SYLLABUS

Module 1: Fundamentals of Geoenvironmental Engineering (5 hours)

Scope and Role of Geoenvironmental Engineering: Role of geoenvironmental engineering in waste containment and site remediation projects, Overview of contamination sources: industrial, agricultural, and municipal.

Waste Classification Relevant to Containment Design: Basic classification- municipal solid waste and hazardous waste, Engineering significance of waste properties affecting containment system design.

Soil-Pollutant Interaction: Role of soil in geo-environmental applications, Key soil properties influencing containment performance: mineralogy and cation exchange capacity, Conceptual understanding of soil-pollutant interaction for liner design.

Environmental Regulations: Introduction to Indian environmental regulations relevant to geoenvironmental design, Solid Waste Management Rules, 2026 with reference to landfill design requirements.

Module 2: Contaminant Transport and Behaviour (5 hours)

Contaminant Transport and Behaviour : Multiphase behaviour of soil- Importance of soil physics, soil chemistry, hydrogeology, biological process – impact of ground contamination on geoenvironment.

Contaminant Transport Mechanisms: Overview of advection, diffusion, dispersion, sorption, and biodegradation, Laboratory evaluation: sequential batch-contact testing & Column percolation testing (brief description only).

Retardation and Contaminant Attenuation: Geochemistry- Geochemical Attenuation- Quantification of attenuation capacities, Concept of retardation factor.

Module 3: Solid and Hazardous Waste Management (9 Hours)

Waste Characterization for Design: Waste generation rates and basic physical-chemical characterization, Engineering relevance of waste properties in landfill design, Identification of Hazardous and Non-Hazardous waste.

Engineered Landfill Design: Landfill site selection based on geological, hydrogeological, and environmental constraints, Major landfill components- Liner systems (single, double and composite), Leachate collection systems (primary and secondary leachate collection and removal system), Gas collection and venting systems (Gas extraction systems-passive and active system), Final cover systems.

Liner System Design Considerations: Design principles of clay liners and geomembranes, Interface behaviour and leakage control concepts.

Module 4: Geosynthetics in Geoenvironmental Engineering

(9 Hours)

Types and Functions of Geosynthetics: Types- Geotextiles, geomembranes, geogrids, geonets, and GCLs, Functional roles - separation, filtration, drainage, reinforcement, and containment. Compacted clay liner- selection of soil for liner, properties- effect of compaction on permeability of clay.

Geosynthetics in Containment Systems: Use of geomembranes and GCLs in landfill liners and covers, Hydraulic and mechanical behaviour under field conditions.

Durability, Quality Control, and Applications: Design considerations for geosynthetic systems, Installation practices, quality assurance, and quality control

Module 5: Site Investigation and Remediation

(8 Hours)

Contaminated Site Investigation: Site characterization and investigation planning, risk assessment of contaminated site. Soil and groundwater sampling methods, Monitoring using piezometers and observation wells.

Data Interpretation and Risk Assessment: Interpretation of investigation data for engineering decisions, Environmental risk assessment - hazard identification and exposure pathways.

Remediation Techniques: Selection and planning of remediation methods, Physical methods - pump-and-treat, soil vapor extraction, Phyto remediation and electro-kinetic remediation, Thermal remediation, biological remediation methods (overview).

Text Books:

1. Sharma, H.D. & Lewis, S.P. *Waste Containment Systems, Waste Stabilization and Landfills: Design and Evaluation*, 1st ed., Wiley-Interscience, New York, 1994
2. Rowe, R.K. *Geoenvironmental Engineering: Contaminated Soils, Pollutant Fate and Mitigation*, 1st ed., CRC Press, Boca Raton, 2001
3. Fetter, C.W. *Contaminant Hydrogeology*, 3rd ed., Waveland Press, Long Grove (IL), 2017

References:

1. Koerner, R.M. *Designing with Geosynthetics*, 6th ed., Xlibris (formerly published by Prentice Hall), Philadelphia, 2012
2. Tchobanoglous, G., Theisen, H., & Vigil, S.A. *Integrated Solid Waste Management: Engineering Principles and Management Issues*, 2nd ed., McGraw-Hill, New York, 1993
3. Daniel, D.E. (ed.) *Geotechnical Practice for Waste Disposal*, 1st ed., Chapman & Hall/Springer, New York, 1993
4. Bear, J. *Dynamics of Fluids in Porous Media*, Revised ed., Dover Publications, New York, 1988
5. Davis, M.L. & Cornwell, D.A. *Introduction to Environmental Engineering*, 5th ed., McGraw-Hill Education, New York, 2012

6. Bagchi, A. *Design of Landfills and Integrated Solid Waste Management*, 1st ed., McGraw-Hill Education (India), New Delhi, 2018 (typical Indian edition year).
7. NPTEL Course – Prof. A. Sridharan (IISc) *Geoenvironmental Engineering*, NPTEL online course material, Indian Institute of Science (IISc), available through NPTEL platform

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	5 hours
1.1	Role of geoenvironmental engineering in waste containment and site remediation projects, Overview of contamination sources: industrial, agricultural, and municipal	1
1.2	Basic classification municipal solid waste and hazardous waste, Engineering significance of waste properties affecting containment system design	1
1.3	Role of soil in geo-environmental applications, Key soil properties influencing containment performance	1
1.4	mineralogy and cation exchange capacity, Conceptual understanding of soil–pollutant interaction for liner design	1
1.5	Introduction to Indian environmental regulations relevant to geoenvironmental design, Solid Waste Management Rules, 2026 with reference to landfill design requirements	1
2	Module 2	5 hours
2.1	Multiphase behaviour of soil- Importance of soil physics, soil chemistry, hydrogeology, biological process – impact of ground contamination on geoenvironment	1
2.2	Overview of advection, diffusion, dispersion, sorption, and biodegradation	1
2.3	Laboratory evaluation: sequential batch-contact testing and Column percolation testing	1

2.4	Geochemistry-Geochemical Attenuation	1
2.5	Quantification of attenuation capacities, Concept of retardation factor and its use in assessing barrier effectiveness	1
3	Module 3	9 hours
3.1	Waste generation rates and basic physical-chemical characterization	1
3.2	Engineering relevance of waste properties in landfill design.	1
3.3	Identification of Hazardous and Non-Hazardous waste.	1
3.4	Landfill site selection based on geological, hydrogeological, and environmental constraints	1
3.5	Major landfill components- Liner systems (single, double and composite), Leachate collection systems (primary and secondary leachate collection and removal system)	2
3.6	Gas collection and venting systems (Gas extraction systems-passive and active system), Final cover systems	1
3.7	Design principles of clay liners and geomembranes	1
3.8	Interface behaviour and leakage control concepts	1
4	Module 4	9 hours
4.1	Types- Geotextiles, geomembranes, geogrids, geonets, and GCLs	1
4.2	Functional roles - separation, filtration, drainage, reinforcement, and containment	2
4.3	Compacted clay liner- selection of soil for liner	1
4.4	Properties- effect of compaction on permeability of clay.	1
4.5	Use of geomembranes and GCLs in landfill liners and covers	1
4.6	Hydraulic and mechanical behaviour under field conditions	1
4.7	Design considerations for geosynthetic systems	1

4.8	Installation practices, quality assurance, and quality control	1
5	Module 5	8 hours
5.1	Site characterization and investigation planning	1
5.2	Risk assessment of contaminated site.	1
5.3	Soil and groundwater sampling methods, Monitoring using piezometers and observation wells	1
5.4	Interpretation of investigation data for engineering decisions	1
5.5	Environmental risk assessment - hazard identification and exposure pathways	1
5.6	Selection and planning of remediation methods	1
5.7	Physical methods - pump-and-treat, soil vapor extraction, Phyto remediation and electro-kinetic remediation, Thermal remediation, biological remediation methods (overview)	2
Total		36 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Identify the major sources of environmental contamination and classify wastes relevant to containment system design.
2. Assess how soil mineralogy and cation exchange capacity influence the selection of materials for landfill liner systems.

Course Outcome 2 (CO 2):

1. Explain the mechanisms of advection, diffusion, and dispersion governing contaminant migration in soils.
2. Evaluate the effectiveness of a liner system using retardation factor and breakthrough curve concepts.

Course Outcome 3 (CO 3):

1. Describe the components of an engineered landfill system and state their functions.
2. Develop a conceptual design for a landfill liner and leachate collection system considering waste characteristics and stability requirements.

Course Outcome 4 (CO 4):

1. Identify different types of geosynthetics and state their functional roles in geoenvironmental applications.
2. Select a suitable geosynthetic system for a landfill liner or cover and justify the choice based on hydraulic and durability considerations.

Course Outcome 5 (CO 5):

1. Explain the objectives of contaminated site investigation and the role of groundwater monitoring systems. .
2. Examine site conditions and apply appropriate remediation techniques based on risk assessment and constructability considerations.

MODEL QUESTION PAPER

QP CODE:

Pages: 3

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

FIFTH SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CE3P13

GEO-ENVIRONMENTAL ENGINEERING

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Define geoenvironmental engineering and state its relevance to waste containment projects.
2. Explain the engineering significance of waste characteristics in containment system design.
3. List the key mechanisms controlling contaminant movement through soil.
4. Describe the importance of retardation factor in evaluating liner performance.
5. An engineered landfill functions as an integrated containment system. Enumerate the major components contributing to its performance.
6. Waste characterization is essential before landfill design. Justify this requirement from an engineering perspective.
7. Name different types of geosynthetics used in geoenvironmental applications.
8. State the functional roles of geosynthetics in containment systems.
9. Outline the objectives of contaminated site investigation.
10. Identify the role of groundwater monitoring in contaminated land assessment.

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. a) Describe the scope of geoenvironmental engineering in site remediation and environmental protection. . (7)
b) Outline the influence of soil mineralogy and cation exchange capacity on soil-pollutant interaction. (7)

OR

12. a) Assess the importance of waste classification in selecting suitable containment systems. (7)
b) Examine the impact of Solid Waste Management Rules, 2026 on landfill design requirements. (7)

MODULE 2

13. a) Explain the processes governing contaminant migration through soil media. (7)
b) Elaborate the role of sorption isotherms in the selection of liner materials. (7)

OR

14. a) Explain sequential batch-contact testing and column percolation testing. (7)
b) Evaluate contaminant migration through a liner using transport and attenuation concepts. (7)

MODULE 3

15. a) Describe the criteria used for landfill site selection from a geoenvironmental perspective. (7)
b) Explain the functions of liner, leachate collection, gas control, and cover systems in a landfill. (7)

OR

16. a) Develop a conceptual design of a composite liner system for a municipal solid waste landfill. (7)
b) With the help of a diagram, explain the major components of a landfill liner system. (7)

MODULE 4

17. a) Describe the hydraulic and mechanical behaviour of geomembranes used in landfill liners. (7)
b) Outline installation practices and quality control measures for geosynthetic liner systems. (7)

OR

18. a) Select a suitable geosynthetic liner system for a landfill and justify the selection criteria. (7)
b) Assess durability and service-life considerations in the design of geosynthetic containment systems. (7)

MODULE 5

19. a) Describe the steps involved in contaminated site investigation and data interpretation. (7)
b) Outline the components of environmental risk assessment with respect to contaminated sites. (7)

OR

20. a) Examine site conditions and apply suitable remediation techniques for contaminated soil and groundwater. (7)
b) Recommend an appropriate remediation strategy based on risk reduction, constructability, and cost considerations. (7)

KNOWLEDGE IS POWER

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE3P14	SAFETY IN CONSTRUCTION	2	1	0	4	3	2024

Preamble

This course introduces principles and practices of construction safety, emphasizing hazard identification, accident prevention, and safety management systems.

Prerequisites: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Understand the need for safety culture and summarize the roles and responsibilities of stakeholders in ensuring construction site safety and accident prevention (Cognitive Knowledge Level: Understand).
CO 2	Apply relevant codes and standards to implement safety measures in various construction operations such as excavation, concreting, masonry, and steel fabrication (Cognitive Level: Apply)
CO 3	Identify potential hazards in different construction activities and propose suitable preventive and protective measures to mitigate risks (Cognitive Level: Understand)
CO 4	Demonstrate safe handling, operation, and storage practices for construction materials and equipment in accordance with prescribed safety standards (Cognitive Level: Understand).
CO 5	Understand comprehensive safety management plan incorporating job safety analysis, hazard identification, PPE selection, and emergency preparedness procedures (Cognitive Level: Understand).

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	2	3	1			1					
CO 2	3	3	1	1	1	1		1			
CO 3	3	3	2			1	1	1			
CO 4	3	3	1	1	1	1	1				
CO 5	2	3	1			1	1				

Assessment Pattern

SAFETY IN CONSTRUCTION			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	50	30	30
Understand	40	60	60
Apply	10	10	10
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course project : 10 marks

Self Study : 5 marks

End Semester Examination Pattern

There will be two parts: Part A and Part B. Part A contain 10 questions, with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module, of which students should answer any one. Each question carries 14 marks and can have a maximum of 2 sub-divisions.

SYLLABUS

Module 1: Introduction to Construction Safety (7 hours)

Need for safety culture in construction industry, Preventing construction accidents, safety in construction industry, Roles and responsibilities (employer, employee, engineer, safety officer), overall safety management at construction sites- accident prevention programme- Framing of contract conditions on safety and related matters.

Module 2: Safety Practices (7 hours)

Safety practice during construction, excavation, safety in concreting work, safety measures needed in fabrication and erection of steel work, masonry work and other general building works. Familiarisation with relevant Indian Standards and the National Building Code provisions on construction safety.

Module 3: Hazards in Construction (7 Hours)

Fall hazards, excavation and trenching hazards, Material handling, lifting operations, Fire hazards, electrical hazards, scaffolding and ladder safety, Confined spaces and working at heights, Underpinning, Safety in tunnelling, Hazards due to bad workmanship and faulty construction.

Module 4: Safety in Material Handling (7 Hours)

Safety in material handling, safety in equipment handling – Safety in storage & stacking of construction materials. Safety in the use of construction equipment/vehicles – excavators, graders and dozers – cranes – hoists & lifts – other lifting gears - wire ropes – chain-pulley blocks – mixers – conveyors – pneumatic and hydraulic tools in construction. Safety in temporary power supply and fire safety at construction site.

Module 5: Safety Management and Planning (8 Hours)

Safety Management and Planning, Safety Policy, Safety Management System (SMS), Job Safety Analysis (JSA) for masonry, concreting, excavation, shuttering, etc. Hazard Identification and Risk Assessment (HIRA), Safety Training and Induction, Personal Protective Equipment (PPE), Emergency preparedness and response plans.

Text Books:

1. Hinze, J.W. (1997) Construction Safety, Prentice Hall

2. MacCollum, D.V. (1995) Construction Safety Planning, John Wiley & Sons
3. Reese, C.D. & Eidson, J.V. (2006) Handbook of OSHA Construction Safety and Health, Taylor & Francis.
4. Lingard, H. & Rowlinson, S. (2005) Occupational health and Safety in Construction Project Management, Spon Press.

References:

1. Holt, A.S.J. (2005) Principles of Construction Safety, Wiley-Blackwell Publishers
2. MacCollum, D.V. (2007) Construction Safety Engineering Principles, McGraw Hill Publishers
3. Bhattacharjee, S.K. (2011) Safety Management in Construction, Khanna Publishers
4. R.K Mishra, Construction Safety, AITBS Publishers, India
5. S.P. Gupta & H.R. Gupta, Construction Safety Management, Laxmi Publications

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	7 hours
1.1	Introduction to Construction Safety, Need for safety culture in construction industry, Preventing construction accidents	2
1.2	Safety in construction industry, Roles and responsibilities (employer, employee, engineer, safety officer)	2
1.3	Overall safety management at construction sites	2
1.4	Accident prevention programme- Framing of contract conditions on safety and related matters	1
2	Module 2	8 hours
2.1	Safety practice during construction, excavation	2
2.2	Safety in concreting work	1
2.3	Safety measures needed in fabrication and erection of steel work, masonry work and other general building works	2
2.4	Familiarisation with relevant Indian Standards and the National Building Code provisions on construction safety	3
3	Module 3	6 hours
3.1	Hazards in Construction, Fall hazards, excavation and trenching hazards, material handling, lifting operations	2
3.2	Fire hazards, electrical hazards, scaffolding and ladder safety	1
3.3	Confined spaces and working at heights	1
3.4	Underpinning, Safety in tunnelling, Hazards due to bad workmanship and faulty construction	2

4	Module 4	7 hours
4.1	Safety in material handling and equipment – Safety in storage stacking of construction materials. hydraulic tools in construction. Safety in temporary power supply and fire safety at construction site	2
4.2	Safety in the use of construction equipment/vehicles – excavators, graders and dozers	2
4.3	Cranes – hoists lifts – other lifting gears-wire ropes – chain-pulley blocks – mixers – conveyors	1
4.4	Pneumatic and hydraulic tools in construction	1
4.5	Safety in temporary power supply and fire safety at construction site	1
5	Module 5	8 hours
5.1	Safety Management and Planning, Safety Policy, Safety Management System (SMS)	1
5.2	Job Safety Analysis (JSA) for masonry, concreting, excavation, shuttering, etc	2
5.3	Hazard Identification and Risk Assessment (HIRA)	2
5.4	Safety Training and Induction, Personal Protective Equipment (PPE)	2
5.5	Emergency preparedness and response plans	1
Total		36 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Summarize the major causes of accidents in the construction sector.
2. Explain the safety responsibilities of the employer, employee, engineer, and safety officer.

Course Outcome 2 (CO 2):

1. Illustrate how you would implement a daily safety checklist for a construction site.
2. Suggest safety precautions to prevent soil collapse and worker injury during excavation in loose soil.

Course Outcome 3 (CO 3):

1. Illustrate how you would implement a daily safety checklist for a construction site.
2. Suggest safety precautions to prevent soil collapse and worker injury during excavation in loose soil.

Course Outcome 4 (CO 4):

1. Describe the significance of training workers in safe material handling techniques.
2. Explain the potential hazards while operating excavators, graders, and dozers.

Course Outcome 5 (CO 5):

1. Explain the meaning and importance of hazard identification in construction.
2. Describe the steps involved in performing a Job Safety Analysis.

MODEL QUESTION PAPER

QP CODE:

Pages: 3

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

FIFTH SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CE3P14

SAFETY IN CONSTRUCTION

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Explain the term construction safety and describe why it is essential in the construction industry.
2. Describe the key elements that promote a strong safety culture in construction projects.
3. Illustrate good housekeeping and waste management practices to maintain safe site conditions.
4. List out three safety violations in construction site.
5. Describe the common types of hazards encountered at construction sites.
6. Describe preventive measures to minimize the risk of falls from heights.
7. Describe the key elements of an effective safety management plan.
8. Describe common hazards associated with manual material handling.
9. Explain the safety precautions to be taken while operating concrete mixers.
10. Explain the concept of a Safety Management System (SMS).

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. a) Discuss the need for developing a positive safety culture in construction sites. (7)
b) Describe the key elements that promote a strong safety culture in construction projects. (7)

OR

12. a) Explain the different types of preventive measures used to reduce accidents at construction sites. (7)
b) Describe how regular safety training and supervision help in accident prevention. (7)

MODULE 2

13. a) Prepare a brief site safety plan for a medium-sized construction project (7)
b) Demonstrate how you would ensure safety of workers and nearby structures during excavation near an existing building. (7)

OR

14. a) Develop a safety checklist for working at height during steel structure erection.
b) Illustrate how you would ensure safety in welding, cutting, and bolting operations during steel fabrication. (6)

MODULE 3

15. a) Explain the term construction hazard and describe its significance in ensuring site safety. (8)
b) Describe the importance of shoring, benching, and sloping in excavation safety. (6)

OR

16. a) Explain the common causes of fire hazards at construction sites. (6)
b) Describe the preventive measures to be adopted for fire safety in construction areas. (8)

MODULE 4

17. a) Explain the main causes of fire hazards in construction sites. (7)
b) Discuss preventive measures to be taken to avoid fire accidents. (7)

OR

18. a) Explain the potential hazards while operating excavators, graders, and dozers. (6)
b) Describe the safety checks to be performed before operating earthmoving equipment. (8)

MODULE 5

19. a) Explain the purpose of conducting a Job Safety Analysis in construction activities. (7)
b) Describe the steps involved in performing a Job Safety Analysis. (7)

OR

20. a) Discuss the difference between hazard, risk, and control measures. (6)
b) Explain the basic steps involved in HIRA at a construction site. (8)

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE3P15	ENGINEERING GEOLOGY	2	1	0	4	3	2024

Preamble

Goal of this course is to introduce to the students the basics of earth processes, materials, groundwater and the geological characteristics of such processes and materials which are relevant to the Civil Engineering applications.

Prerequisites: NIL

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Understand the importance of geological knowledge in planning, designing and construction of various civil projects. (Cognitive Knowledge Level: Apply)
CO 2	Understand the dynamic nature of earth, the associated geomorphic surface and subsurface earth processes and their significance in civil engineering. (Cognitive Knowledge Level: Apply)
CO 3	Apply basic knowledge about ground water and identify the problems created by ground water to civil engineering projects. (Cognitive Knowledge Level: Apply)
CO 4	Understand basic knowledge about different minerals, various rocks and their classification and identification and their significance in civil engineering. (Cognitive Knowledge Level: Apply)
CO 5	Analyse the process involved in rock deformation and formation of various geological structures such as folds, faults, joints and their critical aspects in stability of civil engineering structures. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	2					1	2				
CO 2	3										
CO 3	3										
CO 4	3	2									
CO 5	3	1	3			3	3	2			2

Assessment Pattern

ENGINEERING GEOLOGY			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	20	20	20
Understand	40	40	40
Apply	40	40	40
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course project : 10 marks

Self Study : 5 marks

End Semester Examination Pattern

There will be two parts: Part A and Part B. Part A contain 10 questions, with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module, of which students should answer any one. Each question carries 14 marks and can have a maximum of 2 sub-divisions.

SYLLABUS

Module 1: External Earth Processes (8 hours)

Relevance of Geology in Civil Engineering, Surface Processes of the earth- a) Weathering of rocks-Types of weathering, Processes of Origin of Products of weathering like sand, clay, laterite and soil, soil profile, Soil erosion and soil conservation measures. Engineering significance of weathering. b) Geological processes by rivers. c) Landslides-types, causes and controlling measures, Coastal Processes-Geological work by waves and currents and coastal protection measures.

Module 2: Internal Earth Processes (7 hours)

Internal Processes of the earth- Earthquakes- Plate Tectonics, Origin of earthquakes, Seismic waves, Rating of earthquakes, types of earthquakes, Seismic zones of India. Basics of seismic safety factor, Interior of the earth as revealed by propagation of seismic waves.

Module 3: Groundwater (7 Hours)

Hydrogeology-Occurrence of groundwater, aquifers and types of aquifers, confining beds, porosity and vertical distribution of groundwater. Darcy's Law. Permeability/hydraulic conductivity. Problems created by groundwater to civil engineering structures, Methods to control groundwater problems, Electrical resistivity survey for groundwater exploration. Seawater intrusion in Coastal area. Ghyben Herzberg relation.

Module 4: Earth Materials (7 Hours)

Mineralogy-Physical properties of minerals, physical properties and chemical composition of minerals like quartz, orthoclase, plagioclase, biotite, muscovite, hornblende, augite, hypersthene, calcite, gypsum. Petrology-Igneous, sedimentary and metamorphic rocks, Igneous rocks-Chemical and mineralogical classification and structure. Sedimentary rocks-types based on mode of formation and structures Metamorphic rocks-structures only. Megascopic study of granite, dolerite, basalt, sandstone, limestone, shale, gneiss, marble and charnockite. Rock types of Kerala. Rock cycle

Module 5: Secondary Structures of Rocks (7 Hours)

Structural Geology- Attitude of rocks – Dip and Strike. Terminology, brief classification and engineering significance of folds, faults and joints. Geological part of site investigation for the construction of dams, reservoirs and tunnels. Toposheet. Structural mapping. Clinometer compass and Brunton compass.

Course Project

- Select a local hillside or riverbank site (e.g., in Kerala) and conduct field surveys to identify weathering types (physical, chemical, biological) and soil profiles.
- Choose a city or region in a seismic zone and use online seismic data (e.g., from USGS or IMD) to plot epicenters, seismic waves propagation, and fault lines.
- Survey a coastal aquifer site (e.g., in Kerala) for porosity, permeability, and confining beds using slug tests or simple infiltration experiments.
- Model seawater intrusion using Darcy's Law (calculate hydraulic conductivity via lab permeameter tests on soil samples).
- Conduct a mock electrical resistivity survey (using affordable multimeters or simulated data) to delineate aquifers.
- Collect or source megascopic samples of key rocks (e.g., granite, basalt, charnockite, laterite, sandstone, limestone, gneiss, marble).
- Classify them (igneous/sedimentary/metamorphic) based on mineral composition (e.g., identify quartz, biotite via hand lens) and structures.
- Field mapping: Use clinometer compass to measure dip/strike of local rock attitudes and identify folds/faults/joints.

Text Books:

1. Duggal S.K, Pandey H.K and Rawat N (2014) Engineering Geology, McGraw Hill Education New Delhi
2. Gokhale KVGK (2015) Principles of Engineering Geology, BS Publications, Hyderabad
3. Singh P (2014) Engineering and General Geology, SK Kataria and sons, New Delhi
4. Subinoy Gangopadhyay (2017) Engineering Geology, Oxford University

References:

1. David K Todd & Larry W Mays (2011) Groundwater Hydrogeology, Wiley India Pvt Ltd.
2. Gokhale N.W. (2015) Manual of Geological Maps, CBS Publishers, New Delhi
3. Gribble CD (2005) Rutleys Elements of Mineralogy, Springer
4. Marland P Billings (2016), Structural Geology, Pearson education

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	8 hours
1.1	Relevance of Geology in Civil Engineering	1
1.2	Surface Processes of the earth- a) Weathering of rocks-Types of weathering, Processes of Origin of Products of weathering like sand, clay, laterite and soil	2
1.3	Soil profile, Soil erosion and soil conservation measures, Engineering significance of weathering	1
1.4	Geological processes by rivers	1
1.5	Landslides-types, causes and controlling measures	1
1.6	Coastal Processes-Geological work by waves and currents, coastal protection measures	2
2	Module 2	7 hours
2.1	Earthquakes- Plate Tectonics, Origin of earthquakes	2
2.2	Seismic waves, Rating of earthquakes, types of earthquakes	2
2.3	Seismic zones of India. Basics of seismic safety factor	1
2.4	Interior of the earth as revealed by propagation of seismic waves	2
3	Module 3	7 hours
3.1	Occurrence of groundwater, aquifers and types of aquifers	1
3.2	Confining beds, porosity and vertical distribution of groundwater	1
3.3	Darcy's Law. Permeability/hydraulic conductivity	1
3.4	Problems created by groundwater to civil engineering structures, Methods to control groundwater problems	2

3.5	Electrical resistivity survey for groundwater exploration	1
3.6	Seawater intrusion in Coastal area. Ghyben Herzberg relation	1
4	Module 4	7 hours
4.1	Mineralogy-Physical properties of minerals	1
4.2	Physical properties and chemical composition of minerals like quartz, orthoclase, plagioclase, biotite, muscovite, hornblende, augite, hypersthene, calcite, gypsum	1
4.3	Petrology-Igneous, sedimentary and metamorphic rocks	1
4.4	Igneous rocks-Chemical and mineralogical classification and structure	1
4.5	Sedimentary rocks-types based on mode of formation and structures, Metamorphic rocks-structures only	1
4.6	Megascopic study of granite, dolerite, basalt, sandstone, limestone, shale, gneiss, marble and charnockite	1
4.7	Rock types of Kerala. Rock cycle	1
5	Module 5	7 hours
5.1	Structural Geology– Attitude of rocks – Dip and Strike	1
5.2	Terminology, brief classification and engineering significance of folds, faults and joints	3
5.3	Geological part of site investigation for the construction of dams, reservoirs and tunnels	2
5.4	Toposheet. Structural mapping. Clinometer compass and Brunton compass	1
Total		36 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Explain the three main types of weathering with one example each relevant to civil engineering projects.
2. Discuss the engineering significance of weathering products like clay and laterite in the context of soil formation and slope stability.

Course Outcome 2 (CO 2):

1. Describe the origin of earthquakes in relation to plate tectonics.
2. Explain the Richter scale for rating earthquakes and outline the seismic zones of India.

Course Outcome 3 (CO 3):

1. Discuss the role of confining beds and porosity in groundwater occurrence.
2. State Darcy's Law and its application in calculating hydraulic conductivity.

Course Outcome 4 (CO 4):

1. Classify igneous rocks based on chemical composition and mineralogical content.
2. Describe the structure of metamorphic rocks and their relevance in the rock cycle.

Course Outcome 5 (CO 5):

1. Explain the classification of folds and their engineering significance in tunnel construction.
2. Differentiate between faults and joints, including causes and types.

MODEL QUESTION PAPER

QP CODE:

Pages: 2

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

FIFTH SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CE3P15

ENGINEERING GEOLOGY

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Describe any three depositional features made by the sea.
2. What is laterite and how is it formed.
3. Illustrate the origin of tectonic earthquakes with neat diagram.
4. Define plate tectonics.
5. Elucidate the electrical resistivity survey in groundwater exploration.
6. Discuss the ground water flow equation using Darcy's law.
7. Define a mineral. Give two examples of minerals and their chemical composition.
8. Describe the different types of igneous rocks based on their origin.
9. How is a topographic map helpful to a civil engineer.
10. Write a note on the attitude of geologic structures.

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. The external earth processes modify the morphology of earth. Explain.

OR

12. a) Elaborate the relevance of geology in civil engineering. (8)
b) Discuss about any four coastal protection measures. (6)

MODULE 2

13. a) Explain the use of seismic methods to understand the interior of earth. (7)
b) Discuss the various types of seismic waves and write a note on seismograph and seismogram. (7)

OR

14. a) Give an account on different plate boundaries and the seismic belts of the world. (8)
b) Write a note on the seismic zones of India. (6)

MODULE 3

15. a) Discuss the Ghyben-Herzberg relation with neat sketches and the reason for sea water intrusion in coastal aquifers. (8)
b) Explain any three methods to control problems created by ground water to civil engineering structures. (6)

OR

16. a) Discuss on the problems created by groundwater to civil engineering structures. (7)
b) What is an aquifer. Write a note on the different types of aquifers with neat sketches. (7)

MODULE 4

17. a) Explain the megascopic characteristics of the following rocks. (6)
i. Dolerite ii. Limestone iii. Gneiss
b) Distinguish between metamorphic and sedimentary rocks with respect to their structures. (8)

OR

18. a) Explain rock cycle. (4)
b) Discuss on any five physical properties of minerals with suitable examples. (10)

MODULE 5

19. Write a note on the geologic factors to be considered during the construction of civil structures.

OR

20. a) Given strike and true dip of N50E, 40SE. Find the apparent dip in vertical section trending S70E. (4)
b) Describe the parts of a fold. Give an account on the classification of folds. (10)

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE3P16	HIGHWAY MATERIALS AND DESIGN	2	1	0	4	3	2024

Preamble

This course provides students with fundamental understanding of materials, design principles, and modern practices used in highway engineering. It focuses on the selection, characterization, and testing of pavement materials, design of flexible and rigid pavements, and the adoption of sustainable practices in pavement construction.

Prerequisites: Highway and Pavement Engineering

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Understand pavement types, components, functions, and performance criteria based on design concepts and sustainability principles (Cognitive Knowledge Level: Understand).
CO 2	Assess the physical and rheological properties of bituminous binders and materials for mix design and performance assessment (Cognitive Level: Apply)
CO 3	Characterize soil and aggregates as per IRC/MORTH standards and select suitable materials, including recycled and alternative materials, for highway construction (Cognitive Level: Apply)
CO 4	Design flexible pavements using empirical and mechanistic-empirical methods (IRC:37–2018) and optimize bituminous mix design using Marshal Method (Cognitive Level: Apply).
CO 5	Design rigid pavements and structural components (slab, dowel, tie bars) using IRC:58–2015 guidelines and analyze performance considerations (Cognitive Level: Apply).

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	1	1	1		2					
CO 2	3	1	1	1							
CO 3	3	1	1		1	2					
CO 4	3	2	2	1	2						
CO 5	3	2	2								

Assessment Pattern

HIGHWAY MATERIALS AND DESIGN			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	20	20	20
Understand	50	50	50
Apply	30	30	30
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 10 marks
Self Study	: 5 marks

End Semester Examination Pattern

There will be two parts: Part A and Part B. Part A contain 10 questions, with 2 questions from each module, having 3 marks for each question. Students should answer all questions.

Part B contains 2 questions from each module, of which students should answer any one. Each question carries 14 marks and can have a maximum of 2 sub-divisions.

SYLLABUS

Module 1: Pavement Types and Design Concepts (9 hours)

Classification and applications of flexible and rigid pavements, highway and airfield pavements; pavement components and their functions; pavement performance concepts—structural and functional failures, performance criteria; overview of design approaches and general framework for pavement design; materials used in highway construction; green concepts in highway engineering—use of recycled materials, energy-efficient construction, and life cycle analysis.

Module 2: Characterization and Testing of Binder (9 hours)

Bitumen origin, rheology of bitumen-visco-elastic model, Tests on bitumen. Different systems of grading of bitumen. Bituminous Materials - Types of binders, modified binders, emulsion - additives and modifiers for performance enhancement.

Module 3: Soil and Aggregates (7 Hours)

Classification, properties, and nomenclature; key lab and field tests; IRC/MORT&H standards; materials for low-cost roads. Aggregates: Types, properties, and requirements of aggregates; processing and use in pavement bases, bituminous mixes, and PCC. artificial aggregates, industrial waste as road aggregate, blending of aggregate by triangular chart, trial and error proportioning methods.; lightweight aggregates; key tests and specifications. Reclaimed & Recycled Materials: Use of reclaimed materials and civil engineering waste; impact on material behavior and performance; self-healing, smart, and locally available materials.

Module 4: Flexible Pavement Design (11 Hours)

Factors affecting pavement design: wheel load, traffic, subgrade, climate. CBR method – design steps, limitations. Mechanistic-Empirical design according to IRC:37-2018. Bituminous Mixes: Marshal Mix design, Flow and Stability Tests

Module 5: Rigid Pavement Design (9 Hours)

Types and components of rigid pavements. Design of slab thickness by Westergaard's method and IRC:58-2015. Load and temperature stress calculations. Design of dowel and tie bars. Subgrade and sub-base requirements. Joint types - expansion, contraction. Best practices in construction.

Text Books:

1. Yoder and Witczak, Principles of Pavement Design, John Wiley and Sons, 2018
2. Yang. H. Huang, Pavement Analysis and Design, Second Edition, Prentice Hall Inc., 2008
3. Kadiyali, L.R., Principles and Practices of Highway Engineering, 2005

References:

1. P. T. Sherwood, Alternative Materials in Road Construction, Thomas Telford Publication, London, 1997.
2. MORTH, IS and IRC Publications on relevant topic.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	9 hours
1.1	Classification and applications of flexible and rigid pavements – highway and airfield pavements.	1
1.2	Pavement components and their functions; structural layers and materials. Materials used in highway construction and their performance requirements.	2
1.3	Pavement performance concepts – structural and functional failures, performance criteria. Overview of design approaches and general framework for pavement design.	3
1.4	Green concepts in highway engineering – use of recycled materials and energy-efficient construction. Life-cycle analysis and sustainability considerations in pavement engineering.	3
2	Module 2	9 hours
2.1	Bitumen – origin, composition, and properties. Rheology of bitumen – visco-elastic behaviour and models.	3
2.3	Laboratory tests on bitumen – penetration, softening point, ductility, viscosity, flash and fire point., estimating rheological properties	2
2.4	Bitumen grading systems – penetration, viscosity, and performance grades.	2
2.5	Bituminous materials – types of binders, modified binders, and emulsions. Additives and modifiers for performance enhancement.	2

3	Module 3	7 hours
3.1	Soil classification and properties for highway applications. Key laboratory and field tests for subgrade evaluation; IRC/MORTH standards.	2
3.2	Aggregates – types, properties, and requirements; mechanical and physical tests. Artificial aggregates and industrial waste as road construction materials.	2
3.3	Blending of aggregates – triangular chart and trial - and -error proportioning methods.	3
4	Module 4	11 hours
4.1	Factors affecting flexible pavement design – wheel load, traffic, subgrade, climate.	3
4.2	CBR method – design procedure, limitations, and example problems.	2
4.3	Mechanistic – Empirical design of flexible pavements as per IRC:37-2018.	3
4.4	Bituminous mixes – composition, types, and requirements. Marshall Mix Design – procedure, flow, and stability tests.	3
5	Module 5	9 hours
5.1	Types and components of rigid pavements. Subgrade and sub-base requirements for rigid pavements.	2
5.2	Pavement joints – types, functions, and design (expansion, contraction, construction).	2
5.4	Design of slab thickness – Westergaard’s method and IRC:58-2015.	2
5.5	Load and temperature stresses in concrete slabs.	1
5.6	Design of dowel and tie bars – principles, calculations, and placement.	2
Total		45 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Explain the structural and functional differences between flexible and rigid pavements.
2. Discuss the significance of life-cycle analysis (LCA) in pavement sustainability.

Course Outcome 2 (CO 2):

1. Describe the rheological behaviour of bitumen using visco-elastic models.
2. Discuss the importance of bitumen grading systems and their implications on pavement performance.

Course Outcome 3 (CO 3):

1. Explain the significance of aggregate properties and their tests in pavement construction.
2. Discuss the role of reclaimed and recycled materials in sustainable pavement construction.

Course Outcome 4 (CO 4):

1. Describe the step-by-step design procedure for flexible pavements using the CBR method.
2. Explain the concepts behind the Mechanistic–Empirical design approach as per IRC:37–2018.

Course Outcome 5 (CO 5):

1. Explain the design procedure for rigid pavements using Westergaard's method and IRC:58–2015.
2. Discuss the design considerations for joints, dowel bars, and tie bars in rigid pavements.

MODEL QUESTION PAPER

QP CODE:

Pages: 3

Reg.No.:

Name:

**MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM**

FIRST SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CE3P16

HIGHWAY MATERIALS AND DESIGN

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Define flexible and rigid pavements.
2. State any two functions of sub-base and base courses.
3. List the performance criteria for pavements.
4. What are the main tests used to determine bitumen quality?
5. Define penetration and softening point of bitumen.
6. State the significance of aggregate blending in mix design.
7. What are the key factors influencing pavement design?
8. Write a note on CBR test and its limitations.
9. Define dowel and tie bars.
10. Mention the main types of joints in rigid pavements.

MODULE 1

11. a) Discuss the functional and structural failures of pavements. (7)
b) Explain green concepts in highway construction and the role of life cycle analysis (LCA). (7)

OR

12. a) Describe different components of flexible and rigid pavements with their functions. (8)
- b) Explain the importance of sustainability in pavement engineering. (6)

MODULE 2

13. a) Explain the rheological behaviour of bitumen using visco-elastic models. (7)
- b) Describe the laboratory tests used for bitumen characterization. (7)

OR

14. a) Compare different bitumen grading systems and their significance. (8)
- b) Explain the role of additives and modifiers in improving binder performance. (6)

MODULE 3

15. a) Explain the engineering properties and requirements of aggregates used in pavements. (7)
- b) Discuss the major tests used to evaluate the quality of aggregates for road construction. (7)

OR

16. a) Describe the use of reclaimed and recycled materials in road construction. (6)
- b) Explain the process of aggregate blending using the triangular chart method. (8)

MODULE 4

17. a) Discuss the step-by-step design procedure for flexible pavements using the CBR method. (7)
- b) Explain the influence of traffic, subgrade, and climate on flexible pavement design. (7)

OR

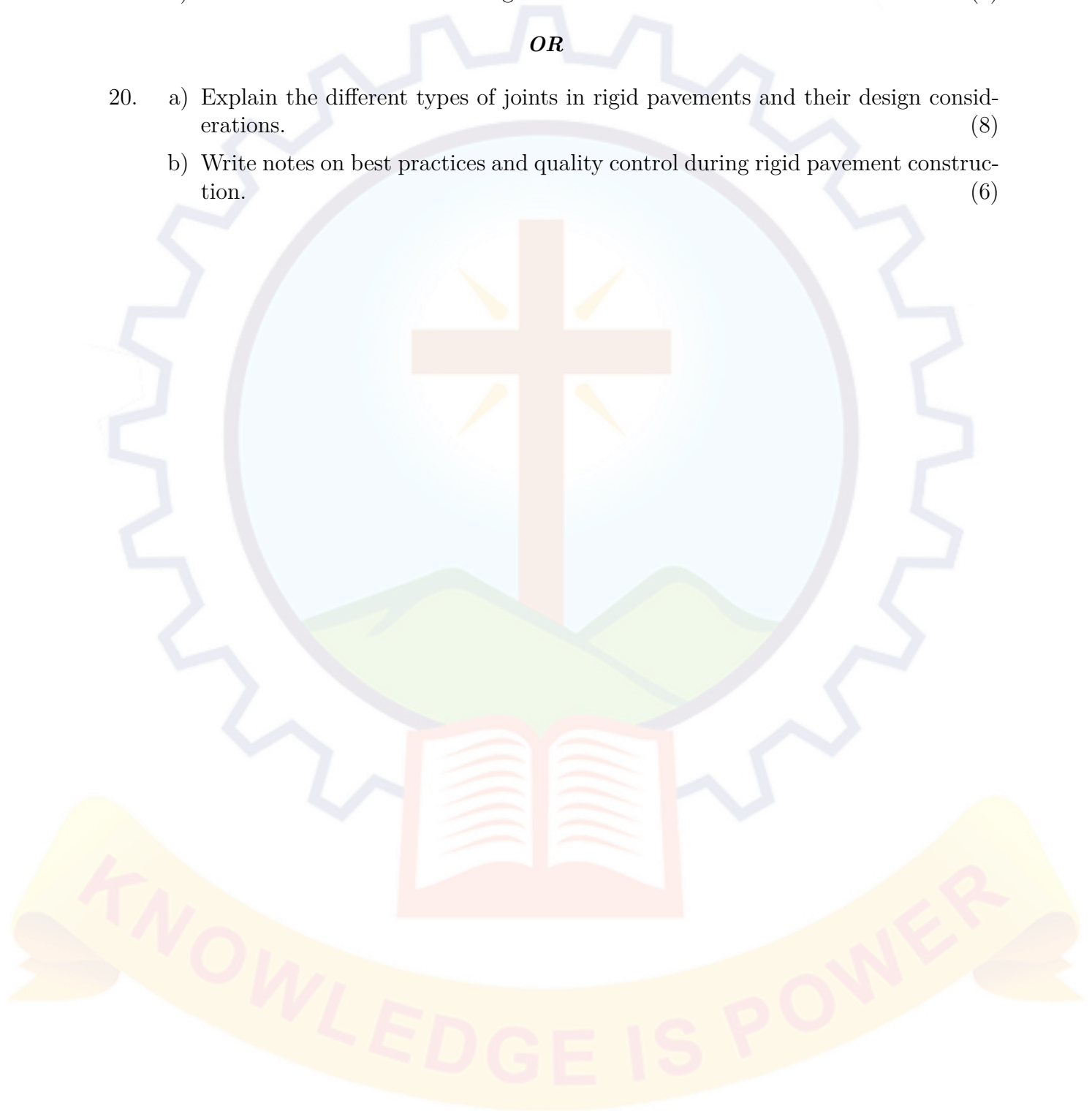
18. a) Explain the concept of Mechanistic–Empirical design of pavements as per IRC:37–2018. (8)
- b) Describe the Marshall Mix Design procedure and its significance in bituminous mix design. (6)

MODULE 5

19. a) Explain the design procedure of rigid pavements as per IRC:58-2015. (7)
b) Discuss the functions and design considerations for dowel and tie bars. (7)

OR

20. a) Explain the different types of joints in rigid pavements and their design considerations. (8)
b) Write notes on best practices and quality control during rigid pavement construction. (6)



CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE3L07	SOIL MECHANICS LABORATORY	0	0	3	2	2	2024

Preamble

Objective of the course is to familiarize students with the laboratory tests used to determine physical, index and engineering properties of geomaterials.

Prerequisites: B24CE2T05 Soil Mechanics.

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Identify and classify soil based on standard geotechnical experimental methods. (Cognitive knowledge level: Understand).
CO 2	Perform and analyze permeability tests (Cognitive knowledge level: Understand).
CO 3	Interpret engineering behaviour of soils based on test results. (Cognitive knowledge level: Analyze).
CO 4	Perform laboratory compaction, CBR and in-place density test for fill quality control in the field. (Cognitive knowledge levels: Remember).
CO 5	Evaluate the strength of soil by performing various tests viz. direct shear test, unconfined compressive strength test (Cognitive knowledge level: Evaluate).

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	2	-	2	1	-	-	-	1	1	1
CO 2	3	3	-	3	2	-	-	-	1	1	1
CO 3	3	3	2	3	2	1	1	-	1	1	2
CO 4	3	2	1	3	2	1	1	-	2	2	2
CO 5	3	3	2	3	2	1	1	1	1	2	2

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	10 marks
Continuous Assessment	10 marks
Viva-Voce (Self Study)	10 marks
Test	15 marks
Lab Record	5 marks

Note:

Marks shall not be awarded for the Lab Record in the End Semester Examination. However, students having a certified Lab Record are only eligible to appear for the End Semester Examination. A weightage of 30% of the total marks shall be given for the Viva-Voce in the End Semester Examination.

End Semester Examination (ESE) Pattern

The following guidelines should be followed regarding the award of marks:

Preliminary work	: 20 marks
Implementation / Conducting the experiment	: 20 marks
Performance, result and inference	: 30 marks
Viva voce	: 30 marks

SYLLABUS

Course Content and Practical Schedule

List of Experiments

No	Topic
1	Determination of Specific Gravity-Pycnometer & Specific Gravity bottle
2	Determination of Water Content-Oven Drying Method
3	Swelling Test-Free Swell
4	Sieve Analysis & Hydrometer analysis
5	Atterberg Limits - Liquid Limit, Plastic Limit, Shrinkage Limit
6	Field Density Test – (i) Core Cutter, (ii) Sand Replacement Method
7	Light Compaction Test (Standard Proctor Test)
8	Direct Shear Test
9	Unconfined Compression Test
10	Consolidation Test.
11	Permeability Test- Constant Head Permeability, Variable Head Permeability
12	California Bearing Ratio (CBR) Test
13	Triaxial Test (Study/Demonstration)

References:

1. IS codes relevant to each test
2. C. Venkatramaiah, *Geotechnical Engineering*, New Age International publishers, 2012
3. Gopal Ranjan and A. S. R. Rao, *Basic and Applied Soil Mechanics*, New Age International Publishers, 2012
4. K. R. Arora, *Soil Mechanics and Foundation Engineering*, Standard Publishers, 2011

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE3L08	TRANSPORTATION ENGINEERING LABORATORY	0	0	3	2	2	2024

Preamble

This laboratory course provides hands-on experience in testing and evaluation of soil, aggregate, and bituminous materials, and introduces methods for bituminous mix design and functional assessment of pavements.

Prerequisites: Highway and Pavement Engineering

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Conduct standard laboratory tests on soil to determine strength and suitability for pavement subgrade applications, including the California Bearing Ratio test (Cognitive Knowledge Level: Apply).
CO 2	Evaluate the physical and mechanical properties of coarse aggregates through standard laboratory tests such as specific gravity, impact, abrasion, crushing, and shape tests as per IRC/MORTH specifications (Cognitive Knowledge Level: Apply).
CO 3	Determine the physical and rheological properties of bituminous binders through standard tests on viscosity, softening point, ductility, and flash/fire point to assess performance characteristics (Cognitive Knowledge Level: Apply).
CO 4	Design bituminous mixes using the Marshall Method and evaluate mix performance parameters such as stability, flow, and volumetric properties (Cognitive Knowledge Level: Apply).
CO 5	Perform functional evaluation of pavement surface characteristics, including roughness measurements using field testing equipment, and interpret the results for performance assessment (Cognitive Knowledge Level: Apply).

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3				3				2		
CO 2	3				3				2		
CO 3	3				3				2		
CO 4	3				3				2		
CO 5	3				3				2		

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	10 marks
Continuous Assessment	10 marks
Viva-Voce (Self Study)	10 marks
Test	15 marks
Lab Record	5 marks

End Semester Examination Pattern

The following guidelines should be followed regarding the award of marks:

Preliminary work	: 20 marks
Conducting the experiment	: 20 marks
Performance, result and inference	: 30 marks
Viva-Voce	: 30 marks

**SYLLABUS
LIST OF EXPERIMENTS**

No.	Description of Experiment
Tests on Aggregates	
1	Aggregate Crushing Value Test (IS 2386 Part IV)
2	Aggregate Impact Value Test (IS 2386 Part IV)
3	Los Angeles Abrasion Test (IS 2386 Part IV)
4	Specific Gravity and Water Absorption of Aggregates (IS 2386 Part III)
5	Shape Tests (Flakiness and Elongation Index) (IS 2386 Part I)
6	Stripping Value of Aggregates (IS 6241)
Tests on Bituminous Materials	
7	Penetration Test on Bitumen (IS 1203)
8	Ductility Test on Bitumen (IS 1208)
9	Softening Point Test on Bitumen (IS 1205)
10	Viscosity Test on Bitumen (Saybolt or Brookfield Viscometer) (IS 1206)
11	Flash and Fire Point Test (IS 1209)
12	Marshall Stability Test for Bituminous Mix Design (ASTM D1559 / IRC SP-20)
Tests on Soil for Subgrade Evaluation	
13	California Bearing Ratio (CBR) Test (IS 2720 Part 16)
14	Proctor Compaction Test (Optimum Moisture Content & Maximum Dry Density) (IS 2720 Part 7)
Additional / Supplementary Tests (Optional)	
15	Roughness Measurement by MERLIN (IS 13143:1991)
16	Field Density Test (Sand Replacement Method) (IS 2720 Part 28:1974)
17	Skid Resistance Test (Pendulum Tester) (IS 15627:2006)
<i>*Minimum Twelve Experiments Are Mandatory</i>	

References:

1. Khanna, S.K., Justo, C.E.G. and Veeraragavan, A., "Highway Materials and Pavement Testing", Nem Chand & Bros., Roorkee
2. G. Venkatappa Rao, K. Ramachandra Rao, Kausik Pahari and D.V. Bhavanna Rao., "Highway Material Testing and Quality Control", I.K. International.
3. L.R.Kadiyali and N.B Lal., "Principles and Practices of Highway Engineering", Khanna Publishers.

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CEM52	RENEWABLE ENERGY	3	1	0	5	4	2024

Preamble

The course is designed to provide a comprehensive understanding of renewable energy sources and their technologies. It covers the principles, applications, and limitations of various non-conventional energy systems including solar, wind, ocean, biomass, hydro, and emerging technologies like hydrogen and fuel cells. The course aims to equip students with knowledge of renewable energy systems, their environmental impacts, and their role in sustainable development.

Prerequisites: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Comprehend the global and Indian energy scenario and classify conventional and non-conventional energy resources with respect to availability, advantages, limitations and suitability for civil engineering applications. (Cognitive Knowledge Level: Understand)
CO 2	Understand ocean and tidal energy systems with respect to resource potential, basic working principles, site-specific challenges and environmental and socio-economic implications relevant to civil engineering projects. (Cognitive Knowledge Level: Understand)
CO 3	Understand wind energy systems by relating wind resource characteristics, energy conversion principles and system components to site selection and planning considerations in civil engineering projects. (Cognitive Knowledge Level: Understand)
CO 4	Explain biomass and urban solid-waste-to-energy conversion routes, biogas technology and national biomass programmes relevant to sustainable waste management. (Cognitive Knowledge Level: Understand)
CO 5	Outline the basic concepts of hydro, hydrogen and fuel-cell systems and appraise their environmental impacts and role in sustainable infrastructure planning. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	2				1	2				
CO 2	3	2				2	3				
CO 3	3	2				1	2				
CO 4	3	2				2	3				
CO 5	3	2	2			2	3				1

Assessment Pattern

RENEWABLE ENERGY			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	20	20	30
Understand	50	50	60
Apply	30	30	10
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course Project : 10 marks

Self Study : 5 marks

End Semester Examination Pattern

There will be two parts: Part A and Part B. Part A contain 10 questions, with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module, of which students should answer any one. Each question carries 14 marks and can have a maximum of 2 sub-divisions.

SYLLABUS

Module 1: Energy Systems and Solar Energy (9 hours)

Energy Systems and Solar Energy: Introduction and classification of energy resources – conventional vs non-conventional – availability, advantages and limitations; role of renewable energy in civil infrastructure. Solar thermal systems: Principles of conversion of solar radiation into heat, solar collectors – flat plate collectors, solar concentrators: parabolic trough, parabolic dish, central tower. Solar electric systems: Solar thermal electric power generation (overview), solar photovoltaic systems, Typical civil engineering applications such as building-integrated PV, street lighting and water pumping.

Module 2: Ocean Energy (9 hours)

Ocean Energy: Ocean energy resources and potential. Ocean Thermal Energy Conversion (OTEC): Principle, site selection criteria, issues of biofouling, corrosion and mooring; advantages and limitations. Tidal Energy: Principles of tidal energy conversion; components of tidal power plants (barrage, sluice gates, turbines, caissons); environmental and socio-economic impacts of tidal power projects.

Module 3: Wind Energy (8 Hours)

Wind Energy: Introduction to wind energy and wind resource assessment. Principles of wind energy conversion systems (WECS). Wind speed measurement and wind-resource mapping. Main components of a wind energy conversion system. Advantages and disadvantages of wind energy; site selection criteria including terrain, land use, environmental and planning considerations.

Module 4: Biomass Energy (9 Hours)

Biomass Energy: Introduction to biomass energy; biomass resources and characteristics. Biomass fuels and conversion technologies – direct combustion, gasification, pyrolysis, fermentation. Urban and industrial solid-waste to energy conversion – incineration, refuse-derived fuel, integrated solid-waste management concepts. Biomass gasification systems; ethanol production from biomass – basic process steps. Biogas generation from organic wastes; factors affecting biogas generation; Typical biogas plant.

Module 5: Hydro and Emerging Technologies (10 Hours)

Hydro power resources and classification as large, small, micro and mini hydro projects. Basic concepts; civil engineering components of small hydro schemes – intake, canal, fore-

bay, penstock, powerhouse and tail race, Small hydro plants: Components and feasibility. Emerging technologies: Fuel cells – efficiency and applications in stationary power. Hydrogen energy – production methods such as electrolysis and thermo-chemical routes (overview), role of hydrogen and fuel cells in future low-carbon civil infrastructure.

Text Books:

1. G.D. Rai, Non-Conventional Energy Sources, Khanna Publishers, 2010.
2. Rao S. and B.B. Parulekar, Energy Technology, Khanna Publishers, 1999.

References:

1. G.N. Tiwari, Solar Energy – Fundamentals, Design, Modelling and Applications, Narosa Publishers, 2002.
2. Earnest J. and T. Wizelius, Wind Power Plants and Project Development, PHI Learning, 2011.
3. Sab S.L., Renewable and Novel Energy Sources, MI Publications, 1995.
4. Sawhney G.S., Non-Conventional Energy Resources, PHI Learning, 2012.
5. Tiwari G.N., Solar Energy – Fundamentals, Design, Modelling and Applications, CRC Press, 2002.
6. A.A.M. Saigh (Ed.), Solar Energy Engineering, Academic Press, 1977.
7. Abbasi S.A. and N. Abbasi, Renewable Energy Sources and Their Environmental Impact, Prentice Hall of India, 2001.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	9 hours
1.1	Introduction and classification of energy resources – conventional vs non-conventional – availability, advantages and limitations.	2
1.2	Role of renewable energy in civil infrastructure.	1
1.3	Solar thermal systems: Principles of conversion of solar radiation into heat, solar collectors – flat plate collectors, solar concentrators: parabolic trough, parabolic dish, central tower.	2
1.4	Solar electric systems: Solar thermal electric power generation (overview), solar photovoltaic systems.	2
1.5	Typical civil engineering applications such as building-integrated PV, street lighting and water pumping.	2
2	Module 2	9 hours
2.1	Ocean Energy: Ocean energy resources and potential.	2
2.2	Ocean Thermal Energy Conversion (OTEC): Principle, site selection criteria, issues of biofouling, corrosion and mooring; advantages and limitations.	2
2.3	Tidal Energy: Principles of tidal energy conversion.	2
2.4	Components of tidal power plants (barrage, sluice gates, turbines, caissons).	1
2.5	Environmental and socio-economic impacts of tidal power projects.	2
3	Module 3	8 hours
3.1	Introduction to wind energy and wind resource assessment.	1
3.2	Principles of wind energy conversion systems (WECS).	2

3.3	Wind speed measurement and wind-resource mapping.	1
3.4	Main components of a wind energy conversion system. Advantages and disadvantages of wind energy.	2
3.5	site selection criteria including terrain, land use, environmental and planning considerations.	2
4	Module 4	9 hours
4.1	Introduction to biomass energy; biomass resources and characteristics.	1
4.2	Biomass fuels and conversion technologies – direct combustion, gasification, pyrolysis, fermentation.	2
4.3	Urban and industrial solid-waste to energy conversion – incineration, refuse-derived fuel, integrated solid-waste management concepts.	2
4.4	Biomass gasification systems; ethanol production from biomass – basic process steps.	2
4.5	Biogas generation from organic wastes; factors affecting biogas generation; Typical biogas plant.	2
5	Module 5	10 hours
5.1	Hydro power resources and classification as large, small, micro and mini hydro projects.	2
5.2	Basic concepts; civil engineering components of small hydro schemes – intake, canal, forebay, penstock, powerhouse and tail race.	2
5.3	Small hydro plants: Components and feasibility.	2
5.4	Emerging technologies: Fuel cells – efficiency and applications in stationary power.	1
5.5	Hydrogen energy – production methods such as electrolysis and thermo-chemical routes (overview).	2
5.6	Role of hydrogen and fuel cells in future low-carbon civil infrastructure.	1
Total		45 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Discuss the need for shifting from conventional fossil-fuel-based energy systems to renewable energy systems with specific reference to buildings and infrastructure in India.
2. Classify energy resources and compare conventional and non-conventional sources based on availability, renewability and environmental impact.

Course Outcome 2 (CO 2):

1. Explain the principle of Ocean Thermal Energy Conversion (OTEC) and discuss the key site selection criteria.
2. Describe the principle of tidal energy conversion and explain the major components of a tidal power plant.

Course Outcome 3 (CO 3):

1. Explain the principle of wind energy conversion systems (WECS). Describe the main components of a wind energy conversion system and their functions.
2. Explain the site selection criteria for wind energy projects with reference to terrain, land use, environmental and planning considerations.

Course Outcome 4 (CO 4):

1. Explain biomass energy and describe the major biomass resources and their characteristics.
2. Explain biogas generation from organic wastes and discuss the factors affecting biogas production.

Course Outcome 5 (CO 5):

1. Describe the basic civil engineering components of a small hydro power scheme.
2. Explain the basic principles of fuel cell and hydrogen energy systems and Discuss the role of hydrogen and fuel cells in future low-carbon and sustainable civil infrastructure.

MODEL QUESTION PAPER

QP CODE:

Pages: 3

Reg.No.:

Name:

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

FIRST SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CEM52

RENEWABLE ENERGY

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Classify conventional and non-conventional energy sources with one example each.
2. State the role of renewable energy systems in sustainable civil infrastructure development.
3. What are ocean energy resources? Briefly state their energy potential.
4. List any two advantages and limitations of Ocean Thermal Energy Conversion (OTEC).
5. Define wind energy and state any two advantages of wind energy.
6. What is wind resource assessment? Mention any two methods used for wind speed measurement.
7. Define biomass energy and list any two biomass resources used for energy generation.
8. State any three factors affecting biogas generation.
9. Differentiate between large, small, mini and micro hydro power projects
10. State any three applications of fuel cells in stationary power generation.

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. a) Explain the availability, advantages and limitations of solar energy as a renewable energy resource. (8)
b) Describe the principle of conversion of solar radiation into heat and explain the construction and working of a flat plate solar collector. (6)

OR

12. a) Explain solar concentrator systems with reference to parabolic trough, parabolic dish and central tower collectors. (8)
b) Explain the basic principle and components of solar photovoltaic systems and discuss their relevance to civil engineering applications. (6)

MODULE 2

13. a) Explain the principle of Ocean Thermal Energy Conversion (OTEC) and discuss the criteria for site selection of OTEC plants. (8)
b) Discuss the major technical challenges associated with OTEC plants such as biofouling, corrosion and mooring issues. (6)

OR

14. a) Explain the principle of tidal energy conversion and describe the major components of a tidal power plant. (8)
b) Discuss the environmental and socio-economic impacts of tidal power projects with suitable examples. (6)

MODULE 3

15. a) Explain the principle of wind energy conversion systems (WECS) and describe the main components of a wind energy conversion system. (8)
b) Explain the methods of wind resource assessment and wind-resource mapping. Discuss their importance in planning wind energy projects. (6)

OR

16. a) Explain the site selection criteria for wind energy projects considering terrain, land use and environmental aspects. (8)
b) Discuss planning and regulatory considerations involved in the implementation of wind energy projects. (6)

MODULE 4

17. a) Explain the characteristics of biomass fuels and discuss the role of biomass energy in sustainable development. (8)
- b) Describe the major biomass conversion technologies such as direct combustion, gasification, pyrolysis and fermentation. (6)

OR

18. a) Explain the principle of biogas generation from organic wastes and describe the layout and functioning of a typical biogas plant. (8)
- b) Explain the working of a biomass gasification system and outline the basic steps involved in ethanol production from biomass. (6)

MODULE 5

19. a) Describe the civil engineering components of a small hydropower plant. (8)
- b) Describe the factors that influence the feasibility of small hydro projects. (6)

OR

20. a) Explain the working principle of fuel cells and discuss their efficiency and applications in stationary power systems. (8)
- b) Explain hydrogen energy systems. Discuss the role of hydrogen and fuel cells in the future low-carbon civil infrastructure. (6)

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CEM53	SUSTAINABLE TRANSPORTATION	3	1	0	5	4	2024

Preamble

This course introduces the principles and practices of sustainable transportation systems that balance environmental, economic, and social objectives. It explores transportation modes, energy efficiency, environmental impacts, and modern mobility solutions in the context of sustainability and resilience. Students will understand how transportation planning integrates with Sustainable Development Goals (SDGs), environmental policies, and emerging technologies.

Prerequisites: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Explain transportation–environment interactions and identify the externalities, sustainability principles, and policy frameworks influencing sustainable transport systems. (Cognitive Knowledge Level: Understand).
CO 2	Identify and evaluate sustainable transportation modes and practices, including public transport, non-motorized transport, shared mobility, TDM strategies, and emerging green mobility technologies.(Cognitive Level: Apply)
CO 3	Analyze the environmental impacts of transportation systems and apply appropriate assessment tools, emission indicators, and clean-fuel technologies to evaluate sustainability. (Cognitive Level: Apply)
CO 4	Evaluate Environmental Impact Assessment (EIA) tools and decision-support systems in transportation projects. (Cognitive Level: Apply).
CO 5	Assess sustainable transportation practices through real-world case studies of highway, railway, airport, and urban transport projects, and apply Life Cycle Assessment (LCA) tools such as OpenLCA for evaluating project sustainability. (Cognitive Level: Apply).

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	2	1			3					
CO 2	3	2	1			3					
CO 3	3	2	1			3					
CO 4	3	2	1			3					
CO 5	3	2	1		3	3				2	

Assessment Pattern

SUSTAINABLE TRANSPORTATION			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	20	20	20
Understand	50	50	50
Apply	30	30	30
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course Project : 10 marks

Self Study : 5 marks

End Semester Examination Pattern

There will be two parts: Part A and Part B. Part A contain 10 questions, with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module, of which students should answer any one. Each question carries 14 marks and can have a maximum of 2 sub-divisions.

SYLLABUS

Module 1: Fundamentals of Transportation and Sustainability (9 hours)

Transportation systems and environmental interaction-Externalities of conventional transport systems: air pollution, noise, congestion, accidents, Emission paradoxes and unintended consequences, Sustainable development goals (SDGs) and transportation. Pillers of sustainability, Sustainability Vs Resilience, System-optimal vs. user-optimal frameworks, International and national policy instruments (NEPA, CAA, Kyoto, Paris Agreement).

Module 2: Sustainable Modes and Practices: (9 hours)

Public transportation systems: Buses, Metro, Rail, and BRT. Non-motorized transport (NMT): walking and cycling infrastructure. Shared mobility and Mobility-as-a-Service (MaaS). Transportation demand management (TDM), Environmental, economic, and social impacts of transportation, Intelligent and Green Transportation Technologies, First-Mile and Last-Mile connectivity, Emerging electric mobility (EVs, e-bikes, micro-mobility).

Module 3: Environmental Impacts and Assessment Tools (9 Hours)

Impacts on air, water, noise, biodiversity, and climate, Energy consumption in various transport modes. Emission types: CO₂, NO_x, PM, and noise. Modelling tools for air/noise pollution Clean fuels and low-emission technologies, Use of electric power, CNG, LPG and Hydrogen as fuel sources quantitative methods/indicators (e.g., emission factors, fuel efficiency metrics).

Module 4: Introduction to Environmental Impact Assessment (9 Hours)

EIA and Decision support tools: Introduction to decision-support and sustainability metrics, Modelling of impacts and scenario-based analysis, Decision support systems for EIA of transport infrastructures.

Module 5: Policies, Planning, and Case Studies (9 Hours)

Case studies of highway, railway and airport projects, urban transport projects (metro systems, BRT corridors, Case studies), OpenLCA tool for life Cycle Assessment.

Activities

1. Debate – “Private Vehicles vs Public Transport: Which is More Sustainable?” and/or E-vehicles Vs fuel vehicles for Net zero vision

2. Street Redesign Audit – Conduct a walkability/bikeability assessment of a local street using NACTO or HCM metrics

Text Books:

1. Nagurney, A. (2000). Sustainable Transportation Networks. Edward Elgar.
2. Tumlin, J. (2012). Sustainable Transportation Planning: Tools for Creating Vibrant, Healthy, and Resilient Communities. Wiley.
3. Black, W. R. (2010). Sustainable Transportation: Problems and Solutions. Guilford Press.
4. Petts, J. (1999). Handbook of Environmental Impact Assessment. Blackwell.

References:

1. Schiller, P., Bruun, E. C., & Kenworthy, J. R. (2010). An Introduction to Sustainable Transportation. Earthscan.
2. Button, K. (2010). Transport Economics. Edward Elgar.
3. Wood, C. (2002). Environmental Impact Assessment: A Comparative Review. Prentice Hall.
4. Indian Roads Congress (1988), 'Guidelines for Environmental Impact Assessment of Highway Projects, IRC 104-1988.
5. Ministry of Environment and Forests (2010), 'Environmental Impact Assessment Guidance Manual for Highways'.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	9 hours
1.1	Transportation systems and their interaction with the environment.	2
1.2	Externalities of transport systems – air pollution, noise, congestion, accidents.	2
1.3	Emission paradoxes and unintended consequences of transport activities.	1
1.4	Sustainable Development Goals (SDGs) and their relevance to transportation.	1
1.5	Pillars of sustainability; Sustainability vs. Resilience.	1
1.6	System-optimal vs. user-optimal frameworks in transportation systems.	1
1.7	International and national policy instruments – NEPA, CAA, Kyoto Protocol, Paris Agreement.	1
2	Module 2	9 hours
2.1	Public transportation systems – Buses, Metro, Rail, BRT.	2
2.2	Non-motorized transport (NMT): walking and cycling infrastructure.	2
2.3	Shared mobility, MaaS (Mobility-as-a-Service).	1
2.4	Transportation demand management (TDM) strategies.	1
2.5	Environmental, economic, and social impacts of transportation.	1
2.6	Intelligent and green transportation technologies.	1
2.7	First-mile and last-mile connectivity solutions; emerging electric mobility (EVs, e-bikes, micro-mobility).	1

3	Module 3	9 hours
3.1	Impacts on air, water, noise, biodiversity, and climate.	2
3.2	Energy consumption in various transport modes.	1
3.3	Emission types – CO ₂ , NO _x , PM, noise pollution.	2
3.4	Modelling tools for air and noise pollution.	2
3.5	Clean fuels and low-emission technologies – electric, CNG, LPG, hydrogen.	1
3.6	Quantitative methods and indicators – emission factors, fuel efficiency metrics.	1
4	Module 4	9 hours
4.1	Introduction to EIA in transportation systems.	2
4.2	Decision-support tools and sustainability metrics.	2
4.3	Modelling of impacts in transportation systems.	2
4.4	Scenario-based analysis for transport projects.	2
4.5	Decision-support systems for EIA of transport infrastructures.	1
5	Module 5	9 hours
5.1	Case studies of highway projects – sustainability assessment.	2
5.2	Case studies of railway and airport projects.	2
5.3	Urban transport case studies – metro systems, BRT corridors.	2
5.4	Introduction to Life Cycle Assessment (LCA) for transport systems.	1
5.5	Use of OpenLCA tool for evaluating transport project sustainability.	2
Total		45 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Explain the major externalities of conventional transport systems such as air pollution, noise, congestion, and accidents.
2. Describe how sustainability principles, SDGs, and international policy instruments (NEPA, CAA, Kyoto Protocol, Paris Agreement) guide the development of sustainable transportation systems.

Course Outcome 2 (CO 2):

1. Explain the role of public transportation systems such as Buses, Metro, Rail, and BRT in promoting sustainable urban mobility.
2. Discuss how non-motorized transport (walking and cycling), shared mobility/MaaS, and emerging electric mobility solutions (EVs, e-bikes, micro-mobility) contribute to environmental, economic, and social sustainability.

Course Outcome 3 (CO 3):

1. Explain the impacts of transportation on air, water, noise, biodiversity, and climate, highlighting key emission types such as CO , NO , and PM.
2. Discuss how modelling tools for air/noise pollution, quantitative indicators (emission factors, fuel efficiency metrics), and clean/alternative fuels (electric power, CNG, LPG, hydrogen) support sustainable transport planning.

Course Outcome 4 (CO 4):

1. Explain the role of sustainability metrics and impact modelling in the Environmental Impact Assessment (EIA) of transportation projects.
2. Discuss how decision-support systems and scenario-based analysis enhance the effectiveness of EIA for transport infrastructures.

Course Outcome 5 (CO 5):

1. Explain how case studies of highway, railway, airport, and metro/BRT projects help in understanding sustainable transportation planning and implementation.
2. Discuss the role of Life Cycle Assessment (LCA) and tools such as OpenLCA in evaluating the environmental performance of transportation infrastructure.

MODEL QUESTION PAPER

QP CODE:

Pages: 3

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

FIFTH SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CEM53

SUSTAINABLE TRANSPORTATION

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Define transportation externalities. Give any two examples.
2. What are the pillars of sustainability? List them.
3. Define Non-Motorized Transport (NMT). Give two examples.
4. What is Transportation Demand Management (TDM)?
5. Define emission factor.
6. What are PM and NO_x emissions?
7. Define Environmental Impact Assessment (EIA).
8. What is a decision-support system (DSS)?
9. What is Life Cycle Assessment (LCA)?
10. Define Bus Rapid Transit (BRT) system.

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. a) Discuss how transport activities contribute to environmental degradation through air, noise, and congestion impacts. (7)
b) Explain how unintended consequences and emission paradoxes influence transport sustainability planning. (7)

OR

12. a) Illustrate the relevance of SDGs to transportation with suitable examples from developing countries. (7)
b) Analyze the role of international agreements such as NEPA, CAA, Kyoto Protocol, and Paris Agreement in shaping sustainable mobility policies. (7)

MODULE 2

13. a) Compare Bus, Metro, Rail, and BRT systems in terms of capacity, efficiency, and suitability for urban corridors. (7)
b) Explain the importance of walking and cycling infrastructure in achieving modal shift towards sustainable mobility. (7)

OR

14. a) Discuss how shared mobility and MaaS platforms transform urban travel behaviour and reduce dependence on private vehicles. (7)
b) Examine the role of intelligent and green transport technologies in managing first-mile and last-mile connectivity challenges. (7)

MODULE 3

15. a) Evaluate the cumulative environmental effects of transportation on biodiversity and climate systems. (7)
b) Discuss how energy consumption patterns vary across different transport modes and their implications for sustainability. (7)

OR

16. a) Describe the use of air and noise pollution modelling tools in assessing transport corridor impacts. (7)
b) Compare electric power, CNG, LPG, and hydrogen as alternative fuel options with respect to environmental performance. (7)

MODULE 4

17. a) Explain the steps involved in conducting an impact analysis for a transport infrastructure project. (7)
- b) Discuss how sustainability metrics support decision-making in evaluating transport development alternatives. (7)

OR

18. a) Examine the role of modelling techniques in predicting environmental and social impacts of transport projects. (7)
- b) Analyze how scenario-based analysis improves the reliability of EIA outcomes in transportation planning. (7)

MODULE 5

19. a) Discuss key sustainability lessons derived from highway, railway, and airport project case studies. (7)
- b) Examine factors that influence the success of metro and BRT systems in improving urban mobility. (7)

OR

20. a) Evaluate the significance of case-based learning in understanding sustainability challenges in transport projects. (7)
- b) Explain how software tools such as OpenLCA assist in comparing environmental performance across transport alternatives. (7)

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CEH51	FUNDAMENTALS OF EARTHQUAKE ENGINEERING	3	1	0	5	4	2024

Preamble

The course offers a comprehensive understanding of the fundamental principles behind the earthquake-resistant design of structures. It introduces engineering aspects of earthquakes, including their characterization and impacts. The syllabus encompasses the design and detailing in accordance with the Indian Standards. Additionally, the course covers earthquake-resistant construction techniques for masonry structures and methods for retrofitting existing buildings.

Prerequisites: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Understand the fundamental mechanism and effects of earthquakes, interpret seismic measurements and analyse the characteristics of response spectra essential for earthquake-resistant design. (Cognitive Knowledge Level: Understand)
CO 2	Analyse the influence of structural and architectural irregularities on seismic behavior, understand the philosophy of capacity design and apply the principles of earthquake-resistant construction to ensure structural safety and integrity. (Cognitive Knowledge Level: Apply)
CO 3	Compute seismic forces on real-life structures using IS code provisions, analyse structural response through static methods, and evaluate base shear distribution in reinforced concrete buildings. (Cognitive Knowledge Level: Apply)
CO 4	Apply the principles of ductility and torsional behavior in earthquake-resistant design, and implement appropriate detailing, repair, and retrofitting techniques as per Indian Standards. (Cognitive Knowledge Level: Apply)
CO 5	Employ earthquake-resistant construction practices for masonry structures and utilize suitable repair and retrofitting techniques to enhance their seismic performance. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	2	2								1
CO 2	3		3								
CO 3	3	2		1	1		1		1		
CO 4	3		3			2	1	1	1	2	1
CO 5	3		3			2		1	1	2	1

Assessment Pattern

FUNDAMENTALS OF EARTHQUAKE ENGINEERING			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember			
Understand	40	40	40
Apply	60	60	60
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course project : 10 marks

Self Study : 5 marks

End Semester Examination Pattern

There will be two parts: Part A and Part B. Part A contain 10 questions, with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module, of which students should answer any one. Each question carries 14 marks and can have a maximum of 2 sub-divisions.

SYLLABUS

Module 1: Introduction to Earthquakes and Seismic Response (9 hours)

Earthquakes: Mechanism, Elastic rebound theory, Seismic waves, Effects of earthquakes. Size of earthquake – intensity & magnitude, concept of Richter scale. Measurement of earthquakes – seismographs and accelerograph Strong motion characteristics, response spectrum, characteristics of response spectrum, design spectrum, construction of tripartite response spectrum

Module 2: Earthquake-Resistant Design Principles (9 hours)

Structural irregularities, Effect of architectural features, Damages during past earthquakes. Concept of capacity design, Strong Column and weak beam, Philosophy of earthquake resistant construction. Principle of earthquake resistant construction.

Module 3: Seismic Analysis of Structures as per IS 1893 (Part 1):2016 (10 Hours)

Seismic force computation using IS code provisions. Static method of analysis, Response spectrum analysis – theoretical aspects. Performance of RC structures during EQ, Base shear calculation as per IS 1893 (Part 1):2016, Zone factor, Importance factor, Response reduction factor, Fundamental time-period estimation, Distribution of lateral forces over height.

Module 4: Ductile Detailing and Earthquake-Resistant Construction Practices (9 Hours)

Torsional behavior of buildings - Codal provisions. Ductility – significance in earthquake resistant design, Ductility factors, Ductile detailing considerations as per IS:13920. Detailing of structural members & joints, Repair and retrofitting of RCC structures, Response reduction techniques, Base isolation.

Module 5: Seismic Performance and Retrofitting of Masonry Structures (8 Hours)

Performance of masonry structures during earthquakes, box action, influence of openings, role of horizontal and vertical bands, rocking of masonry piers. Repair and retrofitting of masonry structures

Text Books:

1. S. K. Duggal, “Earthquake Resistant Design of Structures”, Oxford University Press,

New Delhi.

2. Pankaj Agarwal and Manish Shrikhande, “Earthquake Resistant Design of Structures”, Prentice Hall of India Private Limited, New Delhi, India.
3. Anil K. Chopra, “Dynamics of Structures”. Theory and Applications to Earthquake Engineering, Pearson Education, India.
4. IITK-GSDMA Guidelines, “Earthquake Tips” EQ01–EQ23, Department of Civil Engineering, IIT Kanpur, and Building Materials and Technology Promotion Council (BMTPC), Government of India.

Reference Books:

1. Bruce A. Bolt, “Earthquakes”, H. Freeman and Company, New York
2. Datta T.K., “Seismic Analysis of Structures”, John Wiley & Sons (Asia) Pte. Ltd.
3. IS 1893 (Part 1): 2016 – Criteria for Earthquake Resistant Design of Structures – General Provisions and Buildings, Bureau of Indian Standards, New Delhi.
4. IS 13920: 2016 – Ductile Design and Detailing of Reinforced Concrete Structures Subjected to Seismic Forces – Code of Practice, Bureau of Indian Standards, New Delhi.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	9 hours
1.1	Earthquakes: Mechanism, Elastic rebound theory, Seismic waves, Effects of earthquakes.	3
1.2	Size of earthquake – intensity & magnitude, concept of Richter scale.	2
1.3	Measurement of earthquakes – seismographs and accelerograph	1
1.4	Strong motion characteristics, response spectrum, characteristics of response spectrum, design spectrum, construction of tripartite response spectrum	3
2	Module 2	9 hours
2.1	Structural irregularities, Effect of architectural features, Damages during past earthquakes.	3
2.2	Concept of capacity design, Strong Column and weak beam, Philosophy of earthquake resistant construction.	2
2.3	Strong Column and weak beam, Philosophy of earthquake resistant construction.	2
2.4	Principle of earthquake resistant construction.	2
3	Module 3	10 hours
3.1	Seismic force computation using IS code provisions. Static method of analysis	2
3.2	Response spectrum analysis – theoretical aspects.	2
3.3	Performance of RC structures during EQ, Base shear calculation as per IS 1893 (Part 1):2016.	2
3.4	Zone factor, Importance factor, Response reduction factor, Fundamental time-period estimation	2

3.5	Distribution of lateral forces over height.	2
4	Module 4	9 hours
4.1	Torsional behavior of buildings - Codal provisions	1
4.2	Ductility – significance in earthquake resistant design, Ductility factors, Ductile detailing considerations as per IS:13920.	2
4.3	Detailing of structural members & joints	2
4.4	Repair and retrofitting of RCC structures	2
4.5	Response reduction techniques, Base isolation	2
5	Module 5	8 hours
5.1	Performance of masonry structures during earthquakes	2
5.2	Box action, influence of openings	2
5.3	Influence of openings, role of horizontal and vertical bands, rocking of masonry piers	2
5.4	Repair and retrofitting of masonry structures	2
Total		45 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Explain the Elastic Rebound Theory and discuss its significance in understanding earthquake mechanisms.
2. Describe the different types of seismic waves and explain how each contributes to structural damage during an earthquake.

Course Outcome 2 (CO 2):

1. Examine the effects of plan and vertical irregularities on the seismic performance of buildings with suitable examples. Discuss the role of PCA in data compression and information extraction from multispectral images.
2. Apply the strong column–weak beam principle to propose modifications for an irregular RC frame structure.

Course Outcome 3 (CO 3):

1. Analyse the variation of design base shear with building height and fundamental time period as per IS 1893 (Part 1):2016 for different soil types.
2. Explain the steps involved in response spectrum analysis and analyse how it differs from the equivalent static method.

Course Outcome 4 (CO 4):

1. Illustrate ductile detailing provisions for a beam–column joint as per IS 13920:2016 and justify their importance in seismic performance.
2. Suggest appropriate retrofitting techniques to strengthen a torsionally irregular RC building damaged during an earthquake.

Course Outcome 5 (CO 5):

1. Suggest suitable seismic strengthening measures for a load-bearing masonry wall with large openings.
2. Recommend appropriate repair and retrofitting methods for restoring the box action of a damaged masonry building.

MODEL QUESTION PAPER

QP CODE:

Pages: 3

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

FIFTH SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CEH51

FUNDAMENTALS OF EARTHQUAKE ENGINEERING

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. State the Elastic Rebound Theory and explain its significance in earthquake generation.
2. Differentiate between earthquake intensity and magnitude.
3. Define structural irregularities and mention their types as per IS 1893.
4. Explain the concept of capacity design and its importance in earthquake-resistant structures.
5. What is base shear? Mention the parameters influencing its calculation as per IS 1893 (Part 1):2016.
6. Define fundamental time period and describe its importance in seismic analysis.
7. State the significance of ductility in seismic design of RC structures.
8. What is torsional irregularity? Mention how it affects structural performance during earthquakes.
9. Explain the term box action in masonry structures.
10. What is the role of horizontal and vertical bands in improving seismic performance of masonry buildings

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. a) Explain the mechanism of earthquakes and describe different types of seismic waves. (6)
- b) Discuss the construction and significance of response spectra and the concept of tripartite spectrum. (8)

OR

12. a) Explain how earthquake magnitude and intensity are measured using Richter scale and seismographs. (4)
- b) Discuss the effects of earthquakes on buildings and infrastructure with suitable examples. (10)

MODULE 2

13. a) Describe structural and architectural irregularities and their influence on seismic performance. (4)
- b) Explain the principle of strong column–weak beam and its role in earthquake-resistant design. (10)

OR

14. a) Discuss the philosophy of earthquake-resistant construction and the concept of capacity design. (4)
- b) Summarize the types of damage observed in past earthquakes due to poor architectural planning. (10)

MODULE 3

15. a) Explain the procedure for seismic force computation using the Equivalent Static Method as per IS 1893 (Part 1):2016. (4)
- b) Derive the expression for design base shear and explain how it is distributed over building height. (10)

OR

16. a) Discuss the Response Spectrum Method of analysis and its advantages over static analysis. (4)
- b) Explain the significance of zone factor, importance factor, and response reduction factor in seismic design. (10)

MODULE 4

17. a) Discuss the torsional behavior of buildings and relevant codal provisions for controlling torsion. (4)
b) Explain the ductile detailing requirements for RC members and joints as per IS 13920:2016. (10)

OR

18. a) Describe the repair and retrofitting techniques adopted for earthquake-damaged RC structures. (4)
b) Explain the response reduction techniques, focusing on the concept and application of base isolation. (10)

MODULE 5

19. a) Explain the seismic performance of masonry structures and the importance of box action. (4)
b) Discuss how openings affect the seismic strength and stability of masonry buildings. (10)

OR

20. a) Describe the rocking behavior of masonry piers under earthquake loading. (4)
b) Explain the methods of repair and retrofitting used to enhance the seismic resistance of masonry structures. (10)

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CEH52	STRUCTURAL FORENSIC ANALYSIS	3	1	0	5	4	2024

Preamble

This course deepens the expertise in assessing the integrity of structures. It offers a blend of theoretical knowledge and practical insights, preparing participants to tackle challenges in construction and rehabilitation. By the end of the course, students will be equipped with the knowledge to ensure the safety, durability, and resilience of structures.

Prerequisites: Concrete technology

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Gain insights into the principles of construction theory, safety standards, and failure case studies to identify causes and responsibilities in structural failure. (Cognitive Knowledge Level: Apply)
CO 2	Apply non-destructive testing (NDT) techniques and ASTM standards to assess and interpret the condition and distress level of structural members. (Cognitive Knowledge Level: Apply)
CO 3	Apply test methods and analytical approaches to identify corrosion mechanisms and evaluate other durability issues affecting structural performance. (Cognitive Knowledge Level: Apply)
CO 4	Familiarize with the performance evaluation and damage assessment procedures to determine the effect of fire and earthquake on the strength and ductility of structures. (Cognitive Knowledge Level: Apply)
CO 5	Apply forensic engineering techniques and case study analysis to investigate structural failures and propose remedial or preventive measures. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	2	1	1	2		2	1	1	2		2
CO 2	3	2	1	2	3	3		1	2	1	2
CO 3	2	2	1	2		2		1	2	1	2
CO 4	2	1	2	3			1	2	1		2
CO 5	2	2	1	2		2	3	1	3	1	3

Assessment Pattern

STRUCTURAL FORENSIC ANALYSIS			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	10	10	10
Understand	30	30	30
Apply	60	60	60
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 10 marks
Self Study	: 5 marks

End Semester Examination Pattern

There will be two parts: Part A and Part B. Part A contain 10 questions, with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module, of which students should answer any one. Each question carries 14 marks and can have a maximum of 2 sub-divisions.

SYLLABUS

Module 1: Introduction to Construction theory and Structural Failures (9 hours)

Review of construction theory and principles, Construction Safety Codes - Standards, and Regulations, Structural failures- Causes, Responsibility and accountability, Case studies illustrating lessons learned from failures, Causes of distress in structural members: design errors and material deficiencies, overloading.

Module 2: Condition assessment of structures(9 hours)

Techniques for condition assessment of structures - Non-destructive testing (NDT) methods, Ultrasonic pulse velocity method, rebound hammer method, ASTM classifications for distress assessment, Case studies analyzing distress in single and multistorey buildings, Prediction of structural deterioration using fiber optic methods.

Module 3: Durability and corrosion mechanisms in Concrete Structures (9 Hours)

Corrosion in structures, Carbonation induced, Chloride induced, Identification of corrosion distress, Test methods to identify root cause of corrosion, other durability issues, Sulfate attack, Alkali aggregate reaction.

Module 4: Structural Performance under Fire and Seismic Actions(9 Hours)

Effect of fire on structures, Fire damages, Evaluation of extend of damage and resilience, Influence of earthquake on structures, Assessment of extend of damage in structural elements. Assessment of earthquake resistance, ductility requirements, and principles of capacity design.

Module 5: Case Studies in Structural Failures(9 Hours)

Analysis of building failures, including heritage and high-rise buildings, Case studies focusing on water tanks, bridges, and other structures, Examination of investigative techniques and forensic engineering principles, best practices in structural failure analysis.

Text Books:

1. Robert Ratay, "Forensic Structural Engineering Handbook",2010, Second edition, McGraw-Hill Companies, New York.

2. V. Ramachandran; A.C. Raghuram; R.V. Krishnan; S.K. Bhaumik, "Failure Analysis of Engineering Structures: Methodology and Case Histories", 2005, ASM International.
3. Maierhofer, Christiane & Reinhardt, H.-W & Dobmann, Gerd. (2010), "Non-Destructive Evaluation of Reinforced Concrete Structures: Non-Destructive Testing Methods", Woodhead publishing.
4. Malcolm Holland, "Practical Guide to Diagnosing Structural Movement in Buildings", Second edition, Wiley Blackwell.
5. Luca Bertolini, "Corrosion of Steel in Concrete: Prevention, Diagnosis, Repair", 2003, Wiley.
6. Myer Kutz, "Handbook of Environmental Degradation of Materials", 2005, First edition.
7. Ronald Hamburger and Andrew Whittaker, "Case Studies in Structural Engineering for Architects"

References:

1. N.J. Delatte, "Beyond Failure: Forensic Case Studies for Civil Engineers", ASCE, 2009

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	9 hours
1.1	Review of construction theory and principles	1
1.2	Construction Safety Codes- Standards, and Regulations, Structural failures	2
1.3	Causes, Responsibility and accountability	2
1.4	Case studies illustrating lessons learned from failures	2
1.5	Causes of distress in structural members: design and material deficiencies, overloading	2
2	Module 2	9 hours
2.1	Techniques for condition assessment of structures	1
2.2	Introduction to non-destructive testing (NDT) methods	1
2.3	Ultrasonic pulse velocity method, rebound hammer method	2
2.4	ASTM classifications for distress assessment	2
2.5	Case studies analyzing distress in single and multistorey buildings	2
2.6	Prediction of structural deterioration using fiber optic methods	1
3	Module 3	9 hours
3.1	Introduction to corrosion on structures	1
3.2	Carbonation induced and Chloride induced corrosion	2
3.3	Identification of corrosion distress	2
3.4	Test methods to identify root cause of corrosion	2

3.5	Durability considerations for RCC structures- durability issues, Sulfate attack, Alkali aggregate reaction	2
4	Module 4	9 hours
4.1	Effect of fire on structures	1
4.2	Fire damages	1
4.3	Evaluation of extend of damage and resilience	1
4.4	Influence of earthquake on structures	1
4.5	Assessment of extend of damage in structural elements	1
4.6	Assessment of earthquake resistance- ductility requirements	2
4.5	Principles of capacity design	2
5	Module 5	9 hours
5.1	Analysis of building failures, including heritage and high-rise buildings	2
5.2	Case studies focusing on water tanks, bridges, and other structures	3
5.3	Examination of investigative techniques and forensic engineering principles	2
5.4	Best practices in structural failure analysis	2
Total		45 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. List any three common causes of structural failure in buildings.
2. What is the role of design codes and standards in forensic investigation?
3. Mention two examples of case studies where poor construction practices led to structural distress.

Course Outcome 2 (CO 2):

1. Describe the rebound hammer test.
2. What information can be obtained from the ultrasonic pulse velocity (UPV) test?
3. Explain Non-Destructive Testing (NDT) and give two advantages.

Course Outcome 3 (CO 3):

1. Differentiate between carbonation-induced and chloride-induced corrosion.
2. What is the significance of half-cell potential measurement in corrosion assessment?
3. Discuss about two durability issues that affect concrete structures.

Course Outcome 4 (CO 4):

1. How does fire exposure affect the compressive strength of concrete?
2. Define ductility and explain its importance in earthquake-resistant design.
3. What is capacity design in seismic engineering?

Course Outcome 5 (CO 5):

1. List two common failure modes in high-rise buildings.
2. What are the main objectives of forensic investigation in structural failures?
3. Mention two typical causes of water tank failure.

MODEL QUESTION PAPER

QP CODE:

Pages: 2

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

FIFTH SEMESTER B TECH DEGREE EXAMINATION, 2024

Course Code: B24CEH52

STRUCTURAL FORENSIC ANALYSIS

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. How do engineers ensure the prevention of structural failures through their responsibilities and accountabilities?
2. Explain the basic principles of construction theory. How do these principles guide the design and building processes?
3. How is the rebound hammer method used to assess the quality of concrete structures?
4. Explain the common design and material deficiencies that cause distress in structural members.
5. What are the key considerations in damage assessment for structures affected by earthquakes and floods?
6. Enlist the various causes that necessitate the maintenance of a structure.
7. How are rust eliminators and polymer coatings used for rebar protection?
8. Explain the application of fiber optical sensor in structural health monitoring.
9. Discuss the forensic engineering principles applied in the examination of failed structures.
10. Provide an example of a structure that failed due to overloading. Discuss the key factors that led to the failure.

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. With the help of flow chart explain assessment procedure for evaluating a damaged structure.

OR

12. Brief out various causes of deterioration of a structure.

MODULE 2

13. Describe the principle and applications of the ultrasonic pulse velocity method in non-destructive testing.

OR

14. a) Discuss the ASTM classifications for distress assessment in concrete structures. How are these classifications used in practice? (7)
b) Explain about any one technique used for damage identification? (7)

MODULE 3

15. Write the significance of cracking of concrete. What are the major causes of cracking in reinforced concrete and how can it be prevented?

OR

16. a) Discuss the impact of corrosive, chemical, and marine environments on the durability of structures. (7)
b) Explain the importance of durability considerations in the design and maintenance of RCC structures. (7)

MODULE 4

17. Enumerate the different methods for repairs of concrete works. Discuss any one in detail

OR

18. Provide an overview of modern retrofitting techniques used in the construction industry.

MODULE 5

19. Analyse a case study of a building failure, focusing on either a heritage or a high-rise building. What were the key factors leading to the failure?

OR

20. Describe the steps in the assessment procedure for evaluate the damage in a structure?

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CEH53	ECO-FRIENDLY MATERIALS AND GREEN BUILDINGS	3	1	0	5	4	2024

Preamble

The course introduces sustainable and eco-friendly construction materials, cost-effective and alternative building technologies, green building rating systems, and solar passive design strategies. It emphasizes embodied energy, carbon footprint reduction, life-cycle thinking, and the role of civil engineers in planning and designing environmentally responsible and resource-efficient buildings.

Prerequisites: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Comprehend the principles of sustainable development, green buildings and eco-friendly construction materials, and explain the role of local materials in reducing the carbon footprint of buildings. (Cognitive Knowledge Level: Understand)
CO 2	Describe cost-effective and alternative building technologies including modular, precast and alternative roofing systems, and identify the contributions of key institutions promoting eco-friendly construction. (Cognitive Knowledge Level: Understand)
CO 3	Analyse the environmental impact, embodied energy and carbon footprint of different building materials and perform basic life-cycle and cost comparisons between green and conventional buildings. (Cognitive Knowledge Level: Analyse)
CO 4	Describe the fundamentals of green building design and outline the concepts of major green building rating systems such as IGBC, GRIHA, LEED and BREEAM. (Cognitive Knowledge Level: Understand)
CO 5	Apply solar passive heating and cooling strategies, low-energy cooling techniques and the basic provisions of ECBC to evaluate and improve the energy performance of buildings using case studies. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	2	2	1			2	3	2	1	1	1
CO 2	2	2	3	1	2	2	2	1	1	1	1
CO 3	2	3	2	2	1	2	3	2	1	1	2
CO 4	2	2	2	1	1	2	3	2	1	1	2
CO 5	2	2	3	2	2	2	3	2	1	1	2

Assessment Pattern

ECO-FRIENDLY MATERIALS AND GREEN BUILDINGS			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	20	20	30
Understand	50	50	50
Apply	30	30	20
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course project : 10 marks

Self Study : 5 marks

End Semester Examination Pattern

There will be two parts: Part A and Part B. Part A contain 10 questions, with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module, of which students should answer any one. Each question carries 14 marks and can have a maximum of 2 sub-divisions.

SYLLABUS

Module 1: Introduction to Green Materials and Construction (9 hours)

Overview of sustainable development and the green building movement. Types of eco-friendly materials: stabilized mud blocks, lime, pozzolana cements, bamboo, fibre-reinforced cement, gypsum boards, recycled aggregates. Distinction between sustainable and conventional materials. Role of local and indigenous materials in reducing the embodied energy and carbon footprint of buildings.

Module 2: Cost-Effective and Alternative Building Technologies (9 hours)

Principles of cost-effective and low-energy construction. Modular construction; precast construction and elements: wall panels, roof panels, beams and columns. Alternative roofing systems such as filler slabs, funicular shells, hollow-core slabs and bamboo-based roofing. Use of stabilized soil blocks and local materials in low-carbon construction. Role of agencies such as COSTFORD, Nirmithi Kendra, Laurie Baker's initiatives and Auroville Earth Institute in promoting eco-friendly construction technologies and practices.

Module 3: Environmental Impact of Materials (8 Hours)

Global warming and the contribution of the construction sector. Embodied energy of building materials; data, trends and comparisons. Carbon footprint associated with different material choices. Life-cycle costing and life-cycle assessment – basic ideas and comparisons of green versus conventional buildings. Strategies for waste minimization and resource efficiency at the design stage.

Module 4: Fundamentals of Green Building Design (9 Hours)

Introduction to green building rating systems: IGBC, LEED, GRIHA, BREEAM (concepts only). Sustainable site selection and planning – site context, access, micro-climate and landscape. Principles of energy-efficient building design – building envelope, daylighting, natural ventilation. Principles of water-efficient building design – rainwater harvesting, water-efficient fixtures and reuse concepts. Passive design elements: orientation, shading and natural ventilation.

Module 5: Solar Passive Strategies and Codes for Green Buildings (10 Hours)

Solar passive heating and cooling strategies – orientation, thermal mass, buffer spaces and shading devices. Low-energy cooling techniques for tropical climates – courtyards, wind towers, evaporative cooling and roof treatments. Green composites in construction. Energy

Conservation Building Code (ECBC 2018) – overview and relevance to civil engineers. Case studies of solar-passive and energy-efficient buildings in India and abroad.

Text Books:

1. Kibert, C.J. (2016). Sustainable Construction: Green Building Design and Delivery. Wiley.
2. Pacheco-Torgal, F., Cabeza, L.F., Labrincha, J., & De Magalhães, A. (2014). Eco-efficient Construction and Building Materials. Woodhead Publishing.
3. GRIHA Council (2019). GRIHA Manual – Guidelines for Green Buildings in India. TERI, New Delhi.
4. Indian Green Building Council (IGBC) Manuals and Guidelines, Confederation of Indian Industry (CII).

References:

1. Bureau of Indian Standards (2016). National Building Code of India 2016 – Sustainability Section. BIS, New Delhi.
2. Bureau of Energy Efficiency (2018). Energy Conservation Building Code (ECBC 2018), Ministry of Power, New Delhi.
3. Kubba, S. (2010). LEED Practices, Certification, and Accreditation Handbook. Elsevier.
4. Rider, T.R., Glass, S., & McNaughton, J. (2011). Understanding Green Building Materials. W.W. Norton.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	8 hours
1.1	Overview of sustainable development; green building movement and global context.	2
1.2	Eco-friendly materials – stabilized mud blocks, lime and pozzolana cements.	1
1.3	Eco-friendly materials – bamboo, fibre-reinforced cement, gypsum boards, recycled aggregates.	1
1.4	Distinction between sustainable and conventional materials; role of local materials in reducing carbon footprint.	1
2	Module 2	7 hours
2.1	Principles of cost-effective and low-energy construction; need for alternative technologies..	1
2.2	Modular and precast construction – wall panels, roof panels, beams and columns.	1
2.3	Alternative roofing systems – filler slabs, funicular shells and hollow-core slabs	1
2.4	Bamboo-based roofing systems; use of stabilized soil blocks and local materials in low-carbon construction.	1
2.5	Role of COSTFORD, Nirmithi Kendra, Laurie Baker initiatives and Auroville Earth Institute.	1
3	Module 3	6 hours
3.1	Global warming and contribution of the construction sector.	1
3.2	Embodied energy of building materials – concepts, examples and data.	1
3.3	Carbon footprint of material choices and simple comparisons.	1

3.4	Life-cycle costing and comparison of green vs conventional buildings.	2
3.5	Waste minimization and resource efficiency at design stage.	1
4	Module 4	7 hours
4.1	Introduction to green building rating systems – IGBC, LEED, GRIHA, BREEAM (concepts only).	1
4.2	Sustainable site selection and planning – micro-climate, access and landscape.	1
4.3	Principles of energy-efficient building design – envelope, day-lighting, natural ventilation.	1
4.4	Water-efficient building design – rainwater harvesting and efficient fixtures.	2
4.5	Passive design elements – orientation, shading and natural ventilation	2
5	Module 5	8 hours
5.1	Solar passive heating strategies – thermal mass, sunspaces and buffer zones	2
5.2	Solar passive and low-energy cooling techniques for tropical climates.	1
5.3	Green composites in construction – concepts and examples.	1
5.4	ECBC 2018 – overview, intent and relevance to civil engineering.	1
5.5	Case studies of solar-passive and energy-efficient buildings in India and abroad.	2
Total		36 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Explain the concept of sustainable development and its relevance to the construction sector.
2. List any six eco-friendly materials and briefly mention their typical applications in buildings.
3. Discuss how the use of local and indigenous materials can reduce the embodied energy and carbon footprint of a building.

Course Outcome 2 (CO 2):

1. Explain the principles of modular construction and outline its advantages for affordable housing.
2. With sketches, describe any two alternative roofing systems suitable for eco-friendly buildings.
3. Discuss the role of organizations such as COSTFORD and Nirmithi Kendra in promoting cost-effective and sustainable building technologies.

Course Outcome 3 (CO 3):

1. Define embodied energy and carbon footprint of building materials with suitable examples.
2. Compare the environmental impact of a conventional reinforced concrete frame structure with an alternative low-embodied-energy system.
3. Explain the basic steps involved in life-cycle costing and how it can be applied to compare a green building with a conventional building.

Course Outcome 4 (CO 4):

1. List the main features of any two green building rating systems used in India.
2. Explain the importance of sustainable site selection and planning in green building design.
3. Discuss how energy-efficient and water-efficient design strategies are incorporated in green building rating criteria.

Course Outcome 5 (CO 5):

1. Describe any three solar passive design strategies suitable for warm-humid climates.
2. Explain the significance of ECBC 2018 in improving the energy performance of commercial buildings in India.
3. Using a simple case study, illustrate how passive measures and ECBC provisions together can reduce the operational energy demand of a building.

MODEL QUESTION PAPER

QP CODE:

Pages: 3

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

FIRST SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CEH53

ECO-FRIENDLY MATERIALS AND GREEN BUILDINGS

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Define eco-friendly building material and give one example relevant to civil engineering.
2. List any three advantages of using locally available materials in green building construction.
3. Define modular construction and state one benefit of using modular systems in housing projects.
4. List any three alternative roofing systems commonly adopted in cost-effective and eco-friendly buildings.
5. Define embodied energy of a building material and mention one factor influencing it.
6. State any three ways in which choice of materials can influence the carbon footprint of a building over its life cycle.
7. List any three major green building rating systems used in India and abroad.
8. Mention any three sustainable site selection criteria considered in green building design.
9. State any three solar passive design strategies suitable for buildings in warm-humid climates.
10. List any three key aspects addressed by the Energy Conservation Building Code (ECBC 2018) for commercial buildings

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. a) Explain the concept of sustainable development and discuss the role of the construction sector in achieving sustainability goals. . (8)
b) List and briefly describe any four eco-friendly building materials suitable for use in walls and roofs. (6)

OR

12. a) Explain the evolution of the green building movement in India and its significance for civil engineers. (8)
b) Discuss how the use of local and indigenous materials can reduce environmental impacts and construction costs. (6)

MODULE 2

13. a) With neat sketches, explain the principles and constructional details of filler slab and funicular shell roofing systems. (8)
b) Discuss the advantages and limitations of precast construction in the context of eco-friendly and cost-effective building projects. (6)

OR

14. a) Describe the contributions of COSTFORD, Nirmithi Kendra and Auroville Earth Institute in promoting sustainable and low-cost building technologies. (8) (b) Explain the role of bamboo-based roofing and stabilized soil blocks in low-carbon construction. (6)

MODULE 3

15. a) Define embodied energy and carbon footprint of building materials. Explain, with suitable examples, how they can be used to compare material alternatives. (8)
b) Discuss the major sources of greenhouse gas emissions associated with conventional building materials. (6)

OR

16. a) Describe the steps involved in performing a simple life-cycle costing comparison between a green building and a conventional building. (8)
b) Explain key strategies for reducing construction and demolition waste through design-stage interventions. (6)

MODULE 4

17. a) Compare the main features and focus areas of IGBC and GRIHA rating systems for green buildings in India. (8)
b) Explain how sustainable site selection and planning influence the overall environmental performance of a building project. (6)

OR

18. a) Discuss the principles of energy-efficient and water-efficient building design with reference to envelope design, daylighting and rainwater harvesting. (8)
b) Explain how passive design elements such as orientation, shading and ventilation are integrated into green building guidelines. (6)

MODULE 5

19. a) Explain any four solar passive heating and cooling techniques suitable for warm-humid or composite climates with neat sketches. (8)
b) Discuss the role of ECBC 2018 in enhancing the energy performance of new commercial buildings in India. (6)

OR

20. a) Present a case study of a solar passive or energy-efficient building in India, highlighting its key design features and measured performance. (8)
b) Briefly describe the concept of green composites and their potential applications in building construction. (6)

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CEH54	CONSTRUCTION CONTRACTS, METHODS AND EQUIPMENTS	3	1	0	5	4	2024

Preamble

The course provides fundamental knowledge of construction methods, materials, equipment, and contract management, enabling students to plan, execute, and manage construction projects efficiently with emphasis on quality and safety.

Prerequisites: Construction Techniques and Management

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Understand the fundamental principles of modern construction methods, materials, and equipment used in civil engineering projects. (Cognitive Knowledge Level: Understand).
CO 2	Apply appropriate construction techniques and equipment for earthwork, concrete, masonry, and finishing operations in various site conditions.(Cognitive Level: Apply)
CO 3	Interpret construction contract documents, procurement methods, and legal frameworks for effective project administration.(Cognitive Level: Apply)
CO 4	Develop and manage equipment operation plans, scheduling, and maintenance programs to ensure productivity and cost efficiency. (Cognitive Level: Apply).
CO 5	Understand construction risks, variations, disputes, and quality assurance procedures to ensure safe, sustainable, and compliant project execution. (Cognitive Level: Understand).

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	2						1			2
CO 2	2	3				2		2		2	3
CO 3	1		1			3	2	3			3
CO 4	1		1	1	1						2
CO 5	2	1	2			1	1				2

Assessment Pattern

Construction Contracts, Methods and Equipment			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	20	20	30
Understand	50	50	60
Apply	30	30	10
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 10 marks
Self Study	: 5 marks

End Semester Examination Pattern

There will be two parts: Part A and Part B. Part A contain 10 questions, with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module, of which students should answer any one. Each question carries 14 marks and can have a maximum of 2 sub-divisions.

SYLLABUS

Module 1: Introduction to Construction Safety (8 hours)

Overview of construction industry and project life cycle - Classification of construction equipment and their roles - Fundamentals of construction contracts: definitions, parties, and obligations - Legal principles and types of contracts (lump sum, unit rate, cost-plus, design - build, PPP) - Procurement methods and bidding systems

Module 2: Construction Materials, Foundations & Earthwork Methods (10 hours)

Properties and testing of soil, concrete, masonry, steel, and wood - Excavation techniques, soil stabilization, and ground improvement - Piling, shoring, and formwork systems - Material handling and logistics on site - Standards and codes for materials and methods.

Module 3: Concrete, Masonry & Finishing Works (9 Hours)

Concrete works: batching, mixing, transporting, placing, curing, and finishing- Concrete equipment: mixers, pumps, vibrators - Masonry and carpentry works; formwork and scaffolding systems - Finishing methods: plastering, flooring, painting, and woodwork - Quality assurance, inspection, and compliance procedures.

Module 4: Construction Equipment, Operation & Scheduling (9 Hours)

Heavy and lifting equipment: cranes, earth - moving machinery, hoists, and transport vehicles - Equipment productivity and cost optimization - Preventive maintenance and environmental considerations - Equipment mobilization and scheduling relative to project timelines - Automation, prefabrication, modular construction, and BIM integration

Module 5: Contract Administration, Risk & Project Close-Out-Tendering (9 Hours)

Bid evaluation, and award procedures - Payment terms, bonds, and insurance - Variations, claims, and dispute resolution (arbitration, mediation, litigation) - Roles of owner, contractor, and consultant in contract administration - Project close-out, final account, warranties, and documentation.

Text Books:

1. Gahlot, P. S., & Dhir, B. M. (2008). Construction Planning and Management. New

Age International Publishers.

2. Patil, B. S. (2013). Legal Aspects of Building and Engineering Contracts (6th ed.). Universities Press.
3. Gupta, R., & Singh, S. P. (2016). Construction Contracts and Tendering. Satya Prakashan.

References:

1. Government of India. (1872). The Indian Contract Act, 1872. Ministry of Law and Justice. Retrieved from <https://legislative.gov.in>
2. Levy, S. M. (2018). Project Management in Construction (7th ed.). McGraw-Hill Education.
3. Lambeck, R., & Eschemuller, J. (2009). Urban Construction Project Management. The McGraw-Hill Companies, Inc.
4. Madsen, D. A. (2010). Commercial Building Construction: Materials and Methods (1st ed.). Delmar Cengage Learning.
5. Schexnayder, C. J., & Fiori, C. M. (2021). Handbook for Building Construction: Administration, Materials, Systems, and Safety (1st ed.). McGraw-Hill Education.
6. Peurifoy, R. L., Schexnayder, C. J., Shapira, A., & Schmitt, R. (2018). Construction Planning, Equipment, and Methods (9th ed.). McGraw-Hill Education

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	8 hours
1.1	Overview of construction industry and project life cycle	1
1.2	Classification of construction equipment and their roles	2
1.3	Fundamentals of construction contracts: definitions, parties, and obligations	2
1.4	Legal principles and types of contracts (lump sum, unit rate, cost-plus, design-build, PPP)	2
1.5	Procurement methods and bidding systems	1
2	Module 2	10 hours
2.1	Properties and testing of soil, concrete, masonry, steel, and wood	2
2.2	Excavation techniques, soil stabilization, and ground improvement	2
2.3	Piling, shoring, and formwork systems	2
2.4	Material handling and logistics on site	2
2.5	Standards and codes for materials and methods.	2
3	Module 3	9 hours
3.1	Concrete works: batching, mixing, transporting, placing, curing, and finishing	1
3.2	Concrete equipment: mixers, pumps, vibrators	2
3.3	Masonry and carpentry works; formwork and scaffolding systems	2
3.4	Finishing methods: plastering, flooring, painting, and woodwork	2

3.5	Quality assurance, inspection, and compliance procedures	2
4	Module 4	9 hours
4.1	Heavy and lifting equipment: cranes, earth-moving machinery, hoists, and transport vehicles	2
4.2	Equipment productivity and cost optimization	2
4.3	Preventive maintenance and environmental considerations	1
4.4	Equipment mobilization and scheduling relative to project timelines	2
4.5	Automation, prefabrication, modular construction, and BIM integration	2
5	Module 5	9 hours
5.1	Bid evaluation, and award procedures	1
5.2	Payment terms, bonds, and insurance	2
5.3	Variations, claims, and dispute resolution (arbitration, mediation, litigation)	2
5.4	Roles of owner, contractor, and consultant in contract administration	2
5.5	Project close-out, final account, warranties, and documentation	2
Total		45 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Explain the different stages in a construction project life cycle and how each stage contributes to successful project completion.
2. Describe the various types of construction contracts and procurement methods, highlighting how they influence the roles and responsibilities of project participants.

Course Outcome 2 (CO 2):

1. Apply suitable soil stabilization or ground improvement techniques for a site with weak clayey soil intended for a multi-storey building foundation.
2. Suggest appropriate formwork and material handling systems for constructing a reinforced concrete retaining wall under constrained site conditions.

Course Outcome 3 (CO 3):

1. Apply suitable concrete placing and compaction methods for a large raft foundation where accessibility for conventional vibration is limited.
2. Recommend appropriate finishing and quality assurance procedures for a commercial building to ensure durability and aesthetic performance of concrete and masonry surfaces.

Course Outcome 4 (CO 4):

1. Select suitable types of equipment and prepare a basic equipment schedule for an earthwork operation involving excavation, hauling, and compaction for a highway project.
2. Apply principles of equipment productivity and cost optimization to determine the most efficient combination of cranes and transport vehicles for a multi-storey building project.

Course Outcome 5 (CO 5):

1. Explain the roles and responsibilities of the owner, contractor, and consultant during the different stages of contract administration.
2. Describe the procedures involved in tendering, bid evaluation, and award of a construction contract, highlighting their importance in ensuring fair project execution.

MODEL QUESTION PAPER

QP CODE:

Pages: 2

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

FIRST SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CEH54

CONSTRUCTION CONTRACTS, METHODS AND EQUIPMENTS

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Describe the various stages involved in the construction project life cycle.
2. Explain arbitration as methods of dispute resolution.
3. Suggest corrective measures when soil test results indicate low shear strength or high compressibility.
4. Describe the purpose of tests conducted on soil, concrete, and steel.
5. Describe the significance of equipment mobilization in project planning..
6. Explain the functions different types of heavy equipment.
7. Explain the applications of different types of heavy and lifting equipment used in construction projects.
8. Describe the importance of preventive maintenance in the operation of construction equipment.
9. Discuss the major responsibilities of the owner, contractor, and consultant during contract execution.
10. Discuss the significance of maintaining proper documentation during project execution.

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. Describe the steps involved in bid evaluation and award procedures in a construction project.

OR

12. Describe the common types of claims that may arise in a construction project and their possible causes.

MODULE 2

13. Explain the need for soil stabilization and ground improvement in foundation engineering.

OR

14. Describe the types and uses of formwork systems in concrete construction.

MODULE 3

15. Select suitable equipment for a project requiring excavation and material transport in confined urban spaces.

OR

16. Recommend eco-friendly practices for operating construction machinery in environmentally sensitive areas.

MODULE 4

17. Apply suitable types of equipment and scheduling techniques for executing excavation and material transport in a large infrastructure project.

OR

18. Propose an equipment utilization plan incorporating automation or BIM integration to improve productivity and cost efficiency on a construction site.

MODULE 5

19. Explain the sequence of activities involved in the tendering and bid evaluation process of a construction project.

OR

20. Describe the different types of disputes that may arise in construction contracts and the methods used for their resolution.

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CEH55	TRANSPORTATION SAFETY ENGINEERING	3	1	0	5	4	2024

Preamble

Transportation Safety Engineering focuses on understanding and improving road safety through analysis of human, vehicle, and roadway factors. The course covers crash data analysis, safe roadway design, traffic control, Intelligent Transportation Systems, and policy frameworks, aligning with national and global safety goals to promote sustainable and safer transportation systems

Prerequisites: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Understand the basic concepts, factors, and performance measures influencing road safety, and apply the road safety triangle to analyze safety conditions. (Cognitive Level: Understand).
CO 2	Understand various crash data collection systems and analysis methods, and apply statistical and GIS tools to identify crash patterns and black spots. (Cognitive Level: Understand)
CO 3	Apply roadway design and safety audit principles to evaluate geometric design consistency, roadside safety features, and intersection performance for all road users. (Cognitive Level: Apply)
CO 4	Apply traffic control and ITS-based strategies to manage speed, detect violations, and enhance safety through effective enforcement and monitoring systems. (Cognitive Level: Apply)
CO 5	Apply national road safety policies and safe system principles to develop safety improvement plans, awareness programs, and sustainable mobility strategies. (Cognitive Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	2	1			2	1				
CO 2	2	3	2	2	3	2	1				
CO 3	2	2	3	2	2	3	2		1		
CO 4	2	2	3	2	3	3	2		1		
CO 5	1	2	2	1	2	3	3	2	1	1	1

Assessment Pattern

TRANSPORTATION SAFETY ENGINEERING			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	25	25	25
Understand	25	25	25
Apply	50	50	50
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course project : 10 marks

Self Study : 5 marks

End Semester Examination Pattern

There will be two parts: Part A and Part B. Part A contain 10 questions, with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module, of which students should answer any one. Each question carries 14 marks and can have a maximum of 2 sub-divisions.

SYLLABUS

Module 1: Fundamentals of Road Safety (9 hours)

Introduction to road safety: Definitions, importance, global and Indian scenarios. The road safety triangle: Human – Vehicle – Road. Factors affecting road safety: Human, vehicular, roadway, and environmental. Safety performance measures: Exposure, crash frequency, severity, risk indices. Road safety indicators and Sustainable Development Goals (SDGs).

Module 2: Crash Data Collection and Analysis (9 hours)

Crash investigation and reporting systems in India. Crash data types: Police - reported, hospital-based, insurance data. Accident data formats and coding, Collision diagram, condition diagrams, crash reconstruction, Crash data analysis: Descriptive statistics, trend analysis, severity index. Use of software tools: Excel, GIS, and introduction to Safety Analyst. Identifying crash patterns and high - risk locations (Blackspot identification).

Module 3: Roadway Design and Safety Evaluation (10 Hours)

Design consistency and safety in geometric elements. Roadside safety: Clear zones, guardrails, crash cushions, barriers. Intersection safety: Channelization, roundabouts, signals, lighting. Vulnerable road users: Design for pedestrians, cyclists, elderly, and disabled. Safety audits : aims and objectives, roles and responsibility, design standards, tasks, various stages of safety audits.

Module 4: Traffic Control and Intelligent Transportation Systems (ITS) (10 Hours)

Role of traffic control devices in safety: Signs, signals, markings. Enforcement strategies: Manual and automated enforcement (e.g., speed cameras). ITS applications for safety: Speed enforcement, red light violation detection, incident management, Real - time traffic monitoring and incident management systems. Speed management strategies – geometric, regulatory, and educational.

Module 5: Road Safety Management, Policies, and Education (7 Hours)

Road safety policies: National Road Safety Policy, Motor Vehicle Act amendments. Role of stakeholders: Government, NGOs, police, educational institutions. Five pillars of road safety (UN Decade of Action): Road users, vehicles, roads, enforcement, post - crash response. Education and awareness campaigns: School programs, mass media. Post - crash

care and emergency response systems. Safe School Zones, Safe System Interventions, and Sustainable Mobility, National Road Safety Policy.

Text Books:

1. AASHTO, A policy on Geometric Design of Highways and Streets, AASHTO, 2004.
2. Elvik, R., Høy, A., Vaa, T. and Sørensen, M., The Hand Book of Road Safety Measures, Emerald Group Publishing Limited, 2009.
3. Ezra Haure, Observational Before-After Studies In Road Safety, Pergamon, 2002.
4. Ogden, K.W. Safer Roads: A Guide to Road Safety Engineering, Avebury Technical Cambridge
5. PEDSAFE: Pedestrian Safety Guide and Countermeasure Selection System, USDOT, 2004.
6. Ministry of Surface Transport, Accident Investigation and Prevention Manual for Highway Engineers in India, Government of India, 2001.
7. Indian Roads Congress -IRC (2013), Ministry of Road Transport & Highways (MORTH) Road Safety Audit Manual (IRC: SP-88).
8. Geetam Tiwari, Dinesh Mohan, Transport Planning and Traffic Safety: Making Cities, Roads, and Vehicles Safety, 1st Edition, CRC Press Publication, USA, 2016.
9. Dhillon B.S, Transportation Systems Reliability and Safety, 1st Edition, CRC Press Publication, USA, 2011.
10. Martin Belcher, Steve Proctor and Phil Cook, Practical Road Safety Auditing, 3rd Edition, ICE Publication, Scotland, 2011

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	9 hours
1.1	Introduction to road safety – Definition, importance, global and Indian road safety scenario	1
1.2	The Road Safety Triangle – Human-Vehicle-Road interaction and interdependence	1
1.3	Human factors affecting road safety – behavior, perception, fatigue, violations	1
1.4	Vehicular and roadway factors affecting safety	1
1.5	Environmental and operational factors influencing safety	1
1.6	Safety performance measures – Exposure, crash frequency, severity, risk indices, Measuring and interpreting road safety performance indicators	2
1.7	Road safety and Sustainable Development Goals (SDGs) – global and national targets, Case study/discussion: Indian road safety challenges and mitigation approaches	2
2	Module 2	9 hours
2.1	Crash investigation and reporting systems in India, Crash data sources – police, hospital, insurance databases	2
2.2	Accident data formats, classification, and coding systems, Collision diagrams, condition diagrams – purpose and preparation	2
2.3	Crash reconstruction – concepts and basic methods, Crash data analysis – descriptive statistics, trend analysis, severity index, Software tools for crash analysis – Excel, GIS, Safety Analyst (intro)	3
2.4	Identification of crash patterns and blackspots (high-risk locations), Tutorial/Case study: Crash data analysis for sample road sections	2

3	Module 3	10 hours
3.1	Design consistency and its impact on safety	1
3.2	Roadside safety: concepts, clear zones, guardrails, crash cushions, Safety barriers and containment levels	2
3.3	Intersection safety: design and control principles, Roundabouts, signals, lighting design for safety	3
3.4	Design for vulnerable road users: pedestrians, cyclists, elderly, disabled	1
3.5	Road safety audits – aims, objectives, and responsibilities, Stages of safety audits and example case study	3
4	Module 4	10 hours
4.1	Role of traffic control devices – signs, signals, road markings	1
4.2	Design principles and placement of control devices for safety	2
4.3	Enforcement strategies – manual enforcement methods, Automated enforcement – speed cameras, red-light violation detection	2
4.4	Speed management – geometric, regulatory, and educational approaches,	1
4.5	ITS for road safety: concepts and application, Real-time traffic monitoring and incident management systems	2
4.6	Integration of ITS in urban safety management, Tutorial/Case study: ITS-based safety system implementation	2
5	Module 5	7 hours
5.1	National Road Safety Policy, Motor Vehicle Act amendments, Stakeholders in road safety: Government, NGOs, police, educational institutions	2
5.2	Five pillars of road safety – UN Decade of Action framework, Education and awareness campaigns – schools, media, community	2
5.3	Post-crash care and emergency response systems	1

5.4	Safe school zones, safe system interventions, and sustainable mobility initiative	2
Total		45 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Explain the concept of the road safety triangle and describe the interrelation between human, vehicle, and roadway factors.
2. Discuss the importance of safety performance measures such as crash frequency, severity, and risk indices in evaluating road safety.

Course Outcome 2 (CO 2):

1. Describe different sources and types of crash data (police, hospital, insurance) and their relevance in road safety analysis.
2. Discuss various descriptive statistical methods to summarize crash data.

Course Outcome 3 (CO 3):

1. Evaluate the design consistency of a given roadway alignment and recommend suitable safety improvements.
2. Analyze an intersection layout and propose design modifications to enhance safety for vulnerable road users.

Course Outcome 4 (CO 4):

1. Design an appropriate combination of traffic signs, signals, and markings to improve safety on an urban arterial road.
2. Develop a speed management plan incorporating geometric, regulatory, and educational approaches for a selected roadway segment.

Course Outcome 5 (CO 5):

1. Apply the five pillars of road safety to formulate a district-level road safety improvement action plan.
2. Describe examples such as school-based programs and media campaigns.

MODEL QUESTION PAPER

QP CODE:

Pages: 3

Reg.No.:

Name:

**MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM**

FIRST SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CEH55

TRANSPORTATION SAFETY ENGINEERING

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Define road safety and state its importance in the context of transportation engineering.
2. List the three components of the road safety triangle and briefly explain their interrelationship.
3. Differentiate between collision diagrams and condition diagrams in crash analysis.
4. Define the term black spot and state why identifying such locations is important.
5. List any three roadside safety features and briefly explain their functions
6. State the objectives of a road safety audit and its relevance in the design process.
7. Differentiate between manual and automated traffic enforcement with one example for each.
8. List any three geometric strategies used for effective speed management on urban roads.
9. What are the key objectives of the National Road Safety Policy of India?
10. Write short notes on the role of educational institutions in promoting road safety awareness.

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. a) Explain the concept of the road safety triangle in detail. How do human, vehicle, and roadway factors interact to influence road safety? (7)
- b) Discuss the importance of road safety with reference to the global and Indian road crash scenario, including recent trends or statistics. (7)

OR

12. a) Describe the major factors affecting road safety under human, vehicular, roadway, and environmental categories with suitable examples. (7)
- b) Explain the various safety performance measures—exposure, crash frequency, severity, and risk indices—and their significance in evaluating safety. (7)

MODULE 2

13. a) Describe the various types of crash data (police-reported, hospital-based, insurance data) and analyze how they complement each other for comprehensive safety analysis. (7)
- b) Explain the process of accident data coding and format preparation, and illustrate how collision and condition diagrams assist in crash reconstruction (7)

OR

14. a) Discuss the use of descriptive statistics and trend analysis in crash data interpretation. How are severity indices calculated and used in safety evaluation? (7)
- b) Apply GIS-based analysis techniques to identify crash patterns and blackspots. Explain how tools like Excel, GIS, and Safety Analyst can support this process. (7)

MODULE 3

15. a) Explain the concept of design consistency in geometric design elements. How does inconsistency affect road safety? (7)
- b) Discuss the various roadside safety devices such as clear zones, guardrails, crash cushions, and barriers with suitable sketches or examples. (7)

OR

16. a) Evaluate the safety design aspects of intersections, focusing on channelization, roundabouts, signal design, and lighting. (6)
- b) Explain the stages of road safety audits in a project's life cycle and outline the roles and responsibilities of auditors during each stage. (8)

MODULE 4

17. a) Discuss in detail the functions and safety roles of traffic signs, signals, and road markings. Provide suitable examples. (7)
- b) Explain the working and benefits of automated enforcement systems. How do these systems improve traffic safety?. (7)

OR

18. a) Describe the ITS applications used for incident detection and management. How do real-time traffic monitoring systems assist in reducing congestion and crashes? (7)
- b) Elaborate on different speed management strategies - geometric, regulatory, and educational - with examples of their implementation. (7)

MODULE 5

19. a) Explain the major provisions and goals of the National Road Safety Policy. How does it guide national and state-level actions to reduce road crashes? (7)
- b) Discuss the roles and responsibilities of different stakeholders - government agencies, police, NGOs, and the community - in improving road safety. (7)

OR

20. a) Describe the five pillars of road safety proposed under the UN Decade of Action. Explain how these pillars contribute collectively to a safer transport system. (7)
- b) What are Safe System Interventions and Safe School Zone concepts? Discuss how these initiatives contribute to sustainable mobility and reduction of road accidents. (7)

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CEH56	GROUND MONITORING TECHNIQUES	3	1	0	5	4	2024

Preamble

The course provides an understanding of techniques used to monitor and assess ground behaviour and performance in geotechnical and geoenvironmental contexts. It emphasizes instrumentation, data acquisition, and interpretation methods for evaluating soil and structural responses under various loading and environmental conditions. The course integrates theoretical knowledge with practical applications to ensure accurate measurement of parameters such as displacement, pore pressure, and strain. It aims to develop the ability to select, install, and interpret monitoring systems for geotechnical structures, thereby enhancing safety, reliability, and sustainability in engineering practice.

Prerequisites: Soil Mechanics, Surveying and Geomatics, Basic Data Analysis.

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Explain the importance, objectives, and applications of ground monitoring in various engineering projects. (Cognitive knowledge level: Understand)
CO 2	Select and apply appropriate instruments such as inclinometers, extensometers, and piezometers for monitoring ground behaviour.(Cognitive knowledge level: Apply)
CO 3	Analyze and interpret monitoring data related to ground movement, deformation, and groundwater conditions for engineering decision-making. (Cognitive knowledge level: Analyze)
CO 4	Employ remote sensing and geodetic techniques to assess ground displacement and environmental changes.(Cognitive knowledge level: Apply)
CO 5	Integrate data from multiple monitoring systems and utilize advanced technologies to enhance project safety, performance, and sustainability.(Cognitive knowledge level: Analyze)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	2	0	0	0	1	2	0	0	2	0
CO 2	3	2	2	0	1	0	1	0	0	1	0
CO 3	3	3	2	2	2	0	1	0	0	2	0
CO 4	3	2	2	2	3	1	2	0	0	2	0
CO 5	3	3	3	3	3	2	3	2	1	3	1

Assessment Pattern

GROUND MONITORING TECHNIQUES			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	20	10	20
Understand	40	40	30
Apply	40	40	40
Analyse	-	10	10
Evaluate	-	-	-
Create	-	-	-

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course project : 10 marks

Self Study : 5 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question carries 14 marks and can have maximum 2 sub-divisions.

SYLLABUS

Module 1: Introduction to Ground Monitoring (8 hours)

Overview of Ground Monitoring: Importance and objectives of ground monitoring in engineering projects, Types of ground movements and phenomena (settlement, slope stability, vibrations), Applications of ground monitoring (construction, mining, environmental monitoring).

Ground Monitoring Instruments and Technologies: Common instruments used in ground monitoring (inclinometers, extensometers, piezometers), Emerging technologies in ground monitoring (drones, remote sensing, GPS), Selection criteria for monitoring tools based on project requirements.

Data Collection and Management: Methods for data collection and recording, Data management and integration with other engineering data, Introduction to software for data visualization and analysis.

Module 2: Inclinometers and Extensometers (9 hours)

Inclinometers: Principles of inclinometer operation, Installation methods and calibration, Data interpretation for detecting ground movement and tilt.

Extensometers: Types of extensometers (mechanical, electronic, vibrating wire), Applications in measuring ground deformation and settlement, Installation procedures and data analysis.

Case Studies: Real-world applications of inclinometers and extensometers in engineering projects, Analysis of monitoring data to assess ground behavior.

Module 3: Piezometers and Groundwater Monitoring (9 Hours)

Piezometers: Types of piezometers (open standpipe, vibrating wire, pneumatic), Installation techniques and calibration procedures, Data interpretation for groundwater level and pressure measurement.

Groundwater Monitoring: Importance of groundwater monitoring in geotechnical engineering, Methods for groundwater quality and quantity assessment, Integration of groundwater data with other monitoring results.

Data Management and Analysis: Techniques for analyzing piezometer and groundwater data, Use of data for predicting ground behavior and informing design decisions.

Module 4: Remote Sensing and Geodetic Monitoring (9 Hours)

Remote Sensing Techniques: Overview of remote sensing technologies (satellite imagery,

LiDAR), Applications in ground monitoring and environmental assessment, Data acquisition and interpretation methods.

Geodetic Monitoring: Principles of geodetic measurements (GPS, total stations), Techniques for monitoring ground displacement and deformation, Integration of geodetic data with other ground monitoring methods.

Case Studies and Applications: Examples of remote sensing and geodetic monitoring in various projects, Analysis of data for assessing ground stability and movement.

Module 5: Advanced Monitoring Techniques and Data Integration (10 Hours)

Advanced Monitoring Technologies: Introduction to advanced monitoring systems (fiber optics, digital image correlation), Applications of advanced technologies in complex ground conditions, Benefits and limitations of cutting-edge monitoring techniques.

Data Integration and Interpretation: Methods for integrating data from multiple monitoring systems, Data interpretation techniques for comprehensive analysis, Use of data for decision-making in project management and risk assessment.

Case Studies and Project Applications: Detailed case studies showcasing the use of advanced monitoring techniques, Lessons learned from complex monitoring projects, Future trends and innovations in ground monitoring.

Text Books:

1. Geotechnical Instrumentation for Monitoring Field Performance by John Dunnicliff (and Gordon E. Green), John Wiley & Sons, 1st Edition 1993. ISBN: 978-0471005469.
2. "A Guide to Field Instrumentation in Geotechnics: Principles, Installation and Reading by Richard Bassett, CRC Press / Spon Press, 1st Edition 2012. ISBN: 978-1138072800 (or 978-0415675376 in some prints)
3. Geotechnical Instrumentation and Applications by Myint Win Bo & Jeffrey Barrett, Springer (Cham), 1st Edition 2023. ISBN (hardcover): 978-3-031-34274-5.

Reference Books:

1. Relevant ASTM and ISO standards for ground monitoring instrumentation
2. National and international guidelines for data collection and analysis
3. Familiarization with data analysis and visualization software (e.g., MATLAB, GIS tools)

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	8 hours
1.1	Importance and objectives of ground monitoring in engineering projects.	1
1.2	Types of ground movements and their significance – settlement, slope stability, vibrations.	1
1.3	Applications of ground monitoring in construction, mining, and environmental projects.	2
1.4	Instruments and technologies – inclinometers, extensometers, piezometers, drones, GPS, and remote sensing.	2
1.5	Data collection, management, and visualization using software tools.	2
2	Module 2	9 hours
2.1	Principles and operation of inclinometers – installation and calibration procedures.	2
2.2	Data interpretation for detecting ground movement and tilt.	2
2.3	Extensometers – types (mechanical, electronic, vibrating wire) and their applications.	2
2.4	Installation, data analysis, and interpretation of deformation and settlement.	1
2.5	Case studies demonstrating the use of inclinometers and extensometers.	2
3	Module 3	9 hours
3.1	Types and working principles of piezometers – open stand-pipe, pneumatic, vibrating wire.	2
3.2	Installation, calibration, and maintenance of piezometers.	2

3.3	Groundwater monitoring – methods for assessing water level, pressure, and quality.	2
3.4	Data management and analysis of piezometer readings.	1
3.5	Application of groundwater monitoring data for predicting ground behaviour.	2
4	Module 4	9 hours
4.1	Fundamentals of remote sensing technologies – satellite imagery, LiDAR.	1
4.2	Data acquisition and interpretation for ground and environmental monitoring.	2
4.3	Geodetic monitoring using GPS and total stations.	2
4.4	Integration of geodetic and remote sensing data for deformation analysis.	2
4.5	Case studies on remote sensing and geodetic monitoring applications.	2
5	Module 5	10 hours
5.1	Advanced monitoring systems – fiber optics, digital image correlation, automated networks.	2
5.2	Application of advanced systems in complex ground conditions.	2
5.3	Integration of data from multiple monitoring systems for comprehensive analysis.	2
5.4	Data interpretation for decision-making, project management, and risk assessment.	2
5.5	Case studies, lessons learned, and emerging trends in ground monitoring technologies.	2
Total		45 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Explain the importance of ground monitoring in ensuring the safety and performance of geotechnical structures.
2. Identify different types of ground movements and their implications in civil engineering projects.

Course Outcome 2 (CO 2):

1. Describe the working principles of inclinometers and extensometers used in ground monitoring.
2. Select a suitable monitoring instrument for detecting settlement in a deep excavation project and justify your choice.

Course Outcome 3 (CO 3):

1. Interpret sample data obtained from piezometers to assess variations in groundwater level and pore pressure.
2. Explain how groundwater monitoring supports geotechnical design and stability analysis.

Course Outcome 4 (CO 4):

1. Discuss how remote sensing and geodetic techniques can be used for large-scale ground deformation monitoring.
2. Differentiate between GPS and total station methods in terms of accuracy, application, and data integration.

Course Outcome 5 (CO 5):

1. Explain the advantages of advanced monitoring systems such as fiber optics and digital image correlation in geotechnical applications.
2. Propose an integrated monitoring plan for a slope stabilization project using multiple instrumentation techniques.

MODEL QUESTION PAPER

QP CODE:

Pages: 3

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

FIFTH SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CEH56

GROUND MONITORING TECHNIQUES

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. State the main objectives of ground monitoring in geotechnical engineering projects.
2. List any four common instruments used for ground monitoring and their basic applications.
3. Explain the principle of operation of an inclinometer.
4. Differentiate between mechanical and vibrating wire extensometers.
5. What are the main types of piezometers used in groundwater monitoring?
6. Explain the importance of groundwater data in predicting ground behaviour.
7. Mention the key advantages of remote sensing in ground monitoring.
8. Compare GPS and total station methods in terms of accuracy and application.
9. What are the major advantages of using fibre optic sensors for ground monitoring?
10. Define data integration and explain its importance in multi-instrument monitoring systems.

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. a) Explain the significance of ground monitoring in construction and mining projects. (7)
b) Discuss the different types of ground movements that require monitoring, and the parameters involved. (7)

OR

12. a) Describe the process of data collection and management in ground monitoring. (7)
b) Explain the selection criteria for choosing monitoring tools for a project. (7)

MODULE 2

13. a) Explain with neat sketches the installation and working of inclinometers. (8)
b) Describe how inclinometer data is interpreted for assessing slope movement. (6)

OR

14. a) Explain different types of extensometers and their applications. (8)
b) Present a brief case study showing the use of extensometers in monitoring ground deformation. (6)

MODULE 3

15. a) Discuss the principles, installation, and calibration of vibrating wire piezometers. (8)
b) Explain how piezometer data helps in assessing slope stability. (6)

OR

16. a) Describe various groundwater monitoring methods used in geotechnical engineering. (8)
b) Explain the process of integrating groundwater and deformation data for design improvement. (6)

MODULE 4

17. a) Explain the role of remote sensing and LiDAR in large-area ground monitoring. (8)

- b) Discuss the procedure for integrating geodetic and ground-based monitoring data. (6)

OR

18. a) Describe the working principles of GPS and total station for deformation monitoring. (8)
b) Present a case study where geodetic monitoring was used successfully in a civil engineering project. (6)

MODULE 5

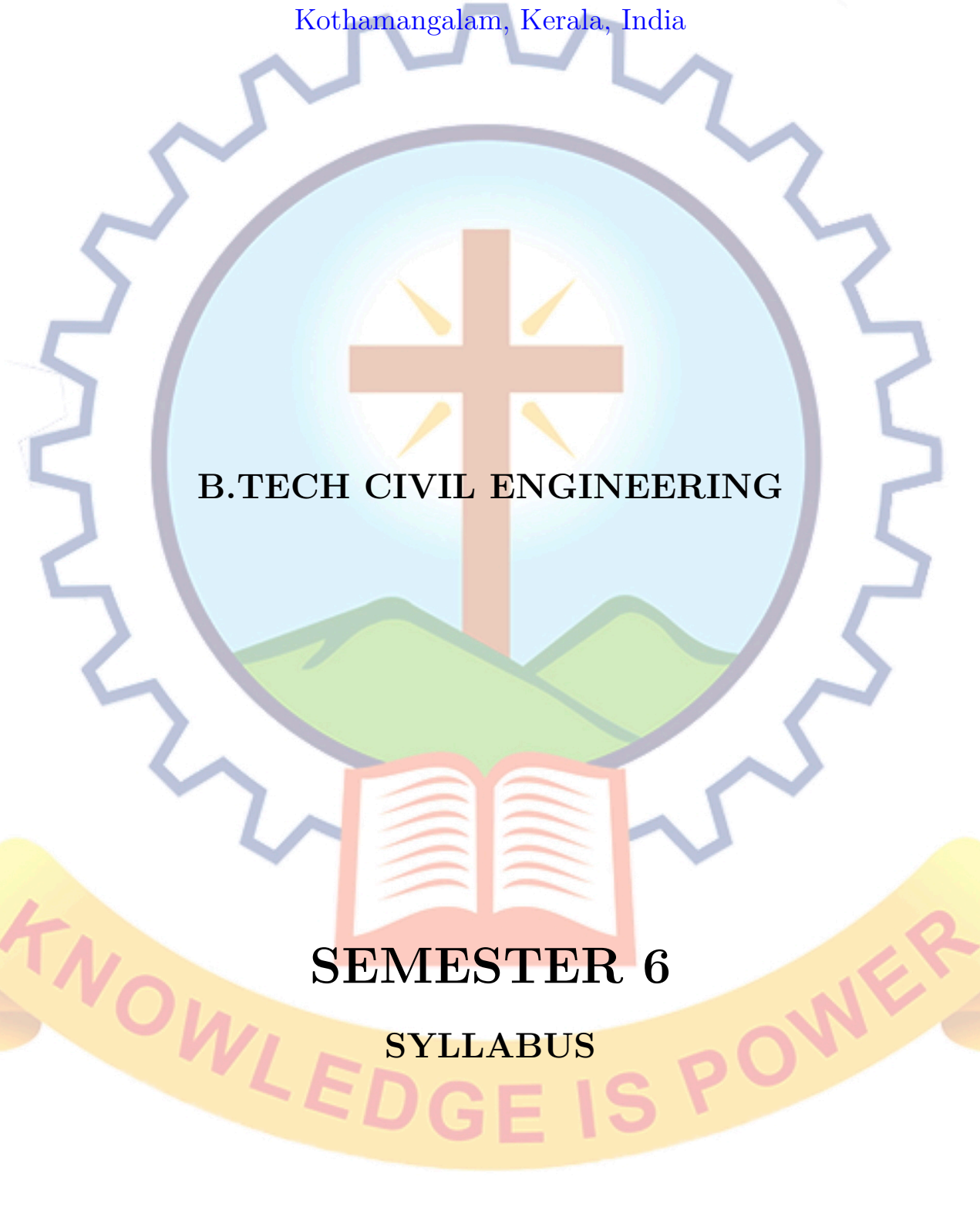
19. a) Explain the concept of advanced monitoring systems such as fiber optics and digital image correlation. (8)
b) Discuss their advantages and limitations in complex ground conditions. (6)

OR

20. a) Explain the process of integrating data from multiple monitoring systems for decision-making. (8)
b) Describe a real-world example where advanced monitoring and data integration improved project safety. (6)

MAR ATHANASIOUS COLLEGE OF ENGINEERING

Government Aided, Autonomous Institution
Kothamangalam, Kerala, India



B.TECH CIVIL ENGINEERING

SEMESTER 6

SYLLABUS

KNOWLEDGE IS POWER

SEMESTER 6

SLOT	COURSE NO.	COURSES	L-T-P-S	HOURS	CREDIT
A	B24CE3T06	DESIGN OF STEEL STRUCTURES	3-1-0-5	4	4
B	B24CE3T07	WATER AND WASTE WATER MANAGEMENT	3-1-0-5	4	4
C	B24CE3T08	QUANTITY SURVEYING AND VALUATION	3-1-0-5	4	4
D	B24CE3T09	FOUNDATION ENGINEERING	3-1-0-5	4	4
E	B24CE3P2x	PROGRAM ELECTIVE II	2-1-0-4	3	3
F	B24CE3G1x	OPEN ELECTIVE I	2-1-0-4	3	3
G	B24CE3L09	MATERIAL TESTING LABORATORY – II	0-0-3-2	3	2
H	B24CE3L10	CIVIL ENGINEERING DESIGN STUDIO	0-0-3-2	3	2
M	B24CEM6x	MINOR	3-1-0-5	4	4
N	B24CEH6x	HONOURS	3-1-0-5	4	4
			TOTAL	36	26

PROGRAMME ELECTIVE II

COURSE NO.	COURSES
B24CE3P21	ADVANCED CONCRETE TECHNOLOGY
B24CE3P22	ENGINEERING LAW
B24CE3P23	SOLID AND LIQUID WASTE MANAGEMENT
B24CE3P24	GROUND IMPROVEMENT TECHNIQUES
B24CE3P25	PRESTRESSED CONCRETE
B24CE3P26	SEISMOLOGY AND EARTHQUAKE ENGINEERING

OPEN ELECTIVE I

COURSE NO.	COURSES
B24CE3G11	SUSTAINABLE CONSTRUCTION MATERIALS AND PRACTICES
B24CE3G12	NATURAL DISASTER & MITIGATION
B24CE3G13	ENVIRONMENTAL RISK ASSESSMENT

MINOR COURSES

COURSE NO.	COURSES
B24CEM62	SUSTAINABILITY AND ENVIRONMENTAL HEALTH
B24CEM63	TRANSPORTATION SYSTEMS

HONOURS COURSES

COURSE NO.	COURSES
B24CEH61	PRECAST STRUCTURES
B24CEH62	REPAIR AND REHABILITATION
B24CEH63	ECO CONSCIOUS CONSTRUCTION
B24CEH64	ADVANCED CONSTRUCTION TECHNIQUES
B24CEH65	LAND USE AND MOBILITY
B24CEH66	STRUCTURAL DESIGN OF FOUNDATIONS AND EARTH RETAINING STRUCTURES

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE3T06	DESIGN OF STEEL STRUCTURES	3	1	0	5	4	2024

Preamble

This course introduces the design principles of steel structures, focusing on connections, tension and compression members, beams, and trusses. It helps students understand structural behaviour, failure modes, and load considerations essential for safe and efficient steel structure design using limit state methods.

Prerequisites: Mechanics of Solids, Structural Analysis

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Design structural steel connections using bolts and welds by applying the concepts of material properties and load combinations, using relevant codal provisions. (Cognitive Knowledge Level: Apply)
CO 2	Apply principles of structural behavior to analyze and design structural steel tension members considering failure modes, slenderness effects, and connection detailing. (Cognitive KnowledgeLevel: Apply)
CO 3	Apply the principles of structural behavior to design compression members, built-up sections and column bases. (Cognitive Knowledge Level: Apply)
CO 4	Design steel beams considering flexural strength, lateral-torsional buckling, shear, bearing, and serviceability requirements. (Cognitive Knowledge Level: Apply)
CO 5	Apply structural design principles and codal provisions to analyse and design roof trusses and I-section purlins by considering appropriate member types, design loads, load combinations, and wind load effects. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	1	3		1	1		1	1	2	
CO 2	3	1	3		1	1		1	1	2	
CO 3	3	1	3		1	1		1	1	2	
CO 4	3	1	3		1	1		1	1	2	
CO 5	3	1	3	1	1	1	1	1	1	2	

Assessment Pattern

DESIGN OF STEEL STRUCTURES			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember			
Understand	40	40	40
Apply	60	60	60
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course Project	: 10 marks
Self Study	: 5 marks

End Semester Examination Pattern

There will be two parts: Part A and Part B. Part A contain 10 questions, with 2 questions

from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module, of which students should answer any one. Each question carries 14 marks and can have a maximum of 2 sub-divisions.

SYLLABUS

Module 1: Introduction to Steel Structures and Connections (12 hours)

Introduction to steel structures, steel properties and sections, design loads and limit state design, fasteners and connections, bolted connection failures, bearing and friction bolts, weld specifications, effective weld area, and design of common welds.

Module 2: Tension Members (8 hours)

Tension members: Types and modes of failure, Slenderness ratio, Net area, Shear lag, Lug angle - Connections in tension members - Design of tension members.

Module 3: Compression Members (9 Hours)

Types of compression members and sections - Behaviour and types of failure - Effective length and slenderness ratio - Column formulae and column curves - Design of solid and built-up columns - Design of built-up laced and battened type columns - Design of column bases: slab base, gusset base.

Module 4: Flexural Members (9 Hours)

Types of beam sections - Flexural strength and lateral stability - Lateral torsional buckling: Design of laterally supported and unsupported beams, Design for shear and bearing, Deflection check.

Module 5: Trusses and Wind Load Assessments (7 Hours)

Design of roof trusses: types, members, design loads, Load combinations - Assessment of wind loads - Design of I-section purlin.

Text Books:

1. Raz, Sarwar Alam. Structural Design in Steel. 3rd ed. New Delhi: New Age International, 2020.
2. Duggal, S.K. Limit State Design of Steel Structures. 4th ed. New Delhi: McGraw Hill Education, 2019.
3. Bhavikatti, S.S. Design of Steel Structures: By Limit State Method as per IS: 800-2007. 5th ed. New Delhi: I.K. International Publishing House, 2019.

References:

1. Subramanian, N. Design of Steel Structures: Limit State Method. 2nd ed. New Delhi: Oxford University Press, 2019.

2. Bureau of Indian Standards, IS 800 – 2007, Code of practice for Structural steel design, New Delhi: BIS
3. Bureau of Indian Standards, IS:875-Part 3-2015 Design loads for buildings Part 3: Wind loads, New Delhi: BIS
4. Bureau of Indian Standards, SP:6(1) – Handbook for Structural Engineers: Structural Steel Sections. New Delhi: BIS, 1964 (Reprint 2005).
5. Bureau of Indian Standards, SP:38 – Handbook for Typified Designs for Structures with Steel Roof Trusses. New Delhi: BIS, 1987.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	12 hours
1.1	Introduction to steel and steel structures, Properties of steel and structural steel sections	1
1.2	Introduction to design loads and load combinations, Limit state design concepts	1
1.3	Types of fasteners and connections	1
1.4	Relative advantages and disadvantages of fasteners - Modes of failure of bolted connections	1
1.5	Design of bearing type connection	2
1.6	Design of friction type connection	2
1.7	Specifications and effective area of welds	2
1.8	Design of fillet, butt, slot, and plug weld connections	2
2	Module 2	8 hours
2.1	Types and modes of failure in tension members	1
2.2	Concepts of Slenderness ratio, Net area, Shear lag, Lug angle,	2

2.3	Connections in tension members	2
2.4	Design of tension members	3
3	Module 3	9 hours
3.1	Types of compression members and sections, Behaviour and types of failure	1
3.2	Effective length and slenderness ratio, Column formulae and column curves	1
3.3	Design of solid columns	2
3.4	Design of built-up laced and battened type columns	3
3.5	Design of column bases: slab base and gusset base	2
4	Module 4	9 hours
4.1	Types of beam sections, Flexural strength and lateral stability,	2
4.2	Lateral torsional buckling - Design of laterally supported beam	3
4.3	Design of laterally unsupported beams	3
4.4	Design for shear and bearing, Deflection check	1
5	Module 5	7 hours
5.1	Design of roof trusses: types, members, and design loads, Load combinations	2
5.2	Assessment of wind loads	2
5.3	Design of I-section purlins	3
Total		45 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Sketch different types of bolted connections.
2. Explain block shear failure.

Course Outcome 2 (CO 2):

1. Explain the purpose of lug angles in tension member connection.
2. What is net effective area in tension members? How is it calculated in various scenarios involving bolt holes and staggered pitch?

Course Outcome 3 (CO 3):

1. A steel column is 3.5 m long and has both ends fixed. It is made of ISHB 250 @ 537 N/m. Calculate the design compressive strength and load-carrying capacity of the column using IS 800:2007.
2. Design a slab base for a column carrying an axial load of 1000 kN. The column section used is ISHB 300. Use M20 concrete and assume necessary design parameters.

Course Outcome 4 (CO 4):

1. Differentiate between laterally supported and laterally unsupported beams. Explain how their design approach differs as per IS 800:2007.
2. Design a simply supported beam of effective span 6 m carrying a UDL of 30 kN/m (inclusive of self-weight). The beam is laterally supported throughout. Use $f_y = 250$ MPa and check for bending, shear, and deflection as per IS 800:2007.

Course Outcome 5 (CO 5):

1. How are wind loads on roof trusses assessed as per IS 875 (Part 3)? Explain with reference to parameters like basic wind speed, terrain category, and structure class.
2. A trussed roof is located in a region with a basic wind speed of 39 m/s. The building is 10 m high and located in Terrain Category 2. Determine the design wind pressure on the roof slope of 15° .

MODEL QUESTION PAPER

QP CODE:

Pages: 3

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

SIXTH SEMESTER B.TECH DEGREE EXAMINATION, YEAR

Course Code: B24CE3T06

DESIGN OF STEEL STRUCTURES

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Describe the various types of structural steel sections with clear sketches.
2. Differentiate between Lap joint and Butt joint.
3. Explain the failure modes of tension member.
4. Explain shear lag? How it can be reduced?
5. Differentiate between gusset base and slab base.
6. Describe the main purpose of lacings and battens?
7. What is lateral torsional buckling of beams?
8. Explain web buckling and web crippling.
9. Explain various loads and load combinations for design of a roof truss.
10. A roof truss has a span of 15m and a rise of 4m is placed at 3m c/c. Calculate the live load on the roof truss.

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. a) Design a lap joint between two plates each 12mm thick. The load to be transferred by the joint is 150kN. Use 20mm diameter bolts of class 4.6. (7)

- b) A tie member $75\text{mm} \times 8\text{mm}$ is connected to a 10mm thick gusset plate by welding provided on all four sides. The overlap of tie member on to the gusset plate is 55mm . Determine the maximum load the connection can carry. (7)

OR

12. a) Explain different types of weld. (4)
b) Determine the tensile strength of ISA $125 \times 95 \times 8\text{ mm}$ connected to the gusset plate of 10mm through the shorter leg by 4, M20 bolts arranged in one row. The grade of steel is Fe410. Take $p = 65\text{ mm}$, Edge & End distance = 40mm (10)

MODULE 2

13. Design a single angle tension member to carry and factored axial tension of 150 kN connected to a 20mm thick gusset plate using M20 Class 4.6 bolts.

OR

14. An angle section ISA $100 \times 75 \times 10\text{ mm}$ is used as a tension member and connected to a gusset plate using 16 mm bolts on the longer leg. Given that the member is subjected to a factored tensile force of 220 kN , i) Check the adequacy of the section against limit states of yielding and rupture ii) Account for shear lag and net effective area. Use IS 800:2007 and assume suitable data wherever required.

MODULE 3

15. Design a built-up column consisting of two channels placed back to back to carry an axial factored load of 800 kN . Length of the column is 7m and the column is restrained in position but not in direction at both ends. Provide batten system with bolted connection. Use steel of grade Fe 410.

OR

16. A steel column made of ISWB 400 is carrying a factored load of 1800 kN . Design a suitable base plate for the column when the column is resting on a pedestal made of M30 grade concrete.

MODULE 4

17. Design a simply supported beam of 10m effective span carrying a total factored load of 60kN/m . The depth of beam should not exceed 500mm . The compression flange of beam is laterally supported by floor construction. Assume stiff end bearing is 75mm .

OR

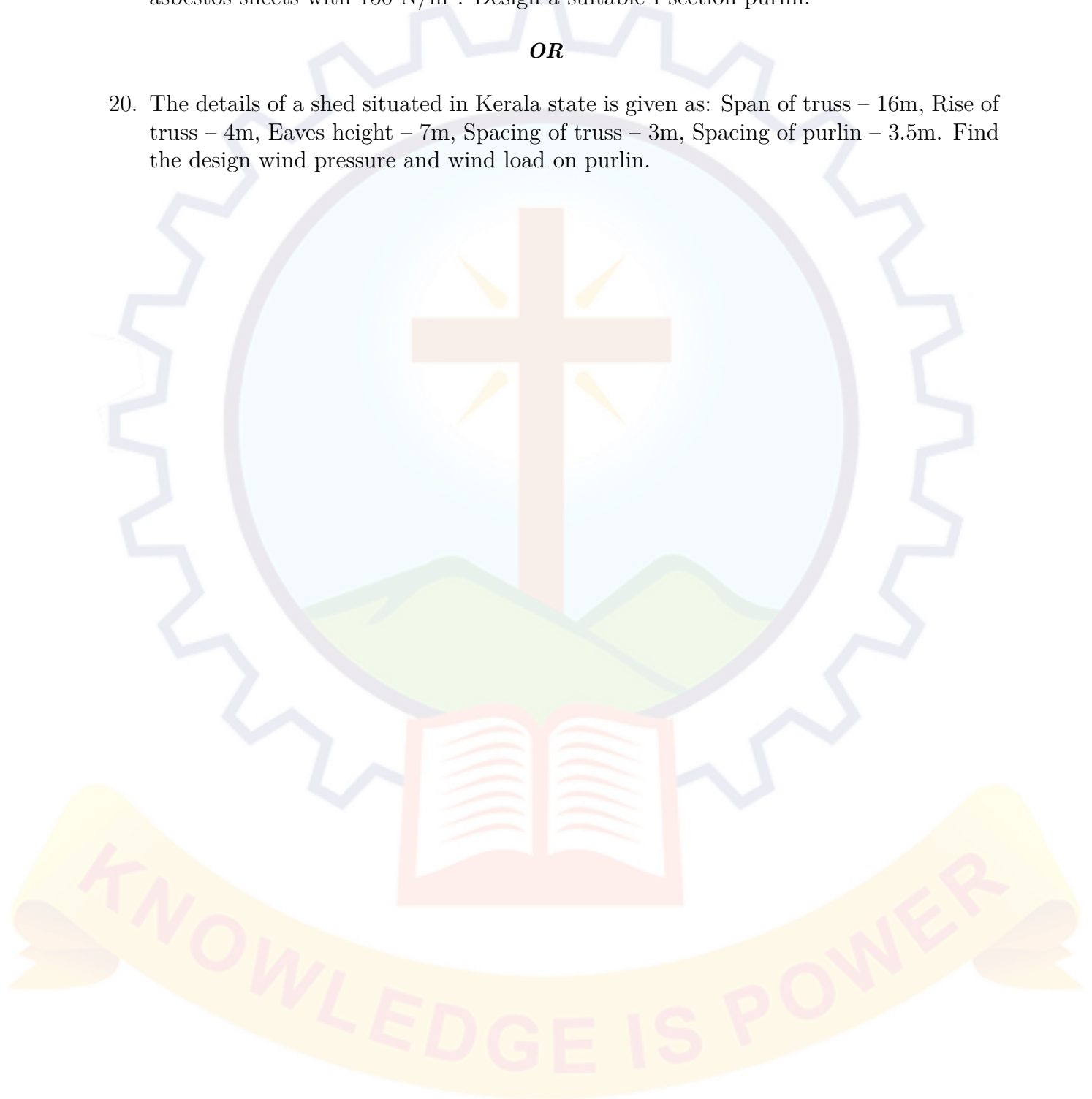
18. Design the simply supported main beam of a building supporting concrete floor slab with the following data: Centre to centre distance of beams – 5m , Span of beam – 6m , Thickness of concrete slab – 240mm , Finished screed – 40mm thick, Weight of concrete slab and finished screed - 24 kN/m^3 , Imposed load – 4 kN/m^2 .

MODULE 5

19. The trusses for a factory building are spaced at 6 m c/c. and the purlin is spaced at 2m c/c. The pitch of truss is 28° and span of truss is 18m. The roof consists of asbestos sheets with 150 N/m². Design a suitable I section purlin.

OR

20. The details of a shed situated in Kerala state is given as: Span of truss – 16m, Rise of truss – 4m, Eaves height – 7m, Spacing of truss – 3m, Spacing of purlin – 3.5m. Find the design wind pressure and wind load on purlin.



CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE3T07	WATER AND WASTEWATER MANAGEMENT	3	1	0	5	4	2024

Preamble

The course aims to provide students with a comprehensive understanding of the principles, practices, and technologies involved in the sustainable management of water supply systems and wastewater treatment processes.

Prerequisites: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Grasp basic knowledge regarding quantification of water demand. Apply the concepts for design of sedimentation tanks (Cognitive Knowledge Level: Apply).
CO 2	Apply theoretical and practical concepts to estimate coagulant requirements and to design filter units (Cognitive Knowledge Level: Apply).
CO 3	Acquire foundational knowledge of the disinfection process, water softening techniques, and the layout of water distribution networks. (Cognitive Knowledge Level: Understand).
CO 4	Apply the concepts for design of sewers and primary treatment units (Cognitive Knowledge Level: Apply).
CO 5	Apply the concepts for design of suspended and attached growth systems (Cognitive Knowledge Level: Apply).

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	1	1			1					1
CO 2	3	1	1			1					1
CO 3	3	1	1			1					1
CO 4	3	1	1			1					1
CO 5	3	1	1			1					1

Assessment Pattern

WATER AND WASTEWATER MANAGEMENT			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	30	30	30
Understand	40	40	40
Apply	30	30	30
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course Project	: 10 marks
Self Study	: 5 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contains 10 questions carrying 3 marks

each. Part B contains 2 questions from each module out of which any one is to be answered. Each question carries 14 marks and can have maximum 2 sub-divisions.

SYLLABUS

Module 1: Estimation of Water Demand (9 hours)

Water treatment: Water demand- quantification of water demand through population forecasting – Factors affecting consumption - Fluctuations in demand - Types of intakes-pumps and location of pumping station-Treatment of water - Theory and principles of Sedimentation tanks Design of Sedimentation tanks (circular and rectangular).

Module 2: Coagulation, Flocculation and Filtration (9 hours)

Coagulation and Flocculation Process – Principle of Coagulation - Types of Coagulants and their characteristics - Coagulant Aids - Chemical feeding devices - Determination of Optimum Coagulant Dosage. Design problems on estimation of Coagulants.

Filtration Process – Theory of Filtration and basic Principles - Classification of Filters used in treatment of water - Filters washing Technique/back wash - Operational troubles and trouble shooting - Design of Slow and Rapid Sand Filters required for water treatment plant.

Module 3: Disinfection and Softening of Water (9 hours)

Water Disinfection Process – Theory of Disinfection and characteristics of good disinfectant-Forms of Chlorination - Break point Chlorination - Measurement of Chlorine Demand and residual Chlorine - Estimation of quantity of Chlorine and Bleaching powder required for treatment of water.

Water Softening - Hardness removal techniques - numerical problems on determination of Hardness in water sample - effects of hardness.

Lay out of water distribution network - Methods of distribution-Hardy cross method-Equivalent pipe method.

Module 4: Basics of Wastewater Treatment Systems (9 Hours)

Objectives of wastewater treatment system -Characteristics of waste water and flow variations - Dry weather and wet weather flow, factors affecting dry weather flow and wet weather flow- classification of sewerage systems- Design of sewers - Wastewater Treatment Flow Diagrams - Theoretical principles and design considerations - screens, equalization basin, grit chamber, primary and secondary settling tanks. Wastewater treatment – aerobic, anaerobic, suspended and attached growth systems. Kinetics of biological treatment systems – Biokinetic constants and their determination, batch and continuous systems.

Module 5: Suspended and Attached growth systems (9 Hours)

Theoretical principles and design considerations of suspended growth system - Conventional activated sludge process and its modifications - Theoretical principles and design considerations of Attached growth system – Trickling filters and Rotating Biological contactors -

sludge treatment and disposal- objectives — Sludge characterization — Thickening — Design of gravity thickener- Sludge digestion — Standard rate and High rate digester design - Biogas recovery — Sludge Conditioning and Dewatering — Sludge drying beds.

Text Books:

1. Howard S Peavy, Donald R Rowe and George Tchobanoglous, Environmental Engineering, Mc Graw Hill Education , 2013.
2. Mackenzie L Davis, David A Cornwell, Introduction to Environmental Engineering, Mc Graw Hill Education, 2014.
3. S.K.Garg, Water Supply Engineering, Khanna Publishers. 2010.
4. G S Birdie, Water Supply and Engineering, Dhanapat Rai Publishing Company, 2014.
5. J. Arceivala, Shyam R. Asolekar, Wastewater Treatment for Pollution Control and Reuse, McGrawhill Education, 2007.
6. S.K. Garg, Sewage disposal and air pollution engineering, Khanna Publishers. 2008.
7. Metcalf & Eddy Inc., George Tchobanoglous, H. David Stensel, Ryujiro Tsuchihashi, Franklin L. Burton , Wastewater Engineering: Treatment and Resource Recovery, New York, USA: McGraw-Hill Education, 2014.
8. Clair Sawyer, Perry McCarty and Gene Parkin, Chemistry for Environmental Engineering and Science, New York, USA: McGraw-Hill Education, 2003.
9. Duggal K.N., “Elements of Environmental Engineering” S.Chand and Co. Ltd., New Delhi, 2014.
10. Punmia, B.C., Jain, A.K., and Jain.A.K., Environmental Engineering, Vol.II, Laxmi Publications, 2010.

References:

1. Davis M. L. and Cornwell D. A., Introduction to Environmental Engineering, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2010.
2. The Central Public Health and Environmental Engineering Organisation(CPHEEO), Manual on Sewerage and Sewage Treatment, Ministry of Urban Development, Government of India.
3. The Central Public Health and Environmental Engineering Organisation(CPHEEO), Manual on Water Supply and Treatment, Ministry of Urban Development, Government of India.
4. Gilbert M. Masters, Wendell P. Ela, Introduction to Environmental Engineering and Science, Noida, India: Pearson India Education Services Pvt. Ltd., 2015.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	9 hours
1.1	Water treatment: Water demand- quantification of water demand through population forecasting – Factors affecting consumption-Fluctuations in demand	4
1.2	Types of intakes- pumps and location of pumping station	2
1.3	Treatment of water-Theory and principles of Sedimentation tanks Design of Sedimentation tanks (circular and rectangular)	3
2	Module 2	9 hours
2.1	Coagulation and Flocculation Process – Principle of Coagulation - Types of Coagulants and their characteristics - Coagulant Aids - Chemical feeding devices - Determination of Optimum Coagulant Dosage. Design problems on estimation of Coagulants.	4
2.2	Filtration Process – Theory of Filtration and basic Principles - Classification of Filters used in treatment of water - Filters washing Technique/back wash - Operational troubles and trouble shooting - Design of Slow and Rapid Sand Filters required for water treatment plant.	5
3	Module 3	9 hours
3.1	Water Disinfection Process – Theory of Disinfection and characteristics of good disinfectant- Forms of Chlorination - Break point Chlorination - Measurement of Chlorine Demand and residual Chlorine - Estimation of quantity of Chlorine and Bleaching powder required for treatment of water.	3
3.2	Water Softening - Hardness removal techniques - numerical problems on determination of Hardness in water sample - effects of hardness	3
3.3	Lay out of water distribution network- Methods of distribution-Hardy cross method-Equivalent pipe method	3

4	Module 4	9 hours
4.1	Objectives of wastewater treatment system -Characteristics of waste water and flow variations - Dry weather and wet weather flow, factors affecting dry weather flow and wet weather flow- classification of sewerage systems- Design of sewers	3
4.2	Wastewater Treatment Flow Diagrams - Theoretical principles and design considerations - screens, equalization basin, grit chamber, primary and secondary settling tanks.	3
4.3	Wastewater treatment – aerobic, anaerobic, suspended and attached growth systems. Kinetics of biological treatment systems – Biokinetic constants and their determination, batch and continuous systems	3
5	Module 5	9 hours
5.1	Theoretical principles and design considerations of suspended growth system- Conventional activated sludge process and its modifications	3
5.2	Theoretical principles and design considerations of Attached growth system– Trickling filters and Rotating Biological contactors.	3
5.3	sludge treatment and disposal- objectives — Sludge characterization — Thickening — Design of gravity thickener- Sludge digestion — Standard rate and High rate digester design- Biogas recovery — Sludge Conditioning and Dewatering — Sludge drying beds	3
Total		45 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Outline various factors affecting water consumption.
2. Enumerate theory of sedimentation.
3. Discuss fluctuations in water demand.

Course Outcome 2 (CO 2):

1. Problems on design of rapid sand filters.
2. Outline theory of filtration.
3. Enumerate different types of coagulants.

Course Outcome 3 (CO 3):

1. Briefly discuss breakpoint chlorination.
2. Discuss various hardness removal techniques.
3. Write a note on methods of water distribution.

Course Outcome 4 (CO 4):

1. Discuss various classification of sewerage systems.
2. Compare anaerobic and aerobic process.

Course Outcome 5 (CO 5):

1. Differentiate suspended and attached growth process.
2. Discuss various methods for sludge treatment.

MODEL QUESTION PAPER

QP CODE:

Pages: 3

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

SIXTH SEMESTER B TECH DEGREE EXAMINATION, MONTH YEAR

Course Code: B24CE3T07

WATER AND WASTEWATER MANAGEMENT

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Enumerate the various factors affecting water consumption.
2. Discuss about fluctuations in water demand.
3. Discuss about backwashing of rapid sand filter.
4. Explain any three coagulants used in water treatment plant.
5. Discuss any two disinfection methods.
6. Enumerate the requirements of a good water distribution system.
7. Compare aerobic and anaerobic wastewater treatment. processes?
8. Distinguish suspended and attached growth systems.
9. Explain the factors affecting the sludge digestion.
10. Define activated sludge process with their operation including advantages and disadvantages.

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. Explain briefly any four different methods for population forecasting of a city. (14)

OR

12. a) Explain any two different types of raw water intakes with sketches? (7)
b) Design a plain sedimentation tank for water supply scheme having capacity to treat water = 10 MLD. Assume the data which is required. (7)

MODULE 2

13. Explain about wet feeding and dry feeding devices. (14)

OR

14. Design a rapid sand filter to treat 4 million litres of raw water per day allowing 4% of filtered water for backwashing. Half hour per day is used for backwashing. Assume necessary data. (14)

MODULE 3

15. a) Enumerate different types of chlorination. (7)
b) Explain the Hardy cross method for water distribution network analysis. (7)

OR

16. a) Describe various hardness removal techniques. (7)
b) Explain briefly various lay out of water distribution network. (7)

MODULE 4

17. A main combined sewer is to be designed to serve an area of 12 sq.km with a population density of 250 persons/hectare. The average rate of sewage flow is 250 LPCD. The maximum flow of 100% in excess of average together with the rainfall equivalent of 15 mm in 24 hours, all of which are runoff Determine the capacity of the sewer. Taking the maximum velocity of flow as 3 m/sec. determine the size of the circular sewer. (14)

OR

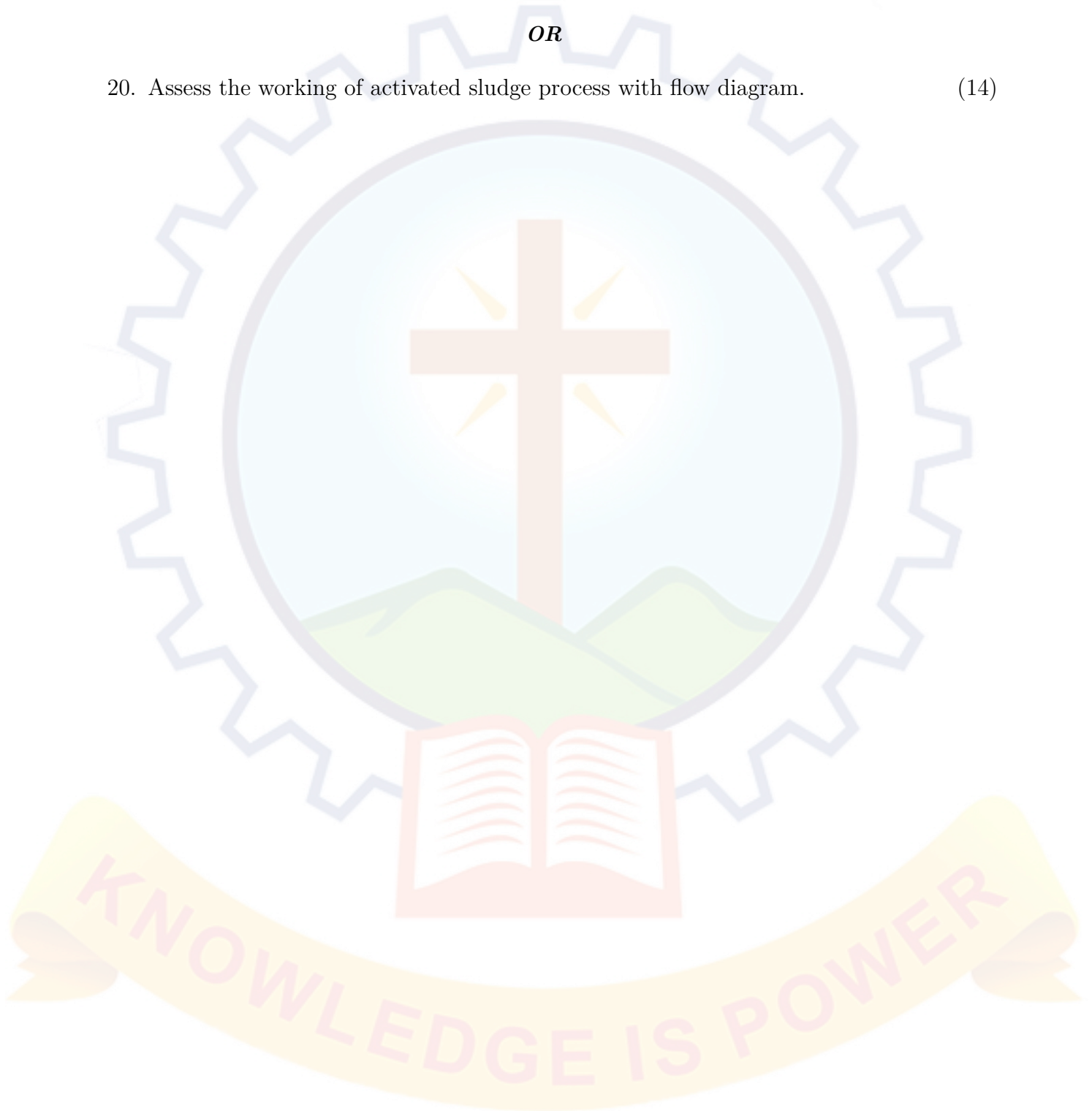
18. Design a grit chamber for a maximum wastewater flow of 10000 m³/day to remove particles up to of 0.25 mm dia, having specific gravity of 2.65. The settling velocities of these particles is found to range from 0.02 to 0.025 m/sec. Maintain a constant flow through velocity of 0.28 m/sec through the provision of a proportional flow weir. (14)

MODULE 5

19. Design suitable dimensions of a circular trickling filter unit for treating 5 million litres of sewage per day. The BOD of sewage is 150 mg/l. (14)

OR

20. Assess the working of activated sludge process with flow diagram. (14)



CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE3T08	QUANTITY SURVEYING AND VALUATION	3	1	0	5	4	2024

Preamble

This course provides knowledge about various types of estimation and specification of different civil engineering works. It equips students to analyze the rate of various work items with reference to standard data and the schedule of rates. This course develops the capability of students to prepare detailed estimates of various work items related to civil engineering construction and to prepare valuations of land and buildings.

Prerequisites: Civil Engineering Drafting Lab.

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Define and explain fundamental concepts and terminology in quantity surveying, estimation, and contract documents. (Cognitive Knowledge Level: Understand)
CO 2	Interpret drawings, specifications, and units of measurement for various building construction items, and apply DAR/DSR data to calculate unit rates. (Cognitive Level: Apply)
CO 3	Prepare detailed measurements, Bill of Quantities (BoQ), and Bar Bending Schedules (BBS) for RCC buildings. (Cognitive Level: Apply)
CO 4	Estimate quantities and prepare detailed measurements for infrastructure projects (roads) and utilities (sanitary and water supply works). (Cognitive Level: Apply)
CO 5	Apply various valuation methods to determine the value of buildings and land. (Cognitive Level: Apply)

Mapping of Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	1			1					2	
CO 2	3	2			2					2	
CO 3	3	2			2					2	2
CO 4	3	2									2
CO 5	3	2			2						3

Assessment Pattern

QUANTITY SURVEYING AND VALUATION			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	20	10	10
Understand	40	40	30
Apply	40	50	60
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 10 marks
Self Study	: 5 marks

End Semester Examination Pattern

The examination will consist of three parts: Part A, Part B, and Part C.

Part A - Modules I and II: Answer any 2 questions out of 3, with each full question carrying 10 marks.

Part B - Modules III and IV: Answer any 2 questions out of 3, with each full question carrying 25 marks.

Part C - Module V: Answer any 2 questions out of 3, with each full question carrying 15 marks.

Note:

1. Part A and Part B should include at least one question from each module.
2. For the analysis of rates and cost estimation, unit rates and labour requirements should be provided along with the questions in the question paper.

SYLLABUS

Module 1: Fundamentals of Quantity Surveying (9 hours)

Quantity Surveying: Basic principles, Role of Quantity surveyor at various stages of construction, Estimate: Type of estimate. Cost Components: Project Costs, Charges and Overhead, Establishment and Resources. Contract documents, Bill of Quantity: Item of works, units of measurement of various materials and works (RCC residential building), General rule & method of measurement with reference to Indian Standard Specification: IS1200. Introduction to digital measurement tools: Use of measurement software Autodesk Revit / RibCostX for take-offs.

Module 2: Schedule of Rates and Specification (8 hours)

Introduction to the use of schedule of rates as per latest Delhi Schedule of Rates (DSR 2023) and Analysis of rate as per latest Delhi Analysis of Rate (DAR 2023) Specifications-General specification of all items of a residential building: foundations, super structure, finishes. Detailed specifications of major item of work like Earth work and excavation in foundation, masonry, Reinforced cement concrete, finishing works. Analysis of rates: Earth work in excavation for foundation, mortars, reinforced cement concrete works, finishing work, masonry work, stone works, flooring with reference to DSR 2023 and DAR 2023.

Module 3: Estimation Techniques for Buildings (10 Hours)

Detailed Estimate- Preparation of detailed measurement using Centre line method & Short wall long wall method for single-storied RCC flat-roof building (Residential/office/school building). BOQ preparation of a single-storied RCC building work: Item-wise BOQ format aligned with DSR 2023 codes. Material quantity calculation of the items of work using DAR 2023: (Rubble, Brick work, Concrete work, Plastering) in detailed estimate prepared for building work. Bar Bending Schedule:Preparation of BBS of RCC beams, slabs. Use of software for bar bending schedule.

Module 4: Estimation for Infrastructure and Utilities (8 Hours)

Road estimation: Estimation of earthwork from longitudinal section for road. Estimation of sanitary and water supply work -Water tank, Septic tank, Manhole : concept of item of work, its general specification and unit of measurement.

Module 5: Valuation in Quantity Surveying (10 Hours)

Valuation: purpose, factor affecting valuation, introduction to terms: Value, Cost, Price, kinds of values, Income: Gross income, net income, outgoings, annuity, sinking fund, Year's purchase, Depreciation, obsolescence. Free hold and leasehold properties. Methods of calculating depreciation: straight line method, constant percentage method, sinking fund method and quantity survey method. Methods of valuation– rental method, direct comparison of capital cost, valuation based on profit, depreciation method. Valuation of land. Introduction to Digital tools for property valuation.

Text Books:

1. B N Dutta, Estimating and costing in Civil Engineering, USB publishers and distributors Ltd. New Delhi, 2022
2. D D Kohli, RC Kohli, A textbook of Estimating and costing, S Chand Publishing, 2011.
3. Dr. S. Seetharaman, M. Chinnasamy, Estimation and Quantity Surveying, Anuradha Publications, Chennai, 2015

References:

1. BS Patil, Civil Engineering contracts and estimates, Universities press, 2015
2. V N Vazirani & S P Chandola, Civil engineering Estimating and Costing, Khanna Publishers, 2004
3. IS 1200-1968; Methods of measurement of Building & Civil Engineering works, 2023
4. CPWD data book and schedule of rates.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	9 hours
1.1	Quantity Surveying: Basic principles, Role of Quantity surveyor at various stages of construction, Estimate: Type of estimate, purposes.	1
1.2	Cost Components: Project Costs, Charges and Overhead, Establishment and Resources.	2
1.3	Contract documents, Bill of Quantity: Item of works, Units of measurement of various materials and works. (RCC residential building)	2
1.4	General rule and method of measurement with reference to Indian Standard Specification: IS1200.	2
1.5	Introduction to digital measurement tools: Use of measurement software Autodesk Revit / RibCostX for take-offs.	2
2	Module 2	8 hours
2.1	Introduction to the use of schedule of rates as per latest Delhi Schedule of Rates (DSR 2023) and Analysis of rate as per latest Delhi Analysis of Rate (DAR 2023) Specifications.	1
2.2	General specification of all items of a residential building: foundations, super structure, finishes.	1
2.3	Detailed specifications of major item of work like Earth work and excavation in foundation, masonry, Reinforced cement concrete, finishing works.	2
2.4	Analysis of rates: Earth work in excavation for foundation, mortars, reinforced cement concrete works, finishing work with reference to DSR 2023 and DAR 2023.	2
2.5	Analysis of rates: masonry work, stone works, flooring with reference to DSR 2023 and DAR 2023.	2

3	Module 3	10 hours
3.1	Detailed Estimate:Preparation of detailed measurement using Centre line method and Short wall long wall method for single-storied RCC flat-roof building (Residential/office/school building).	3
3.2	BOQ preparation of a single-storied RCC building work: Item-wise BOQ format aligned with DSR 2023 codes.	2
3.3	Material quantity calculation of the items of work using DAR 2023: (Rubble, Brick work, Concrete work, Plastering) in detailed estimate prepared for building work.	3
3.4	Bar Bending Schedule:Preparation of BBS of RCC beams, slabs. Use of software for bar bending schedule.	2
4	Module 4	8 hours
4.1	Road estimation: Estimation of earthwork from longitudinal section for a road.	3
4.2	Estimation of sanitary and water supply work:Water tank, Septic tank	3
4.3	Manhole : concept of item of work, its general specification and unit of measurement.	2
5	Module 5	10 hours
5.1	Valuation: purpose, factor affecting valuation, introduction to terms: Value, Cost, Price, kinds of values.	1
5.2	Income: Gross income, net income, outgoings, annuity, sinking fund, Year's purchase, Depreciation, obsolescence. Free hold and leasehold properties.	2
5.3	Methods of calculating depreciation: straight line method, constant percentage method, sinking fund method and quantity survey method.	3
5.4	Methods of valuation:rental method, direct comparison of capital cost, valuation based on profit, depreciation method.	2
5.5	Valuation of land. Introduction to Digital tools for property valuation.	2
Total		45 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Explain the factors to be considered for the preparation of a detailed estimate.
2. Explain the following terms: (a) Contingencies (b) Work charged establishment (c) Provisional sum (d) Overhead cost.

Course Outcome 2 (CO 2):

1. Explain the term specification and types of specification.
2. Explain the specification of cement concrete work.

Course Outcome 3 (CO 3):

1. Prepare Bar Bending Schedule of the RCC beam shown in Figure 1.

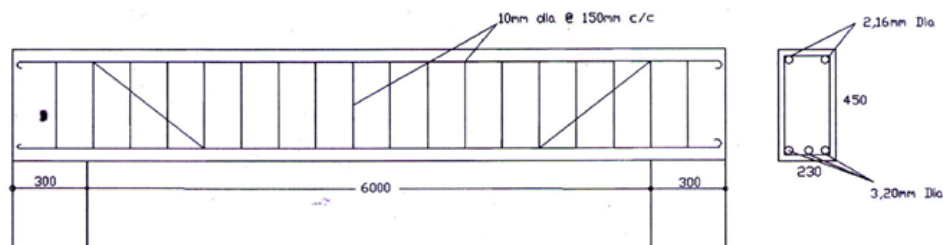


Figure 1: RCC Beam for Bar Bending Schedule

2. Work out the quantity of material for 10 cum cement concrete of 1:2:4.

Course Outcome 4 (CO 4):

1. Estimate the quantity of earthwork for a portion of a district road for 400 metre length with the following data. Formation width of the road = 10 metres, Side slopes in cutting = 1.5:1, Downward gradient = 1 in 200, Formation level at RL = 150.

Distance in metre	0	40	80	120	160	200	240	280	320	360	400
R.L of ground	149.00	148.90	148.50	148.80	148.60	148.70	149.20	140.40	149.30	149.00	148.60

Figure 2: RL of ground vs Distance in metres

2. List any three items of work with unit of measurement for water supply plumbing system.

Course Outcome 5 (CO 5):

1. Explain the purpose of valuation.
2. A builder purchased a leasehold property for Rs. 2500000/- which will generate a net annual income of Rs. 150000/-. The lease is for 28yrs. Calculate the sum that the builder should place annually in a sinking fund which will accumulate at 4 % compound interest. So that the builder can redeem the purchase money at the termination of the lease.



MODEL QUESTION PAPER

QP CODE:

Pages: 4

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

SIXTH SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CE3T08

QUANTITY SURVEYING AND VALUATION

Max. Marks: 100

Duration: 3 hours

PART A

Answer any two full questions, each carries 10 marks.

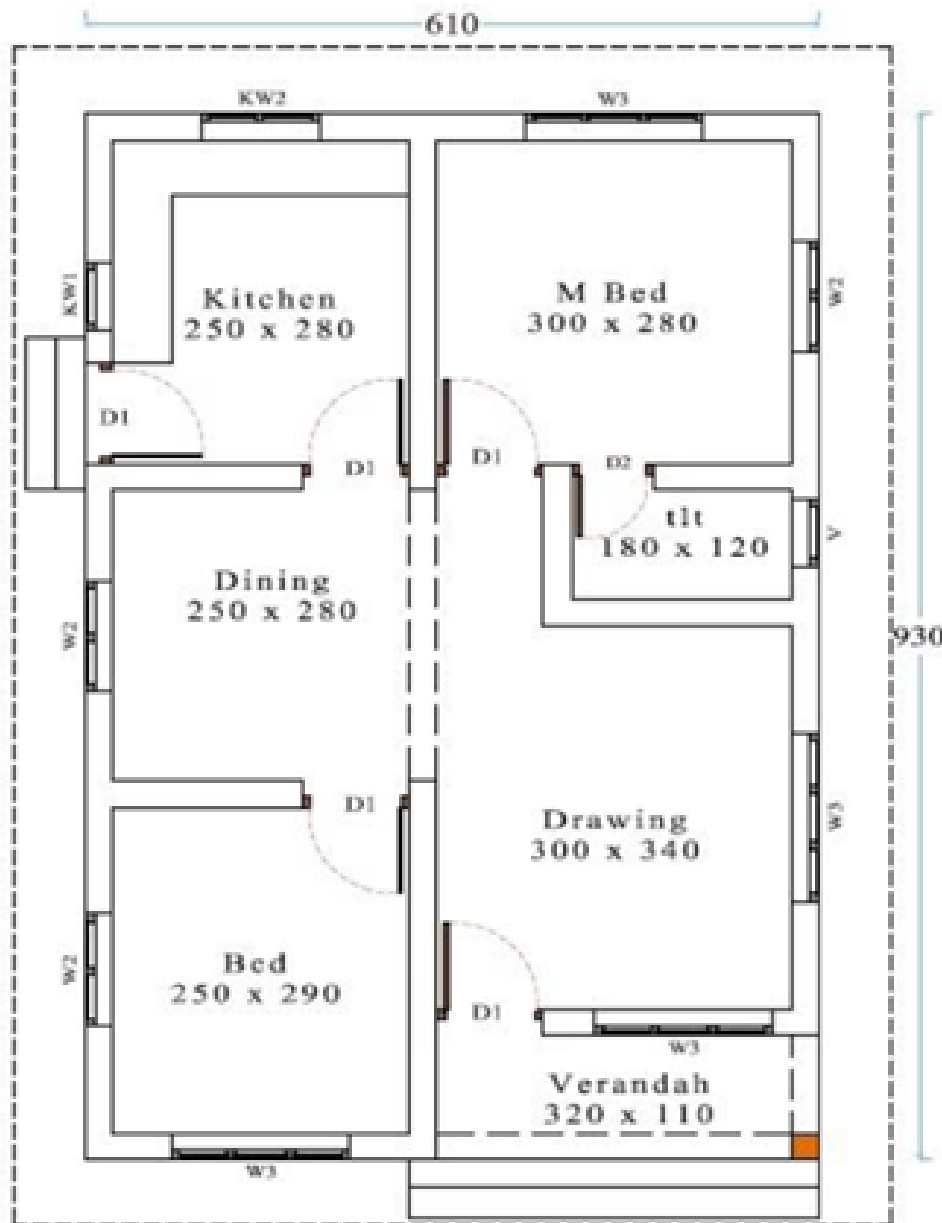
1. (a) Briefly explain the detailed specification of Earthwork excavation for foundation in ordinary soil. (6 marks)
- (b) Write the unit of measurement of
 - (i) Carpentry fittings
 - (ii) Pointing of Brick wall(4 marks)
2. Work out the unit rate for P.C.C work in 1:6 Cement sand mortar for 10 m³ (Broken stone 12.5 m³ @ Rs.800/m³, river sand 4.2 m³ @ Rs.1200/m³, Cement 1000 kg @ Rs.8000/ton, 12.5 masons @ Rs.750/each, 10.5 men @ Rs.650/each and 11 women @ Rs.550/each). (10 marks)
3. (a) List the essential documents to be accompanied with the detailed estimate. (6 marks)
- (b) What is meant by overhead charges? Give the percentage adopted for the contractor's profit and overhead in CPWD DSR rate analysis. (4 marks)

PART B

Answer any two full questions, each carries 25 marks.

4. Prepare detailed estimate for the following items of work for the construction of residential building:

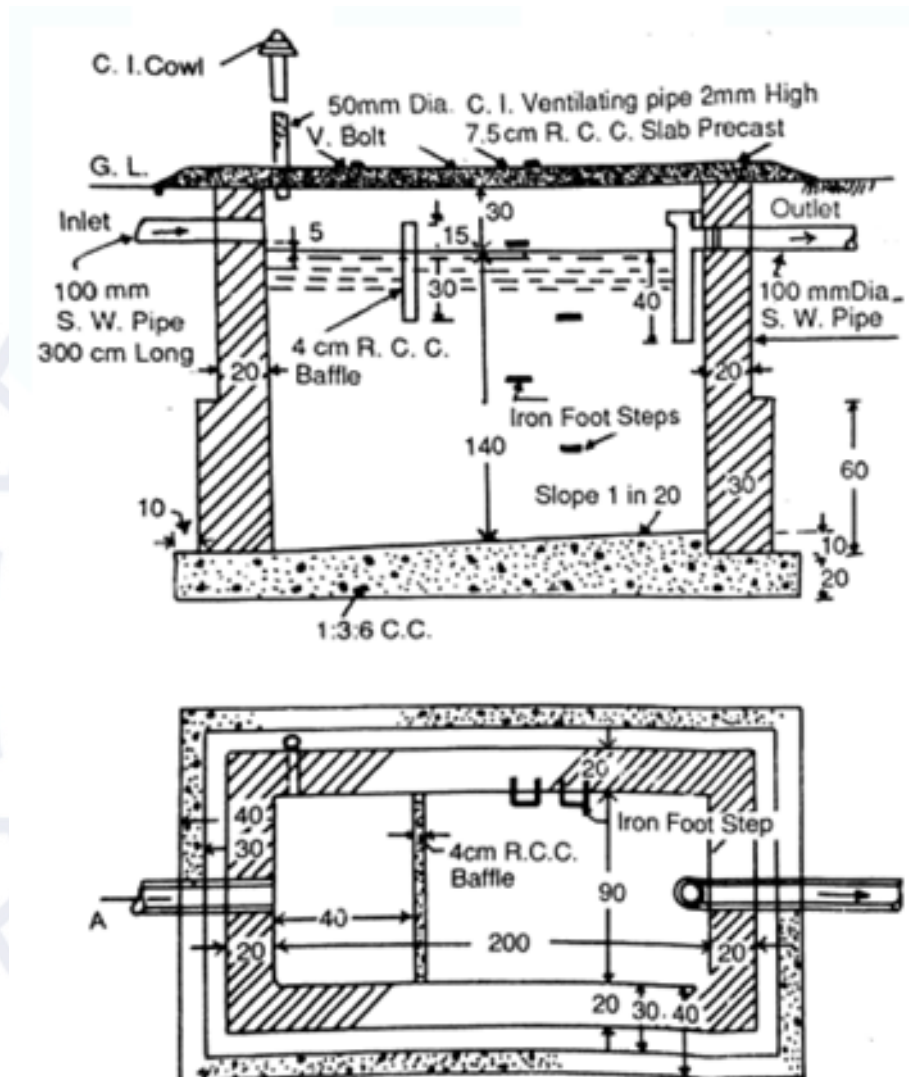
- (a) RRM for foundation ($75 \text{ cm} \times 75 \text{ cm}$) and basement ($50 \text{ cm} \times 50 \text{ cm}$), Wall thickness 20 cm.
 - (b) Quantity of earth filling inside the plinth.
 - (c) RCC works for slab (12 cm thick), lintel (15 cm thick), and sunshade (60 cm projection).
 - (d) Painting for walls, doors (D1– 100×210 ; D2– 80×210) and windows (W2– 100×150 ; W3– 150×150 ; KW1– 50×100 ; KW2– 100×100); V(90×60).
- All dimensions are in centimetres. Any missing data may be suitably assumed.



(25 marks)

5. Prepare a bar bending schedule and quantities of RCC and reinforcement of a simply supported beam of length 6.5 m, depth 50 cm, and width 30 cm reinforced with 3 Nos of 20 mm dia at bottom as straight bars, 2 Nos of 20 mm dia cranked at 45° , 2 Nos 16 mm Φ at top of beam and 8 mm Φ 2-legged stirrups @ 15 cm c/c. (25 marks)

6. Prepare a detailed estimate of a Septic tank from the given drawings.



(25 marks)

PART C

Answer any two full questions, each carries 15 marks.

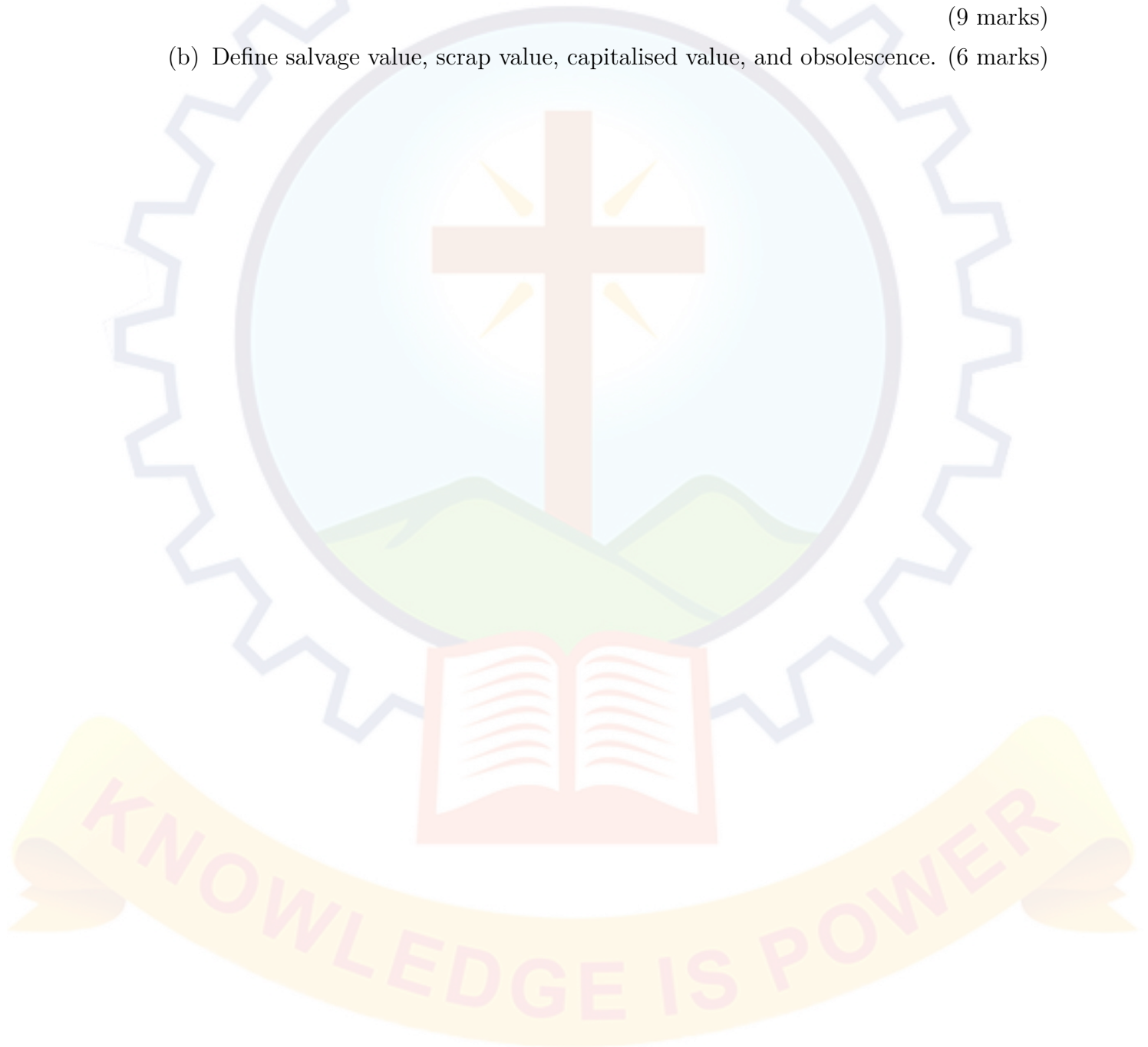
7. (a) Explain valuation and its purpose. (5 marks)
(b) What are the methods for calculating depreciation? (10 marks)
8. (a) Discuss different methods for finding valuation of a building. (8 marks)
(b) The cost of construction of a new building according to present market rate is Rs. 80,000/- having a life of 70 years. But if the building is 15 years old, determine the depreciation amount which should be deducted from the cost of the new building at 6% compound interest. (7 marks)
9. (a) A building is constructed at a cost of Rs. 2,50,000 on a land purchased at Rs. 50,000. The owner of the property expects a return of 9% on the cost of

construction and 8% on the cost of land. The building is estimated to have a future life of 60 years at the end of which it requires Rs. 3,25,000 for constructing a new building in its place. Determine the standard rent of the property given:

- Rate of interest for sinking fund at 6%
- Annual repairs at 1.5% of cost of the construction
- All other outgoings 28% of the net income of the property
- Scrap value at the end of the useful life of the building is 10%

(9 marks)

(b) Define salvage value, scrap value, capitalised value, and obsolescence. (6 marks)



CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE3T09	FOUNDATION ENGINEERING	3	1	0	5	4	2024

Preamble

Foundation Engineering is a crucial branch of Civil Engineering that deals with the study of soil behaviour and the design of foundations to safely transmit structural loads. This course provides an understanding of shallow and deep foundations, bearing capacity, settlement analysis, and earth pressure theories. It also covers the design of retaining walls and the principles of site investigation and soil exploration as per Indian Standards. By studying this subject, students gain the analytical and practical skills necessary to design safe, economical, and reliable foundations suited to diverse soil and loading conditions in engineering practice.

Prerequisites: Soil Mechanics.

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Understand the fundamental concepts of soil behaviour and foundation systems (Cognitive knowledge level: Understand).
CO 2	Apply standard procedures for site investigation, soil exploration, and interpretation of field test data. (Cognitive knowledge level: Apply).
CO 3	Recall and explain the theories and influencing factors of bearing capacity and settlement of shallow foundations (Cognitive knowledge levels: Remember and Understand).
CO 4	Explain the principles of load transfer in piles, group efficiency, negative skin friction, and the construction challenges encountered during well sinking. (Cognitive knowledge level: Understand).
CO 5	Remember the definitions of active, passive, and at-rest earth pressures, and the types of retaining walls (Cognitive knowledge levels: Remember).

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	2	-	-	1	-	1	-	-	-	-
CO 2	3	2	1	-	1	-	1	-	-	-	-
CO 3	3	2	2	1	1	-	1	-	-	-	-
CO 4	3	1	1	-	1	-	1	-	-	-	-
CO 5	3	3	2	2	3	-	1	-	2	2	2

Assessment Pattern

FOUNDATION ENGINEERING			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	40	20	25
Understand	40	40	35
Apply	20	40	40
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 10 marks
Self Study	: 5 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question carries 14 marks and can have maximum 2 sub-divisions.

SYLLABUS

Module 1: Foundation Engineering & Stress in Soil Mass (9 hours)

Definition and importance - Types of foundations: Shallow and deep - Types of Shallow Foundations. Introduction to Deep Foundations - Types - Pile foundations, caissons. Factors determining selection of deep foundations. Stress distribution in soil under loads, Boussinesq's theory, Assumptions and Limitations - Numerical problems - Vertical pressure due to uniformly distributed loads beneath strip, circular (no derivation required) - Numerical problems. Pressure Isobars - Pressure bulbs, distribution of contact pressure beneath footings.

Module 2: Site Investigation and Soil Exploration (8 hours)

Site investigation: Objectives - planning - reconnaissance - Guidelines for choosing spacing and depth of borings [I.S. guidelines only].

Soil exploration - Methods of subsurface exploration -test pits - Auger borings – Wash Boring - Standard Penetration Test – procedure and Corrections for SPT value – Numerical Problems - Sampling - disturbed samples, undisturbed samples and chunk samples (brief discussion only)- Boring log – Soil profile.

Module 3: Shallow Foundations (10 hours)

Bearing Capacity of Shallow Foundations - General, local and punching shear failure. Terzaghi's theory, Gross and Net bearing pressure - Ultimate and Safe bearing capacity, factors affecting bearing capacity, Terzaghi's bearing capacity theory for strip footing [no derivation required] – Assumptions – Bearing capacity factors – Numerical problems - Terzaghi's formula for circular and square footings - Numerical problems – Factors affecting bearing capacity - Effect of water table on bearing capacity - Numerical problems.

Settlement of Shallow Foundations: Immediate, consolidation, and differential settlement- estimation of immediate settlement –Numerical problems - Allowable settlement-Maximum and differential settlements as per Indian standard.

Module 4: Deep Foundations (9 Hours)

Pile Foundation: Types of piles-Load-carrying capacity of piles (static and dynamic methods)- negative skin friction, I.S. Pile load tests (static load test), Settlement of Pile Foundations-Numerical problems for single piles and pile groups- Group action - Group efficiency - Capacity of Pile groups.

Well foundation: Elements of a well foundation – construction details of well foundations - Problems encountered in well sinking – Methods to rectify tilts and shifts.

Module 5: Retaining Walls

(9 Hours)

Lateral Earth Pressure Theories: Rankine's and Coulomb's theories, active and passive earth pressures, earth pressure coefficients. Earth pressure and point of application for cohesionless and cohesive soils -Influence of surcharge and water table on earth pressure - Numerical problems- Earth pressure with layered backfill - Numerical problems - Coulomb's theory [no derivation required].

Retaining Walls Types of retaining walls(gravity, cantilever, sheet pile),Proportioning of gravity retaining walls.

Course Activity: Interpret bore log data to analyse subsurface conditions and recommend a suitable foundation type based on soil classification, bearing capacity, and groundwater conditions.

Text Books:

1. Ranjan G. and A. S. R. Rao, *Basic and Applied Soil Mechanics*, New Age International, 2002.
2. Arora K. R., *Geotechnical Engineering*, Standard Publishers, 2006.

References:

1. Das B. M., *Principles of Geotechnical Engineering*, Cengage India Pvt. Ltd., 2010.
2. Venkatramaiah, *Geotechnical Engg*, Universities Press, 2000.
3. Terzaghi K. and R. B. Peck, *Soil Mechanics in Engineering Practice*, John Wiley, 1967.
4. A V Narasimha Rao and C Venkatramaiah, *Numerical Problems, Examples and Objective questions in Geotechnical Engineering*, Universities Press (India) Ltd., 2000
5. Purushothamaraj P., *Soil Mechanics and Foundation Engineering*, Dorling Indersley(India) Pvt. Ltd., 2013
6. Taylor D.W., *Fundamentals of Soil Mechanics*, Asia Publishing House, 1948.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	9 hours
1.1	Definition and importance of foundation engineering; Types of foundations – Shallow and Deep; Types of shallow foundations	1
1.2	Introduction to deep foundations – Pile foundations and caissons	1
1.3	Factors determining selection of deep foundations	1
1.4	Stress distribution in soil under loads, Boussinesq's theory, Assumptions and Limitations - Numerical problems	2
1.5	Vertical pressure due to uniformly distributed loads beneath strip, circular [no derivation required] - Numerical problems	3
1.6	Pressure Isobars - Pressure bulbs, distribution of contact pressure beneath footings.	1
2	Module 2	8 hours
2.1	Site investigation: Objectives - planning - reconnaissance	1
2.2	Guidelines for choosing spacing and depth of borings [I.S. guidelines only]	1
2.3	Soil exploration Methods of subsurface exploration -test pits	1
2.4	Auger borings – Wash Boring	1
2.5	Standard Penetration Test – procedure and Corrections for SPT value – Numerical Problems	2
2.6	Sampling - disturbed samples, undisturbed samples and chunk samples (brief discussion only)	1
2.7	Boring log – Soil profile	1

3	Module 3	10 hours
3.1	Introduction to Shallow Foundations; Types of failures – General, Local, and Punching shear	1
3.2	Terzaghi's theory – Gross and Net bearing pressure; Ultimate and Safe bearing capacity	1
3.3	Terzaghi's bearing capacity theory for strip footing – Assumptions and bearing capacity factors	1
3.4	Numerical problems on strip footing bearing capacity	2
3.5	Terzaghi's formula for circular and square footings - Numerical problems	2
3.6	Factors affecting bearing capacity; Effect of water table on bearing capacity; Numerical problems	1
3.7	Settlement of shallow foundations – Immediate, consolidation, differential settlements; Estimation of immediate settlement; Numerical problems.	2
4	Module 4	9 hours
4.1	Introduction to Deep Foundations; Types of piles and their applications	1
4.2	Load-carrying capacity of piles – Static and dynamic methods	2
4.3	Negative skin friction and its impact on pile performance	1
4.4	I.S. Pile load tests (static load test) – Procedure and interpretation	1
4.5	Settlement of pile foundations – Single piles and pile groups; Group action and group efficiency	2
4.6	Well foundations – Elements and construction details	1
4.7	Problems in well sinking- Tilts and shifts; Methods to rectify errors	1

5	Module 5	9 hours
5.1	Introduction to Lateral Earth Pressure; Active, Passive, and At-Rest pressures; Earth pressure coefficients	1
5.2	Rankine's theory – Assumptions, active and passive earth pressure; Application to cohesionless soils	1
5.3	Rankine's theory for cohesive soils; Point of application of earth pressure; Numerical problems	2
5.4	Influence of surcharge and water table on earth pressure; Numerical problems	2
5.5	Earth pressure for layered backfill; Numerical problems	1
5.6	Coulomb's theory – Assumptions and practical application (no derivation)	1
5.7	Retaining walls – Types (Gravity, Cantilever, Sheet Pile); Proportioning of gravity retaining wallson	1
Total		45 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Explain the differences between shallow and deep foundations and give two examples of each.
2. Describe the factors influencing the selection of a suitable foundation system for a building constructed on clayey soil.

Course Outcome 2 (CO 2):

1. A Standard Penetration Test (SPT) in a borehole gives an N-value of 25 at 3 m depth. Calculate the corrected N-value if the overburden correction factor is 1.2 and discuss what this indicates about the soil.
2. Interpret the following bore log and recommend a suitable foundation type: [Provide sample log showing clay, silt, and sand layers with groundwater table at 2 m]. Explain your reasoning considering bearing capacity and soil type.

Course Outcome 3 (CO 3):

1. List and briefly explain the three types of shear failure that may occur in shallow foundations.
2. Explain Terzaghi's bearing capacity theory for a strip footing and discuss the effect of water table on the ultimate bearing capacity.

Course Outcome 4 (CO 4):

1. Explain the mechanism of load transfer in a friction pile and the effect of negative skin friction on pile capacity.
2. Discuss the common problems encountered during well foundation sinking and the methods used to rectify tilts and shifts.

Course Outcome 5 (CO 5):

1. Define active, passive, and at-rest earth pressures. Provide one practical situation for each.
2. List the types of retaining walls and explain briefly the key differences between gravity and cantilever walls.

MODEL QUESTION PAPER

QP CODE:

Pages: 3

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

SIXTH SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CE3T09
FOUNDATION ENGINEERING

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Define bearing capacity and its significance in foundation engineering.
2. List the types of shallow foundations.
3. What is Standard Penetration Test (SPT) and why is it used?
4. Describe two problems encountered during well sinking.
5. What are the basic assumptions of Terzaghi's bearing capacity theory?
6. Differentiate between total and differential settlement.
7. Briefly explain the purpose of soil exploration.
8. State any three objectives of site investigation.
9. List common types of retaining walls.
10. Explain Rankine's theory of earth pressure.

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. a) Explain the principles governing the behaviour of soil under foundation loads. (7)
b) With the help of neat sketches, describe the classification of deep foundations. (7)

OR

12. Discuss the factors affecting the selection of foundation type and site selection. (14)

MODULE 2

13. a) Outline the steps in planning a soil exploration program for a major construction project. (7)
b) Explain different types of soil sampling techniques and their importance. (7)

OR

14. Interpret a given boring log and recommend suitable foundation solutions for a site with challenging soil conditions. (14)

MODULE 3

15. a) Derive Terzaghi's bearing capacity equation for shallow foundations. (7)
b) A strip footing 1.5 m wide is placed at a depth of 1 m below ground surface. Calculate the ultimate bearing capacity, given necessary soil properties (provide data). (7)

OR

16. Differentiate between immediate and consolidation settlement. Provide examples and calculations for each. (14)

MODULE 4

17. a) Describe the classification of pile foundations. (7)
b) Explain the procedure to determine the load carrying capacity of a pile group based on field test results. (7)

OR

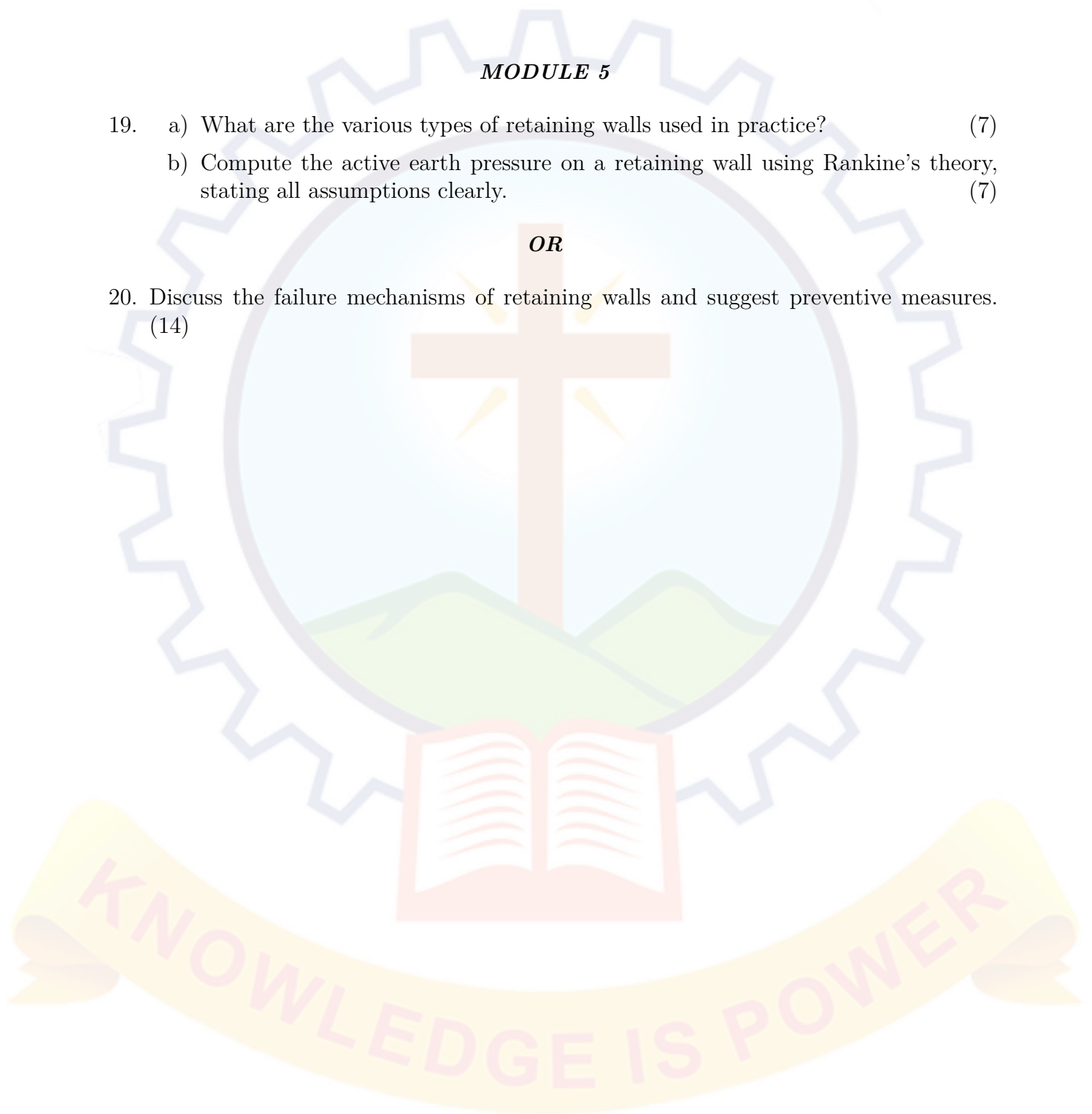
18. a) With neat sketches, explain the components and construction steps of a well foundation. (7)
b) Discuss remedial measures for tilting and shifting. (7)

MODULE 5

19. a) What are the various types of retaining walls used in practice? (7)
b) Compute the active earth pressure on a retaining wall using Rankine's theory, stating all assumptions clearly. (7)

OR

20. Discuss the failure mechanisms of retaining walls and suggest preventive measures. (14)



CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE3P21	ADVANCED CONCRETE TECHNOLOGY	2	1	0	4	3	2024

Preamble

The course covers the properties of the ingredients of concrete and its influence on the performance of concrete. The course also focus to develop a strong understanding about the latest developments in the area of concrete technology with a clear knowledge about the fundamental mechanisms.

Prerequisites: Basics of Civil Engineering, Concrete Technology.

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Understand cement composition, hydration, aggregates, and admixtures to evaluate their influence on concrete properties. (Cognitive Knowledge Level: Understand)
CO 2	Analyse the rheological behavior of fresh concrete by understanding the role of mineral and chemical admixtures, evaluating workability characteristics through standard tests . (Cognitive Level: Analyse)
CO 3	Analyze the mechanical and time-dependent properties of hardened concrete affecting its performance. (Cognitive Level: Analyse)
CO 4	Evaluate concrete durability and assess structural condition using NDT methods. (Cognitive Level: Analyzs)
CO 5	Apply special concretes and modern construction technologies to practical field applications. (Cognitive Level: Apply)

Mapping of Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	2	1	1	1						2
CO 2	3	3	2	2	2						2
CO 3	3	3	2	2	2						2
CO 4	2	3	2	3	3	2	1		2		2
CO 5	2	2	3	2	3	2	1	2	2	2	3

Assessment Pattern

ADVANCED CONCRETE TECHNOLOGY			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	30	20	10
Understand	50	40	50
Apply	20	30	30
Analyse		10	10
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course project : 10 marks

Self Study : 5 marks

End Semester Examination Pattern

There will be two parts: Part A and Part B. Part A contain 10 questions, with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module, of which students should answer any one. Each question carries 14 marks and can have a maximum of 2 sub-divisions.

SYLLABUS

Module 1: Cement and Concrete Materials (6 hours)

Cement production process and chemical composition - Bogue's compounds and their roles - Cement hydration, Hydration products and its role - Hydrated cement paste (HCP) structure - Aggregates: types (natural, artificial, lightweight, heavyweight), sampling, testing - influence and properties - Chemical admixtures: types, uses, mechanism of action.

Module 2: Concrete Rheology (8 hours)

Mineral admixtures: types, chemical composition, physical characteristics, effects on concrete - Principles of high - performance concrete mixture proportioning - Workability: factors affecting workability, slump test, compaction factor test, Vee Bee consistometer test - Properties of fresh concrete: slump, flow, viscosity, setting time.

Module 3: Properties of Hardened Concrete (8 Hours)

Mechanical properties: modulus of elasticity, compressive strength, split tensile strength, flexural strength - Effect of water-cement ratio on concrete properties - Time - dependent properties: creep - factors influencing it, effects on concrete - Shrinkage: types (plastic, drying, autogenous, carbonation), factors affecting shrinkage.

Module 4: Durability and NDT of Concrete (7 Hours)

Durability factors: Review of - permeability, cracking, reinforcement corrosion, chemical attacks (sulfate, acid, carbonation, chloride) - Durability in special environments: sea water, fire resistance, alkali-silica reaction, frost damage -Non-destructive testing methods: surface hardness, ultrasonic pulse velocity, penetration resistance, pull - out test, core cutting, reinforcement cover measurement.

Module 5: Special Concretes and Construction Technologies (7 Hours)

Types: lightweight concrete, heavyweight concrete, high-strength concrete, high-performance concrete, self-compacting concrete, polymer concrete, fibre-reinforced concrete, pumped concrete, ready-mix concrete, green concrete-Construction techniques and processes: sprayed concrete, underwater concrete, mass concrete, slip form construction, prefabrication technology, 3D concrete printing.

Text Books:

1. Neville A.M., Properties of Concrete , Trans-Atlantic Publications, Inc.; 5e, 2016.
2. R. Santhakumar, Concrete Technology , Oxford Universities Press, 2018.

3. Shetty M. S., Concrete Technology , S. Chand & Co., 2018.

References:

1. Mehta and Monteiro, Concrete-Micro structure, Properties and Materials , McGraw Hill Professional 2017.
2. Lea, Chemistry of Cement and Concrete , Butterworth-Heinemann Ltd, 5e, 2017.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	6 hours
1.1	Cement production process and chemical composition - Bogue's compounds and their roles.	2
1.2	Hydration products and its role - Hydrated cement paste (HCP) structure - Aggregates: types (natural, artificial, lightweight, heavyweight).	2
1.3	Sampling, testing - influence and properties - Chemical admixtures: types, uses, mechanism of action.	2
2	Module 2	8 hours
2.1	Mineral admixtures:types, chemical composition, physical characteristics, effects on concrete - Principles of high-performance concrete mixture proportioning.	4
2.2	Workability: factors affecting workability, slump test, compaction factor test, Vee Bee consistometer test.	2
2.3	Properties of fresh concrete: slump, flow, viscosity, setting time.	2
3	Module 3	8 hours
3.1	Mechanical properties:modulus of elasticity, compressive strength, split tensile strength, flexural strength.	2

3.2	Effect of water - cement ratio on concrete properties - Time-dependent properties: creep - factors influencing it.	4
3.3	Effects on concrete-Shrinkage: types (plastic, drying, autogenous, carbonation), factors affecting shrinkage.	2
4	Module 4	7 hours
4.1	Durability factors:Review of - permeability, cracking, reinforcement corrosion, chemical attacks (sulfate, acid, carbonation, chloride)	3
4.2	Durability in special environments: sea water, fire resistance, alkali-silica reaction, frost damage	2
4.3	Non-destructive testing methods: surface hardness, ultrasonic pulse velocity, penetration resistance, pull-out test, core cutting, reinforcement cover measurement.	2
5	Module 5	7 hours
5.1	Types: lightweight concrete, heavyweight concrete, high-strength concrete, high-performance concrete, self-compacting concrete, polymer concrete.	2
5.2	Fibre-reinforced concrete, pumped concrete, ready-mix concrete, green concrete - Construction techniques and processes.	2
5.3	Sprayed concrete, underwater concrete, mass concrete, slip form construction, prefabrication technology, 3D concrete printing.	3
Total		36 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Explain the manufacturing process of Ordinary Portland Cement (OPC). Discuss the chemical composition and roles of Bogue's compounds in cement hydration.
2. Describe the types, properties, and testing of aggregates used in concrete production. How do aggregate characteristics influence concrete performance?

Course Outcome 2 (CO 2):

1. Explain the principles of concrete rheology. Discuss the factors affecting workability and explain the tests used to measure it.
2. What are mineral admixtures?. Discuss the effects of fly ash, silica fume, and GGBS on the fresh and hardened properties of concrete.

Course Outcome 3 (CO 3):

1. Explain the mechanical properties of hardened concrete. Discuss the relationship between water - cement ratio and strength of concrete.
2. Write short notes on: a) Creep of concrete. (b) Types of shrinkage and their influence on durability.

Course Outcome 4 (CO 4):

1. Discuss the main durability issues in concrete structures. Explain the mechanisms of sulfate attack, chloride ingress, and carbonation.
2. Describe the working principles and applications of NDT methods such as rebound hammer, UPV, and pull-out tests in evaluating concrete quality.

Course Outcome 5 (CO 5):

1. Explain the characteristics, mix design, and applications of high-performance concrete (HPC) and self-compacting concrete (SCC).
2. Write detailed notes on advanced concrete construction techniques such as sprayed concrete, underwater concreting, and 3D concrete printing.

MODEL QUESTION PAPER

QP CODE:

Pages: 2

Reg.No.:

Name:

**MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM**

SIXTH SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CE3P21

ADVANCED CONCRETE TECHNOLOGY

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. List the four main Bogue's compounds in cement and briefly mention their roles in hydration.
2. Differentiate between natural and artificial aggregates with suitable examples.
3. Define workability of concrete. Mention any two factors affecting it.
4. What is the significance of using mineral admixtures in concrete?
5. Write short notes on plastic and drying shrinkage in concrete.
6. Define creep of concrete. What are the factors influencing it?
7. List any four causes of reinforcement corrosion in concrete structures.
8. Name any four non-destructive testing (NDT) methods used for assessing concrete quality.
9. Write a note on self-compacting concrete (SCC) and its advantages.
10. What is meant by 3D concrete printing? Mention one key benefit of this technology.

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. Explain the manufacturing process of Ordinary Portland Cement (OPC). Discuss the chemical composition and roles of Bogue's compounds in cement hydration.

OR

12. Describe the types, properties, and testing of aggregates used in concrete production. How do aggregate characteristics influence concrete performance?

MODULE 2

13. Explain the principles of concrete rheology. Discuss the factors affecting workability and explain the tests used to measure it.

OR

14. What are mineral admixtures? Discuss the effects of fly ash, silica fume, and GGBS on the fresh and hardened properties of concrete.

MODULE 3

15. Explain the mechanical properties of hardened concrete. Discuss the relationship between water-cement ratio and strength of concrete.

OR

16. Write short notes on:
- a) Creep of concrete
 - b) Types of shrinkage and their influence on durability

MODULE 4

17. Discuss the main durability issues in concrete structures. Explain the mechanisms of sulfate attack, chloride ingress, and carbonation.

OR

18. Describe the working principles and applications of NDT methods such as rebound hammer, UPV, and pull-out tests in evaluating concrete quality.

MODULE 5

19. Explain the characteristics, mix design, and applications of high-performance concrete (HPC) and self-compacting concrete (SCC).

OR

20. Write detailed notes on advanced concrete construction techniques such as sprayed concrete, underwater concreting, and 3D concrete printing.

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE3P22	ENGINEERING LAW	2	1	0	4	3	2024

Preamble

This course introduces the fundamentals of construction law and contract management in the Indian context. Students learn about legal literacy, statutory laws, tendering, contract formulation, and administration. Through practical exercises and case studies, students gain skills in drafting contracts, tender documents, and managing contracts. By the end, students will be equipped to navigate the complexities of construction law and manage contracts effectively in real-world projects.

Prerequisites: Construction Technology and Management.

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Identify the importance of legal literacy in construction practice and the roles of stakeholders in the construction industry. (Cognitive Knowledge Level: Understand)
CO 2	Apply relevant statutory laws, including the Indian Contract Act, Arbitration and Conciliation Act, and RERA, to construction projects and disputes. (Cognitive Level: Apply)
CO 3	Analyze the tendering process, including prequalification, bid evaluation, and contract award, and identify potential legal issues. (Cognitive Level: Apply)
CO 4	Draft valid construction contracts, including essential clauses and provisions. (Cognitive Level: Apply)
CO 5	Apply alternative dispute resolution techniques to resolve disputes in construction contracts, ensuring effective contract administration and monitoring. (Cognitive Level: Apply)

Mapping of Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	1	1				2		2	1	2	
CO 2	2	2	1	2	1	3	1	3	2	2	1
CO 3	2	3	1	2	1	2		2	2	2	1
CO 4	1	2	2	1	1	2		2	2	3	1
CO 5	1	2		1		3		3	2	2	2

Assessment Pattern

ENGINEERING LAW			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	30	30	30
Understand	40	40	40
Apply	30	30	30
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course project : 10 marks

Self Study : 5 marks

End Semester Examination Pattern

There will be two parts: Part A and Part B. Part A contain 10 questions, with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module, of which students should answer any one. Each question carries 14 marks and can have a maximum of 2 sub-divisions.

SYLLABUS

Module 1: Construction Law Fundamentals (7 hours)

Importance of Legal Literacy in Construction Practice, Overview of the Indian Legal System: Constitution, Statutory and Common Law, Evolution of Construction Law in India, Roles of Stakeholders: Employer, Engineer, Contractor, Subcontractor, Supplier.

Module 2: Statutory Laws in Construction (7 hours)

Indian Contract Act, 1872 (Form of FIDIC contract): overview and relevance to construction, Arbitration and Conciliation Act, 1996 (as amended) :overview and relevance to construction, Real Estate (Regulation and Development) Act, 2016 (RERA): scope, coverage, implications, overview of :Land Acquisition Act, Registration Act, Stamp Duty Laws and Penal Code provisions relevant to site safety, cheating, negligence, and misrepresentation.

Module 3:Tendering and Prequalification (7 Hours)

Prequalification Process: Legal basis, technical and financial eligibility criteria, Pre-bid meetings and clarifications, Legal recourse against unjust disqualification, Transparency and accountability under public procurement rules. Tendering Process: Notice of Inviting Tender, Standard Bidding Documents, Government Procurement Rules. Legal Issues in Tendering: Misrepresentation, Fraud, Estoppel, Warranty for Accuracy of Information, Confidentiality. Letter of Intent vs Contract Award - Legal Status and Interpretation.

Module 4:Contract Formulation and Management(8 Hours)

Essentials of a Valid Contract - Offer, Acceptance, Consideration, Capacity, Free Consent. Types of Construction Contracts: Item Rate, Lump Sum, EPP (Engineering Procurement and Construction), BOT (Build Operate Transfer), PPP (Public-Private Partnership), Design-Build. Contractual Clauses: Time is of the Essence, Termination, Indemnity, Escalation, Defect Liability, Privity of Contract and Novation. Relevant Provisions from the National Building Code (NBC of India): NBC as a statutory benchmark in contractual enforcement and municipal compliance.

Module 5: Contract Administration and Dispute Resolution(7 Hours)

Receipt of tenders: Documentation, opening, record keeping, preparing qualifications, Comparative statement, prepare common datum for evaluation of Tenders received, Negotiation, selection, Letter of Intent/Letter of Acceptance. Contract Administration: On-boarding Contractors/ Vendors, Critical aspects of Contract Administration: periodic monitoring

and management of Contract, Essential protocols: Communication protocol, Statutory submittals: Performance Bank Guarantee, Insurance, Licences, Tax Registration, Introduction to Alternative Dispute Resolution: Arbitration, Negotiation, mediation, Conciliation.

Course Project

- Case study discussion on a contract dispute in a public infrastructure project.
- Drafting exercise of a model prequalification notice.
- Drafting exercise of a basic construction agreement/ Contract, tender document.
- Drafting standard form of contract administration template.

Text Books:

1. G.T. Gajria and Kishore Gajria, “Law Relating to Building and Engineering Contracts in India”, Lexis Nexis, 2000.
2. B.S. Patil, “Legal Aspects of Building and Engineering Contracts ”, CRC Press,2019.
3. David Chappell, “Construction Contracts: Questions and Answers”, Routledge,2020.

References:

1. Bureau of Indian Standards (BIS), “National Building Code of India, 2016”.
2. CPWD, “CPWD Works Manual and General Conditions of Contract”.
3. Ministry of Road Transport and Highways (MoRTH), “NHAI EPC and HAM Model Concession Agreements”.
4. FIDIC, “FIDIC Conditions of Contract” ,Red and Silver Book.
5. Julian Bailey, “Construction Law”, London Publishing Partnership,2024.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	7 hours
1.1	Importance of Legal Literacy in Construction Practice.	1
1.2	Overview of the Indian Legal System: Constitution, Statutory and Common Law.	2
1.3	Evolution of Construction Law in India.	1
1.4	Roles of Stakeholders: Employer, Engineer, Contractor, Sub-contractor, Supplier.	3
2	Module 2	7 hours
2.1	Indian Contract Act, 1872 (Form of FIDIC contract): overview and relevance to construction.	2
2.2	Arbitration and Conciliation Act, 1996 (as amended):overview and relevance to construction.	1
2.3	Real Estate (Regulation and Development) Act, 2016 (RERA): scope, coverage, implications.	1
2.4	Overview of: Land Acquisition Act, Registration Act.	1
2.5	Overview of: Stamp Duty Laws and Penal Code provisions relevant to site safety, cheating, negligence, and misrepresentation.	2
3	Module 3	7 hours
3.1	Prequalification Process: Legal basis, technical and financial eligibility criteria, Pre-bid meetings and clarifications,	1
3.2	Legal recourse against unjust disqualification, Transparency and accountability under public procurement rules.	1
3.3	Tendering Process: Notice of Inviting Tender, Standard Bidding Documents, Government Procurement Rules.	2

3.4	Legal Issues in Tendering: Misrepresentation, Fraud, Estoppel, Warranty for Accuracy of Information, Confidentiality.	2
3.5	Letter Of Intent vs Contract Award — Legal Status and Interpretation.	1
4	Module 4	8 hours
4.1	Essentials of a Valid Contract - Offer, Acceptance, Consideration, Capacity, Free Consent.	1
4.2	Types of Construction Contracts: Item Rate, Lump Sum, EPP (Engineering Procurement and Construction)	2
4.3	BOT (Build Operate Transfer), PPP (Public-Private Partnership), Design-Build.	2
4.4	Contractual Clauses: Time is of the Essence, Termination, Indemnity, Escalation, Defect Liability, Privity of Contract and Novation.	2
4.5	Relevant Provisions from the National Building Code (NBC of India): NBC as a statutory benchmark in contractual enforcement and municipal compliance.	1
5	Module 5	7 hours
5.1	Receipt of tenders: Documentation, opening, record keeping, preparing qualifications.	1
5.2	Comparative statement, prepare common datum for evaluation of Tenders received, Negotiation, selection, Letter of Intent/Letter of Acceptance.	1
5.3	Contract Administration: On-boarding Contractors/ Vendors, Critical aspects of Contract Administration: periodic monitoring and management of Contract,	1
5.4	Essential protocols: Communication protocol, Statutory submittals: Performance Bank Guarantee, Insurance, Licences, Tax Registration	2
5.5	Introduction to Alternative Dispute Resolution: Arbitration, Negotiation, mediation, Conciliation.	2
Total		36 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Compare and contrast the roles of the employer and contractor in a construction project.
2. Describe the significance of legal literacy in construction projects? Provide examples.

Course Outcome 2 (CO 2):

1. How does the Indian Contract Act, 1872 apply to construction contracts? Provide examples of its relevance?
2. How does RERA protect the interests of homebuyers in real estate projects? What are its implications for developers and contractors?

Course Outcome 3 (CO 3):

1. Elucidate the key factors to consider during the prequalification process in a tender? How can a contractor ensure they meet the eligibility criteria?
2. Explain the implications of a Letter of Intent versus a Contract Award? How can contractors ensure they are not bound by unintended commitments?

Course Outcome 4 (CO 4):

1. Describe the essential elements of a valid construction contract? How can contractors ensure that their contracts are enforceable?
2. How can contractors ensure that their contracts allocate risks effectively between parties? Provide examples of risk allocation clauses.

Course Outcome 5 (CO 5):

1. Explain the benefits of using alternative dispute resolution techniques in construction disputes? How can they be incorporated into contracts?
2. Compare and contrast negotiation, mediation, and arbitration as dispute resolution techniques. When is each most effective?

MODEL QUESTION PAPER

QP CODE:

Pages: 3

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

SIXTH SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CE3P22

ENGINEERING LAW

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Explain the significance of legal literacy in construction practice with an example.
2. Describe the contractor's role and key responsibilities in a construction project.
3. Elucidate the key provisions of the Indian Contract Act, 1872 relevant to construction contracts? Explain with examples.
4. How does RERA protect homebuyers' interests? What are its implications for developers?
5. Explain the technical and financial eligibility criteria in a tender's prequalification process with examples.
6. Differentiate between a Letter of Intent and a Contract Award, and their legal implications.
7. Explain the essentials of a valid contract, focusing on offer, acceptance, and consideration.
8. Describe the significance of the "Time is of the Essence" clause in construction contracts and its impact on project execution.
9. Explain the key steps in tender receipt and evaluation, and the importance of a comparative statement.
10. Describe the purpose and benefits of a Performance Bank Guarantee in contract administration.

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. Analyze the roles and responsibilities of the employer, engineer, and contractor in a construction project. How do their roles impact the project's success? (14)

OR

12. a) Discuss the importance of understanding the Indian legal system in construction practice. (7)
b) Explain the evolution of construction law in India. How have economic reforms and technological advancements influenced construction law? (7)

MODULE 2

13. Discuss the legal implications of site safety, cheating, negligence, and misrepresentation in construction projects. How can parties ensure compliance with relevant laws and regulations? (14)

OR

14. a) Discuss the relevance of the Indian Contract Act, 1872 to construction contracts. How does it impact the rights and obligations of parties involved? (7)
b) Explain the scope and coverage of RERA. How does it regulate real estate projects and protect homebuyers? (7)

MODULE 3

15. Discuss the prequalification process, including legal basis, eligibility criteria, transparency, and accountability. (14)

OR

16. Analyse key legal issues in tendering including misrepresentation, fraud, estoppel, warranty, confidentiality. What are the implications of Letter of Intent versus Contract Award? (14)

MODULE 4

17. Discuss the essentials of a valid contract such as offer, acceptance, consideration, capacity, free consent and their application in construction contracts. (14)

OR

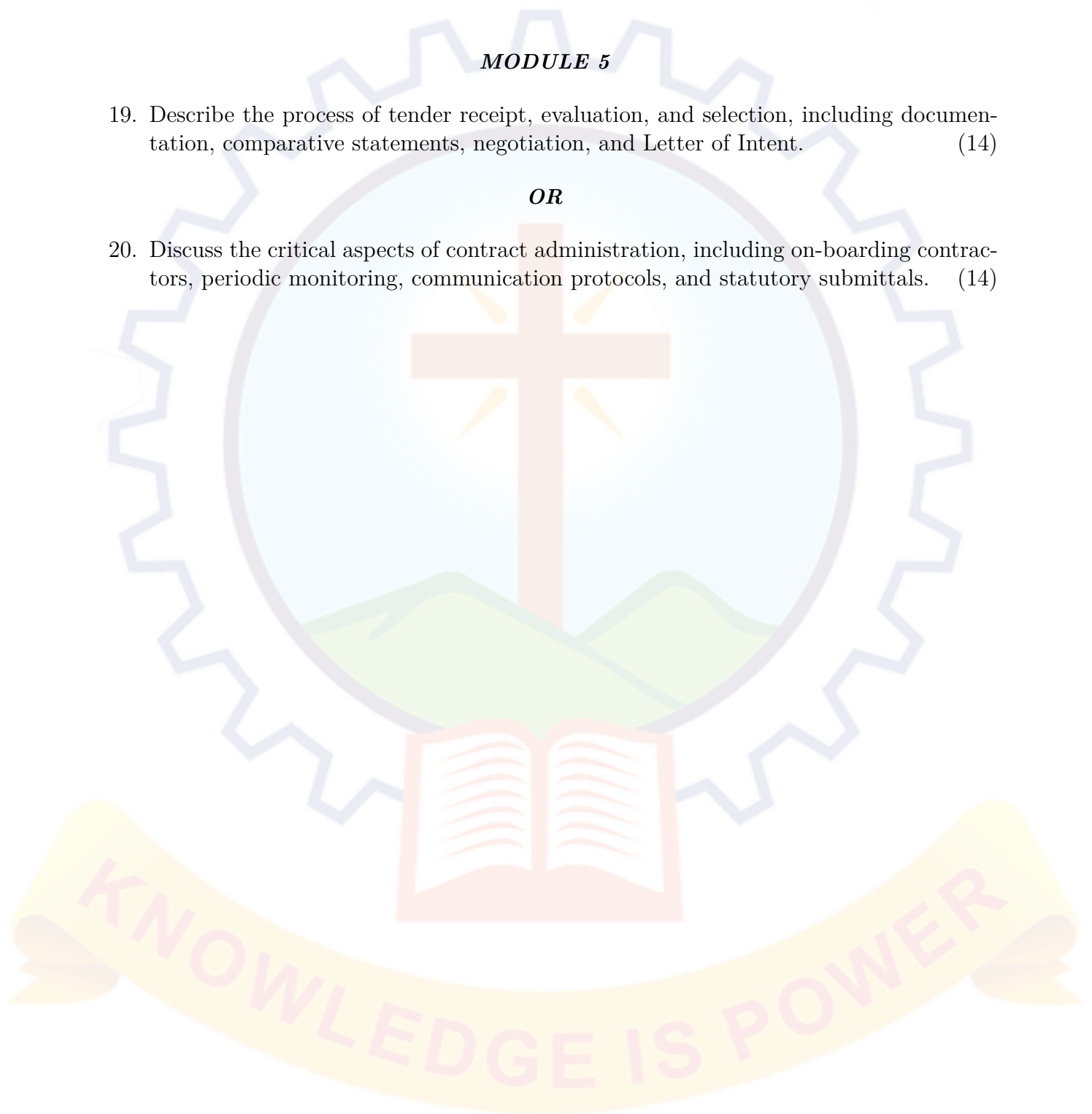
18. Explain the different types of construction contracts, such as Item Rate, Lump Sum, EPP (Engineering Procurement and Construction), BOT (Build Operate Transfer), PPP (Public-Private Partnership), Design-Build and their characteristics. (14)

MODULE 5

19. Describe the process of tender receipt, evaluation, and selection, including documentation, comparative statements, negotiation, and Letter of Intent. (14)

OR

20. Discuss the critical aspects of contract administration, including on-boarding contractors, periodic monitoring, communication protocols, and statutory submittals. (14)



CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE3P23	SOLID AND LIQUID WASTE MANAGEMENT	2	1	0	4	3	2024

Preamble

The course focuses on the principles, methods, and technologies involved in the collection, treatment, and disposal of solid and liquid wastes. It emphasizes sustainable waste management practices to minimize environmental pollution and promote resource recovery. The course also provides insights into regulatory frameworks, waste management systems, and emerging approaches for effective waste minimization and reuse.

Prerequisites: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Understand the sources, types, and characteristics of solid and liquid wastes and their impacts on the environment. (Cognitive Knowledge Level: Understand)
CO 2	Explain the methods of collection, segregation, storage, and transportation of solid wastes used in urban and rural areas. (Cognitive Knowledge Level: Apply)
CO 3	Describe and apply various techniques for processing and treatment of solid wastes including composting, incineration, and energy recovery. (Cognitive Knowledge Level: Apply)
CO 4	Explain the design and operational aspects of sanitary landfills and liquid waste treatment systems. (Cognitive Knowledge Level: Apply)
CO 5	Identify and evaluate sustainable waste management practices, including resource recovery, recycling, and case studies of integrated waste management systems. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	1				1					1
CO 2	3	1				1					1
CO 3	3	1				1					1
CO 4	3	1				1					1
CO 5	3	1				1					1

Assessment Pattern

Solid and Liquid Waste Management			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	40	40	40
Understand	40	40	40
Apply	20	20	20
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 10 marks
Self Study	: 5 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contains 10 questions carrying 3 marks each. Part B contains 2 questions from each module out of which anyone is to be answered. Each question carries 14 marks and can have maximum 2 sub-divisions.

SYLLABUS

Module 1: Introduction to Solid and Liquid Waste (8 hours)

Definition and classification of solid waste – municipal, industrial, hazardous, biomedical, and e-waste; sources and characteristics of solid waste; definition and types of liquid waste – domestic sewage, industrial effluent, leachate; factors affecting waste generation rates; impacts of improper waste disposal on health and environment; overview of waste management hierarchy; legislative framework in India – Solid Waste Management Rules 2016, Plastic Waste Management Rules, Hazardous Waste Rules, Bio-Medical Waste Rules, and relevant CPCB guidelines.

Module 2: Solid Waste Collection, Transportation, and Processing (8 hours)

Waste storage at source; primary and secondary collection systems; transportation methods and routing; transfer stations – design and operation; processing techniques – segregation, compaction, shredding, baling; material recovery facilities; recycling and reuse methods; composting and bio methanation; case studies on successful segregation and collection systems in Indian cities such as Indore and Pune.

Module 3: Solid Waste Treatment and Disposal (6 Hours)

Biological treatment methods – aerobic and anaerobic digestion; thermal treatment – incineration, pyrolysis, gasification; sanitary landfill design – site selection, liners, leachate and gas management, post-closure care; hazardous waste treatment and secured landfilling; integrated solid waste management approach; case studies – Okhla waste-to-energy plant, sanitary landfill at Ghazipur, and composting facility at Mysuru.

Module 4: Liquid Waste Management (6 Hours)

Sources and characteristics of domestic and industrial wastewater; wastewater sampling and analysis; primary, secondary, and tertiary treatment processes – sedimentation, activated sludge process, trickling filters, UASB reactors, membrane processes; industrial wastewater treatment approaches – physico-chemical and biological methods; sludge treatment and disposal; case studies – Common Effluent Treatment Plants (CETPs) in Gujarat, wastewater reuse in Tirupur textile industry.

Module 5: Sustainable Practices and Emerging Technologies (8 Hours)

Zero waste and circular economy concepts; waste minimization techniques; energy recovery from waste; decentralized treatment systems; emerging technologies – anaerobic membrane bioreactors, plasma arc gasification, advanced composting; digital solutions in waste man-

agement – GIS mapping, IoT-based bins, and tracking systems; public participation and awareness programs; case studies – decentralized solid waste management in Alappuzha, industrial symbiosis in Kalundborg (Denmark), and India's Swachh Bharat Mission best practices.

Text Books:

1. Tchobanoglous, G., Kreith, F., Handbook of Solid Waste Management, 2nd Ed., McGraw-Hill, 2002.
2. Tchobanoglous, G., Theisen, H., Vigil, S., Integrated Solid Waste Management: Engineering Principles and Management Issues, 2nd Ed., McGraw-Hill, 2002.
3. Peavy, H.S., Rowe, D.R., Tchobanoglous, G., Environmental Engineering, McGraw-Hill, updated reprint 2013 (for SLWM fundamentals).
4. Qasim, S.R., Chiang, W., Sanitary Landfill Leachate: Generation, Control and Treatment, CRC Press, 2017.
5. Khatib, I., Sustainable Management of Waste and Recycling, Springer, 2016.

References:

1. UNEP, Solid Waste Management, Volume I–IV, United Nations Environment Programme, updated 2016.
2. CPCB, Guidelines for Solid Waste Management, Central Pollution Control Board, New Delhi, 2016.
3. Government of India, Solid Waste Management Rules, Ministry of Environment, Forest and Climate Change, 2016 (with amendments up to 2022).
4. Metcalf & Eddy, Wastewater Engineering: Treatment and Resource Recovery, 5th Ed., McGraw-Hill, 2014.
5. Vesilind, P.A., Wastewater Treatment Plant Design, IWA Publishing, 2003.
6. WHO, Safe Management of Wastes from Health-Care Activities, 2nd Ed., World Health Organization, 2014.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	8 hours
1.1	Definition and classification of solid waste – municipal, industrial, hazardous, biomedical, and e-waste; sources and characteristics of solid waste	2
1.2	Definition and types of liquid waste – domestic sewage, industrial effluent, leachate; factors affecting waste generation rates; impacts of improper waste disposal on health and environment	3
1.3	Overview of waste management hierarchy; legislative framework in India – Solid Waste Management Rules 2016, Plastic Waste Management Rules, Hazardous Waste Rules, Bio-Medical Waste Rules, and relevant CPCB guidelines	3
2	Module 2	8 hours
2.1	Waste storage at source; primary and secondary collection systems; transportation methods and routing; transfer stations – design and operation	3
2.2	Processing techniques – segregation, compaction, shredding, baling; material recovery facilities; recycling and reuse methods; composting and bio methanation	3
2.3	Case studies on successful segregation and collection systems in Indian cities such as Indore and Pune	2
3	Module 3	6 hours
3.1	Biological treatment methods – aerobic and anaerobic digestion; thermal treatment – incineration, pyrolysis, gasification	2
3.2	Sanitary landfill design – site selection, liners, leachate and gas management, post-closure care; hazardous waste treatment and secured landfilling	2

3.3	Integrated solid waste management approach; case studies – Okhla waste-to-energy plant, sanitary landfill at Ghazipur, and composting facility at Mysuru	2
4	Module 4	6 hours
4.1	Sources and characteristics of domestic and industrial wastewater; wastewater sampling and analysis; primary, secondary-treatment processes	2
4.2	Tertiary treatment processes – sedimentation, activated sludge process, trickling filters, UASB reactors, membrane processes; Industrial wastewater treatment approaches – physico-chemical and biological methods; sludge treatment and disposal	2
4.3	Case studies – Common Effluent Treatment Plants (CETPs) in Gujarat, wastewater reuse in Tirupur textile industry	2
5	Module 5	8 hours
5.1	Zero waste and circular economy concepts; waste minimization techniques; energy recovery from waste; decentralized treatment systems	2
5.2	Emerging technologies – anaerobic membrane bioreactors, plasma arc gasification, advanced composting;	2
5.3	Digital solutions in waste management – GIS mapping, IoT-based bins, and tracking systems; public participation and awareness programs;	2
5.4	Case studies – decentralized solid waste management in Alappuzha, industrial symbiosis in Kalundborg (Denmark), and India's Swachh Bharat Mission best practices.	2
Total		36 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Define solid waste and explain its various sources.
2. What are the characteristics of municipal solid waste?
3. Discuss the environmental and health impacts caused by improper waste disposal.

Course Outcome 2 (CO 2):

1. Explain the methods of collection and segregation of solid waste in urban areas.
2. Describe the various systems of waste storage and transfer used in municipalities.
3. What are the factors influencing the selection of vehicles for solid waste transportation?

Course Outcome 3 (CO 3):

1. Explain the process of composting and list its advantages.
2. Differentiate between incineration and pyrolysis.
3. Describe the steps involved in energy recovery from solid waste.

Course Outcome 4 (CO 4):

1. Explain the design considerations of a sanitary landfill.
2. What are the major steps involved in the treatment of liquid waste?
3. Describe the operational problems associated with landfilling and leachate control.

Course Outcome 5 (CO 5):

1. Explain the concept of the 3Rs (Reduce, Reuse, Recycle) in waste management.
2. Describe the role of public participation in sustainable waste management.
3. Discuss a case study of an integrated solid waste management system in India.

MODEL QUESTION PAPER

QP CODE:

Pages: 2

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

SIXTH SEMESTER B TECH DEGREE EXAMINATION, MONTH YEAR

Course Code: B24CE3P23

SOLID AND LIQUID WASTE MANAGEMENT

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Define solid waste and list any four major sources of solid waste.
2. What are the main objectives of solid and liquid waste management?
3. Differentiate between primary and secondary collection of solid waste.
4. What are the important factors affecting the frequency of waste collection?
5. What is composting? Mention any two factors affecting the composting process.
6. Write a short note on the advantages of incineration.
7. What is a sanitary landfill? How is it different from an open dump?
8. List the main steps involved in liquid waste (sewage) treatment.
9. What is meant by integrated solid waste management?
10. Explain the importance of public awareness and participation in sustainable waste management.

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. a) Define solid waste and classify it based on its source and characteristics. (6)
b) Discuss the major environmental and public health impacts of improper waste management. (8)

OR

12. Explain the functional elements of solid waste management with a neat schematic diagram. (14)

MODULE 2

13. a) Describe the methods used for the collection and storage of solid waste in urban areas. (8)
b) What are the key considerations in designing a waste collection route? (6)

OR

14. Explain the systems of waste transportation and the types of vehicles used. Discuss the factors affecting their selection. (14)

MODULE 3

15. a) Describe the process of composting and factors influencing it. (7)
b) Compare incineration and pyrolysis in terms of process, efficiency, and by-products. (7)

OR

16. Explain the methods of energy recovery from municipal solid waste with suitable flow diagrams. (14)

MODULE 4

17. a) Explain the design features and operational steps of a sanitary landfill. (8)
b) What are the environmental problems associated with leachate generation and control? (6)

OR

18. Describe the various stages of liquid waste (sewage) treatment with a flow diagram and explain the role of each stage. (14)

MODULE 5

19. a) Explain the concept of integrated solid waste management. (7)
b) Discuss the significance of the 3Rs (Reduce, Reuse, Recycle) in sustainable waste management. (7)

OR

20. Present a case study of a successful solid waste management system in an Indian city. Highlight the technologies adopted and lessons learned. (14)

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE3P24	GROUND IMPROVEMENT TECHNIQUES	2	1	0	4	3	2024

Preamble

The course introduces various ground improvement techniques essential for enhancing the engineering behavior of weak and problematic soils. It covers mechanical, hydraulic, chemical, and reinforcement-based methods for improving strength, stability, and settlement characteristics. The course aims to build the ability to select and apply appropriate ground improvement techniques for sustainable geotechnical engineering solutions.

Prerequisites: Soil Mechanics.

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Identify the need, scope, and classification of ground improvement methods and recognize different types of problematic soils requiring treatment. (Cognitive level: Understand)
CO 2	Describe various mechanical stabilization methods and apply compaction, vibro-compaction, and preloading techniques to enhance soil strength and reduce settlement.(Cognitive level: Understand)
CO 3	Interpret the principles of dewatering, vertical drain, and electro-osmosis techniques and apply suitable hydraulic methods for improving soft and fine-grained soils. (Cognitive level: Apply)
CO 4	Describe chemical stabilization and grouting processes and select appropriate stabilizers or grouting materials for practical soil improvement applications. (Cognitive level: Apply)
CO 5	Apply soil reinforcement methods using geosynthetics, soil nails, and thermal techniques for stabilization and ground strengthening works. (Cognitive level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	2	1	1	1	1	1	-	-	-	-
CO 2	3	3	2	2	2	-	1	-	-	-	-
CO 3	3	3	2	2	2	1	2	-	-	-	-
CO 4	3	2	3	2	2	-	2	1	-	-	-
CO 5	3	3	3	2	3	1	2	1	2	1	2

Assessment Pattern

GROUND IMPROVEMENT TECHNIQUES			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	20	20	20
Understand	40	40	30
Apply	40	40	50
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course project : 10 marks

Self Study : 5 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question carries 14 marks and can have maximum 2 sub-divisions.

SYLLABUS

Module 1: Introduction to Ground Improvement Techniques (7 hours)

Overview and Need for Ground Improvement: Definition and scope of ground improvement. Situations requiring ground improvement (weak soils, high settlement areas). Classification of ground improvement techniques.

Soil Properties and Their Improvement: Soil types and problematic soils (soft clays, loose sands, expansive soils). Influence of soil properties on ground improvement methods.

Concepts of Load Transfer and Soil Reinforcement: Basic principles of soil reinforcement. Factors influencing load transfer mechanisms in improved soils.

Module 2: Mechanical Stabilization Techniques (8 hours)

Compaction Methods: Shallow compaction (roller compaction, dynamic compaction). Deep compaction techniques (vibro-compaction, dynamic deep compaction). Impact of compaction on soil properties (density, shear strength, permeability).

Vibro-Compaction and Vibro-Replacement: Principles and applications of vibro-compaction for granular soils. Vibro-replacement (stone columns) in soft and loose soils. Equipment and design considerations for vibro methods.

Preloading and Surcharging: Mechanism and process of preloading with or without vertical drains. Reduction of settlement and improvement of soft soils.

Module 3: Hydraulic Modification Techniques (7 Hours)

Dewatering Techniques: Well point systems, deep wells, and vacuum dewatering. Applications in construction and infrastructure projects. Effect on soil properties and stability.

Vertical Drains and Prefabricated Vertical Drains (PVDs): Principles of vertical drains for soil consolidation. Design and installation of PVDs. Applications in soft clay and peat soil improvement.

Electro-Osmosis and Electro-Kinetic Stabilization: Mechanism of electro-osmosis for dewatering. Applications in fine-grained soils and slope stability. Advantages and limitations of electro-kinetic methods.

Module 4: Chemical Stabilization and Grouting Techniques (7 Hours)

Chemical Stabilization of Soils: Principles and types of chemical stabilizers (lime, cement, fly ash, polymers). Mechanisms of soil-cement and soil-lime reactions. Applications in expansive soils and road construction.

Grouting Techniques: Types of grouting: permeation grouting, jet grouting, compaction

grouting. Materials used in grouting (cement, chemical, and clay-based grouts). Applications in foundation strengthening and leak prevention.

Soil Stabilization with Geopolymers: Introduction to geopolymers for ground improvement. Environmental benefits of using geopolymers. Case studies of geopolymer applications in soil stabilization.

Module 5: Reinforcement Techniques and Special Methods

(7 Hours)

Soil Reinforcement with Geosynthetics: Types of geosynthetics (geotextiles, geogrids, geomembranes, geocells). Functions of geosynthetics in soil reinforcement, separation, and drainage. Applications in embankments, retaining walls, and road construction.

Soil Nailing and Micro-Piles: Concepts of soil nailing for slope stabilization and excavation support. Design and installation of soil nails and micro-piles. Applications in retaining structures and slope reinforcement.

Ground Improvement Using Thermal Methods: Introduction to thermal stabilization techniques. Applications in frost heave prevention and soil strengthening. Case studies of thermal soil treatment methods.

Text Books:

1. Hausmann, M. R. (1990). *Engineering Principles of Ground Modification*. McGraw-Hill.
2. Purushothama Raj, P. (2015). *Ground Improvement Techniques* (2nd ed.). Laxmi Publications.
3. Koerner, R. M. (2012). *Designing with Geosynthetics* (6th ed.). Xlibris Corporation.

References:

1. Das, B. M., & Sobhan, K. (2018). *Principles of Geotechnical Engineering* (9th ed.). Cengage Learning.
2. Moseley, M. P., & Kirsch, K. (2004). *Ground Improvement* (2nd ed.). Spon Press.
3. Sharma, S. K. (2017). *Soil Mechanics and Foundation Engineering*. CBS Publishers & Distributors.
4. Bowles, J. E. (1996). *Foundation Analysis and Design* (5th ed.). McGraw-Hill.
5. Bell, F. G. (1993). *Engineering Treatment of Soils*. E & FN Spon.
6. Chu, J., Indraratna, B., & Rujikiatkamjorn, C. (2016). *Ground Improvement Case Histories: Embankments with Special Reference to Consolidation and Other Physical Methods*. Butterworth-Heinemann.
7. Mitchell, J. K., & Santamarina, J. C. (2005). Biological Considerations in Geotechnical Engineering. *Journal of Geotechnical and Geoenvironmental Engineering, ASCE*.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	MODULE 1	7 hours
1.1	Definition and scope of ground improvement. Situations requiring ground improvement (weak soils, high settlement areas).	1
1.2	Classification of ground improvement techniques	2
1.3	Soil types and problematic soils (soft clays, loose sands, expansive soils).	1
1.4	Influence of soil properties on ground improvement methods	1
1.5	Basic principles of soil reinforcement. Factors influencing load transfer mechanisms in improved soils	2
2	MODULE 2	8 hours
2.1	Shallow compaction (roller compaction, dynamic compaction).	1
2.2	Deep compaction techniques (vibro-compaction, dynamic deep compaction).	1
2.3	Impact of compaction on soil properties (density, shear strength, permeability)	1
2.4	Principles and applications of vibro-compaction for granular soils.	1
2.5	Vibro-replacement (stone columns) in soft and loose soils. Equipment and design considerations for vibro methods	2
2.6	Mechanism and process of preloading with or without vertical drains. Reduction of settlement and improvement of soft soils	2
3	MODULE 3	7 hours
3.1	Well point systems, deep wells, and vacuum dewatering. Applications in construction and infrastructure projects. Effect on soil properties and stability	2

3.2	Principles of vertical drains for soil consolidation. Design and installation of PVDs.	1
3.3	Applications in soft clay and peat soil improvement.	1
3.4	Mechanism of electro-osmosis for dewatering. Applications in fine-grained soils and slope stability.	2
3.5	Advantages and limitations of electro-kinetic methods	1
4	MODULE 4	7 hours
4.1	Principles and types of chemical stabilizers (lime, cement, fly ash, polymers).	1
4.2	Mechanisms of soil-cement and soil-lime reactions. Applications in expansive soils and road construction	2
4.3	Types of grouting: permeation grouting, jet grouting, compaction grouting.	1
4.4	Materials used in grouting (cement, chemical, and clay-based grouts). Applications in foundation strengthening and leak prevention.	1
4.5	Introduction to geopolymers for ground improvement. Environmental benefits of using geopolymers.	1
4.6	Case studies of geopolymer applications in soil stabilization	1
5	MODULE 5	7 hours
5.1	Types of geosynthetics (geotextiles, geogrids, geomembranes, geocells). Functions of geosynthetics in soil reinforcement, separation, and drainage.	1
5.2	Applications in embankments, retaining walls, and road construction	1
5.3	Concepts of soil nailing for slope stabilization and excavation support. Design and installation of soil nails and micro-piles.	2
5.4	Applications in retaining structures and slope reinforcement	1
5.5	Introduction to thermal stabilization techniques. Applications in frost heave prevention and soil strengthening.	1

5.6	Case studies of thermal soil treatment methods	1
Total		36 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Define ground improvement and list situations where ground improvement techniques are essential.
2. Select suitable ground improvement methods for soft clay and expansive soil conditions and justify your choice based on soil behavior.

Course Outcome 2 (CO 2):

1. Describe the differences between shallow and deep compaction techniques and their influence on soil properties.
2. Given a site with loose sandy soil, suggest an appropriate mechanical stabilization method and explain the expected improvement in soil performance.

Course Outcome 3 (CO 3):

1. State the principle of prefabricated vertical drains (PVDs) and their role in accelerating soil consolidation.
2. For a soft clay foundation with high moisture content, recommend a suitable hydraulic modification technique and outline the steps involved in its implementation.

Course Outcome 4 (CO 4):

1. List the commonly used chemical stabilizers and describe the mechanism of soil-lime reaction in improving soil strength.
2. Propose an appropriate grouting method for strengthening a weak foundation soil beneath an existing structure and justify your selection.

Course Outcome 5 (CO 5):

1. Explain the primary functions of geosynthetics in soil reinforcement and separation applications.
2. Suggest a suitable ground improvement technique for stabilizing a steep slope and justify its suitability in terms of safety and economy.

MODEL QUESTION PAPER

QP CODE:

Pages: 3

Reg.No.:

Name:

**MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM**

SIXTH SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CE3P24

GROUND IMPROVEMENT TECHNIQUES

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Define ground improvement and mention any two situations where it becomes necessary.
2. Differentiate between soft clay and loose sand in terms of their influence on ground improvement methods.
3. List the various types of compaction techniques used in ground improvement.
4. Describe how preloading reduces settlement in soft soil deposits.
5. What is dewatering and list two methods commonly used in construction projects.
6. Summarize the mechanism of electro-osmosis in improving fine-grained soils.
7. Briefly explain any three chemical stabilizers used for improving weak soils.
8. Explain the mechanism of lime stabilization in clayey soils.
9. Identify the main functions of geosynthetics in reinforced soil structures.
10. Enumerate the basic concept of soil nailing and its application in slope stabilization.

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. a) Explain the classification of ground improvement techniques with suitable examples. (7)
b) For a site having weak clayey soil with high settlement, suggest a suitable ground improvement technique and justify your choice. (7)

OR

12. a) Evaluate how soil reinforcement improves load transfer mechanisms in granular soils. (7)
b) Analyze the role of soil properties such as permeability and compressibility in selecting ground improvement methods. (7)

MODULE 2

13. a) Explain the working principle and applications of vibro-compaction and vibro-replacement methods. (7)
b) Select a suitable mechanical stabilization method for loose sand at shallow depth and justify your selection. (7)

OR

14. a) Design a preloading scheme (with or without vertical drains) for improving soft soil at a construction site. (7)
b) Analyze the influence of compaction energy on the density and shear strength of soils. (7)

MODULE 3

15. a) Explain the design and installation procedure of prefabricated vertical drains (PVDs). (7)
b) Propose an appropriate hydraulic modification technique for a foundation area affected by high groundwater and justify your selection. (7)

OR

16. a) Compare the performance of deep well and vacuum dewatering systems for different soil conditions. (7)
b) Explain the effect of hydraulic modification on soil strength and stability during construction. (7)

MODULE 4

17. a) Enumerate the different types of grouting techniques and their suitable field applications. (7)
- b) Recommend a chemical stabilization method for expansive soil under a pavement and justify your choice. (7)

OR

18. a) Analyze how the use of geopolymers contributes to sustainable soil stabilization. (7)
- b) Assess the suitability of jet grouting over permeation grouting for controlling seepage below dam foundations. (7)

MODULE 5

19. a) Explain the types and functions of geosynthetics used in soil reinforcement systems. (7)
- b) Propose a suitable reinforcement technique for stabilizing an embankment on soft ground and justify your design approach. (7)

OR

20. a) Evaluate the applicability of thermal methods for improving soil properties in cold regions. (7)
- b) Analyze the performance and advantages of soil nailing compared to conventional retaining structures. (7)

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE3P25	PRESTRESSED CONCRETE	2	1	0	4	3	2024

Preamble

This is a comprehensive course on prestressed concrete design. Prestressed concrete is a fascinating field that offers structural engineers a powerful tool for creating efficient and durable structures. By introducing students to the engineering aspects, principles, and design standards, this course equips them with the knowledge and skills needed to design various types of prestressed concrete members. Additionally, the inclusion of composite member design broadens student's perspectives, highlighting the versatility of prestressed concrete in combination with other materials.

Prerequisites: Engineering Mechanics, Mechanics of Solids

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Understand the basic aspects of prestressed concrete structures and analyze the stresses. (Cognitive knowledge level: Understand, Apply)
CO 2	Analyse the losses and deflections in prestressed concrete systems. (Cognitive level: Analyse)
CO 3	Analyse and design prestressed concrete structural sections subjected to flexural and shear forces. (Cognitive level: Apply)
CO 4	Analyse the transfer of prestress in pretensioned members and design the anchorage zones of prestressed concrete elements. (Cognitive level: Analyse)
CO 5	Understand the concepts of statically indeterminate prestressed concrete beams to adopt suitable cable profiles. (Cognitive level: Understand)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	3	2	1	2		1	1	2	1	1
CO 2	3	3	2	2	2		1	1	2	2	1
CO 3	3	3	2	2	3			1	2	2	1
CO 4	3	3	3	2	2	1	1	1	2	2	2
CO 5	3	3	2	2	3	1	1	1	2	2	1

Assessment Pattern

Structural Forensic Analysis			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	10	10	10
Understand	40	40	40
Apply	50	40	40
Analyse		10	10
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 10 marks
Self Study	: 5 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contain 10 questions carrying 3 marks each. Part B contains 2 questions from each module out of which 1 to be answered. Each question carries 14 marks and can have a maximum of 2 sub - divisions.

SYLLABUS

Module 1: Basic concept and principles of pre-stressed concrete (8 hours)

Prestressing - Pre tensioning and Post tensioning, Thermo elastic and Chemical prestressing. Need of high strength concrete and steel, Advantages of prestressed concrete over reinforced concrete, Different prestressing systems.

Analysis of prestress and bending stress - Stress concept, Strength concept - Pressure line and internal resisting couple and Load balancing concept for extreme fiber stresses for various tendon profile.

Module 2: Losses of Prestress (7 hours)

Stages of losses, Types of losses in pre-tensioning and post-tensioning due to Elastic shortening, Shrinkage, Creep, Relaxation, Anchorage Slip, Friction and Sudden changes in temperature; Loss of pre-stress Stresses at transfer and service loads.

Deflections of prestressed concrete members-Importance, factors, short term and long term deflection (Concept only). Codal provisions.

Module 3: Flexural strength and Shear Resistance of PSC members (7 Hours)

Codal provision for Limit state design. Design of rectangular sections for flexure: - Expressions for minimum section modulus, Prestressing force, and Eccentricity. Limiting zone for prestressing force.

Shear Resistance of PSC members- Shear and Principal stresses, Ultimate shear resistance of PSC members - Design for shear using IS code.

Module 4: Transfer of Prestress in Pretensioned members (7 Hours)

Transmission length, Bond stresses, Transverse Tensile Stresses, End-Zone reinforcement, Flexural bond stresses, Code Provisions.

Anchorage zone Stresses in post tensioned members- Stress distribution in end block, Methods of investigation, Anchorage zone reinforcements, Design (IS Code method only).

Module 5: Prestressing of statically indeterminate structures (concepts only) (7 Hours)

Advantages, Effect, Method of achieving continuity, Primary, Secondary and Resultant moments, Pressure line, Concept of Linear transformation, Guyon's theorem, Concordant cable profile and its determination.

Composite sections and PSC slabs (Concepts only)- Introduction to composite construction, PSC slabs- PSC One-way and two- way slabs (concept only)

Text Books:

1. Krishna Raju N., “Prestressed concrete”, 5th Edition, Tata McGraw Hill Company New Delhi, 2012.
2. Pandit.G.S. and Gupta.S.P., “Prestressed Concrete”, CBS Publishers and Distributors Pvt. Ltd, 2012.
3. Rajagopalan.N, “Prestressed Concrete”, Narosa Publishing House, 2002.
4. Nagarajan, P., Prestressed Concrete Design, Pearson 2013.
5. IS 1343:2012, Code of Practice for Prestressed Concrete, Bureau of Indian Standards, New Delhi, 2012.
6. IS 3370- Part 3 (1967) (Reaffirmed – 2008) Indian standard Code of practice for concrete structures for the storage of liquids, Bureau of Indian Standards, New Delhi, 2008.
7. IS 3370- Part 4 (2008) Indian standard Code of practice for concrete structures for the storage of liquid- Design tables, Bureau of Indian standards, New Delhi.

References:

1. Dayaratnam.P., “Prestressed Concrete Structures”, Oxford and IBH, 2013 .
2. Lin T.Y. and Ned.H.Burns, “Design of prestressed Concrete Structures”, Third Edition, Wiley India Pvt. Ltd., New Delhi, 2013.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	8 hours
1.1	Basic concept and principles of pre-stressed concrete; Prestressing: Pre tensioning and Post tensioning, Thermo elastic and Chemical prestressing	1
1.2	Need of high strength concrete and steel, Advantages of prestressed concrete over reinforced concrete, Different prestressing systems	1
1.3	Analysis of prestress and bending stress- Stress concept	2
1.4	Strength concept - Pressure line and internal resisting couple	2
1.5	Load balancing concept for extreme fiber stresses for various tendon profile	2
2	Module 2	7 hours
2.1	Losses of Prestress: Stages of losses, Types of losses in pre-tensioning and post-tensioning due to Elastic shortening, Shrinkage, Creep, Relaxation, Anchorage Slip, Friction and Sudden changes in temperature; Loss of pre-stress Stresses at transfer and service loads	4
2.2	Deflections of prestressed concrete members: Importance, factors, short term and long term deflection. Codal provisions	3
3	Module 3	7 hours
3.1	Flexural strength - Codal provision for Limit state design	2
3.2	Design of rectangular sections for flexure: - Expressions for minimum section modulus, Prestressing force, and Eccentricity. Limiting zone for prestressing force	3
3.3	Shear Resistance of PSC members - Shear and Principal stresses, Ultimate shear resistance of PSC members - Design for shear using IS code	2

4	Module 4	7 hours
4.1	Transfer of Prestress in Pretensioned members: Transmission length, Bond stresses, Transverse Tensile Stresses	2
4.2	End-Zone reinforcement, Flexural bond stresses, Code Provisions	1
4.3	Anchorage zone : Stresses in post tensioned members: Stress distribution in end block, Methods of investigation	2
4.4	Anchorage zone reinforcements, Design (IS Code method only)	2
5	Module 5	7 hours
5.1	Prestressing of statically indeterminate structures: Advantages, Effect, Method of achieving continuity	2
5.2	Primary, Secondary and Resultant moments, Concept of Linear transformation, Guyon's theorem, Concordant cable profile (Concepts only)	3
5.3	Composite sections and PSC slabs: Introduction to composite construction, PSC slabs- PSC One-way and two-way slabs (concept only)	2
Total		36 Hours

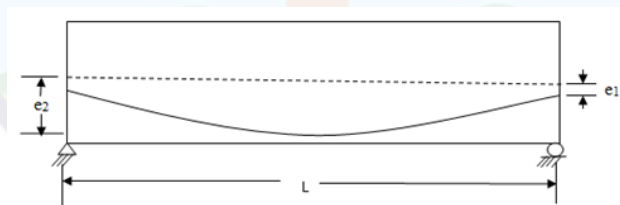
CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Two identical beams loaded with live load and dead load is prestressed with straight tendons. Both beams are having same eccentricity but first one is having a positive eccentricity and the second one is with a negative eccentricity. Which beam will deflect more? Provide a valid argument for full credit.
2. A 6 m span prestressed concrete beam is 400×600 mm. The cable with 50 mm eccentricity at the supports and linearly varying to 100 mm at the center is prestressed with an effective force of 1000 kN. The beam is subjected to a point load of 200 kN at the centre. The unit weight of concrete is 25 kN/m^3 . Sketch the stress distribution for the end section and mid span section.
3. A rectangular beam section 300 mm wide and 700 mm deep is prestressed by 7 mm diameter high strength wires of 20 numbers, whose centre of gravity is located at 250 mm above the soffit of the beam. If the effective prestress in the wires is 750 N/mm^2 , what is the maximum total bending moment that can be applied on the section without causing any tension at the soffit of the beam?

Course Outcome 2 (CO 2):

1. Elaborate on different type of losses in a post-tensioned beams.
2. Obtain the expression for deflection for a tendon profile shown in Figure.



3. A prestressed concrete beam of width 200 mm and depth 300 mm is prestressed with 300 mm^2 of steel located at an eccentricity 75 mm. The wires are initially tensioned to 1000 kN. The span of the beam is 12 m. Calculate the percentage loss of stress in wires if, (a) the beam is pretensioned (b) the beam is post-tensioned. Relaxation of steel is 5% of initial stress, shrinkage of concrete is 300×10^{-6} for pretensioning and 200×10^{-6} for post-tensioning, creep coefficient = 1.6, slip at anchorage = 1 mm, $E_s = 210 \text{ kN/mm}^2$ and $E_c = 31.5 \text{ kN/mm}^2$. Frictional coefficient for wave effect is 0.0015/m.

Course Outcome 3 (CO 3):

1. Explain with sketches the IS:1343 code method of computing the moment of resistance of rectangular sections.
2. A pretensioned prestressed concrete beam having a rectangular section 150 mm wide and 340 mm deep has an effective cover of 50 mm. Given:

$$f_{ck} = 40 \text{ N/mm}^2, \quad f_p = 1600 \text{ N/mm}^2, \quad A_p = 461 \text{ mm}^2, \quad f_{pe} = 0.8f_p$$

Calculate the ultimate flexural strength of the section using IS:1343 provisions.

3. A pretensioned beam of rectangular section 400 mm wide and 600 mm overall depth is stressed by 1700 mm² of high tensile steel wires located 100 mm from the soffit of the section. If $f_{ck} = 50 \text{ N/mm}^2$, and $f_p = 1600 \text{ N/mm}^2$, estimate the flexural strength of the section using Indian standard code. Assume the effective prestress after all losses as 960 N/mm².

Course Outcome 4 (CO 4):

1. Explain the importance of anchorage zone in prestressed members.
2. Consideration of transmission length and development length in post tensioned member is meaningless. Justify. Also explain the nature of stresses developed in anchorage of post tensioned member.
3. The end block of a post-tensioned prestressed member is 600 mm x 600 mm. Four cables, each made of 7 ply 8 mm dia strands and carrying a force of 1200 kN are anchored by a plate anchorage of 170 mm x 170 mm, located with their centres at 125 mm from the edge of the end block. Adopt M40 concrete yield strength of untensioned steel reinforcement is 250 N/mm². Design suitable anchorages and the end block with necessary reinforcement. Sketch details.

Course Outcome 5 (CO 5):

1. Differentiate between 'Fully continuous prestressed beam' and 'Partially continuous prestressed beam'. Explain the reasons why a prestressed continuous beam cannot be designed economically.
2. Discuss on segmental construction. Explain its advantages.
3. Elaborate on various methods of achieving continuity.

MODEL QUESTION PAPER

QP CODE:

Pages: 4

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

FOURTH SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CE3P25

PRESTRESSED CONCRETE

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Explain concept of load balancing.
2. What is pressure line? Write its significance.
3. What are the methods for reducing frictional losses.
4. Explain the effect of tendon profile on deflection of prestressed beams.
5. Distinguish between web shear, flexural and flexure-shear cracks in concrete beams with sketches.
6. Explain the IS:1343 code method of computing the moment of resistance of rectangular sections.
7. Consideration of transmission length and development length in post tensioned member is meaningless. Justify.
8. Sketch the typical tensile stress distribution in an end block of a post tensioned beam with a single anchorage.
9. State and explain Guyon's theorem. Explain the methods of achieving continuity in prestressed concrete members.
10. Explain the disadvantages of prestressed concrete continuous beams compared to RCC beams.

PART B

Answer any one question from each module. Each question carries 14 marks.

MODULE 1

11. A rectangular beam section 300mm wide and 700 mm deep is prestressed by 7 mm diameter high strength wires 20 numbers, whose centre of gravity is located at 250 mm above the soffit of the beam. If the effective prestress in the wires is 750 N/mm^2 , what is the maximum total bending moment that can be applied on the section without causing any tension at the soffit of the beam?

OR

12. A prestressed concrete beam 250 mm wide and 400 mm deep is prestressed by an eccentric tendon. The span of the beam is 7 m and the beam has to support an imposed load of 4.5 kN/m. Find the prestressing force necessary so that the tension is just avoided at the soffit of the mid section if the eccentricity is 60 mm. Concrete weight is 25 N/mm^3 .

MODULE 2

13. A beam 10 m span having 200 mm wide and 300 mm deep is post tensioned with parabolic cable having an area of 320 mm^2 located at an eccentricity of 50 mm at mid-span and zero at supports. Initial stress in the cable having characteristic strength of 1500 MPa is 1000 MPa. Calculate the maximum percentage loss of prestress due to friction, if it is stressed from one end. Take $E_s = 2.1 \times 10^5 \text{ N/mm}^2$, $E_c = 3.5 \times 10^4 \text{ N/mm}^2$ and age of concrete is 28 days and missing data if any can be assumed based on relevant code.

OR

14. A post tensioned concrete beam having span 10 m is of 250 mm wide and 350 mm deep. The beam is prestressed with a parabolic cable having an area of 350 mm^2 located at an eccentricity of 50 mm at mid-span and zero at supports. Initial stress in the cable is 1000 MPa and relaxation of steel strain is 5% of initial stress. Calculate the percentage loss of prestress by all means specified in Code. Take $E_s = 2.1 \times 10^5 \text{ N/mm}^2$, $E_c = 3.5 \times 10^4 \text{ N/mm}^2$ and age of concrete is 28 days.

MODULE 3

15. A post tensioned beam with an unbounded tendon is of rectangular section 400mm wide with an effective depth of 800mm. The cross-sectional area of the prestressing steel is 2840 mm^2 . The effective prestress in the steel after all losses is 900 N/mm^2 . The effective span of the beam is 16 m. If $f_{ck} = 40 \text{ N/mm}^2$, estimate the ultimate moment of resistance of the section.

OR

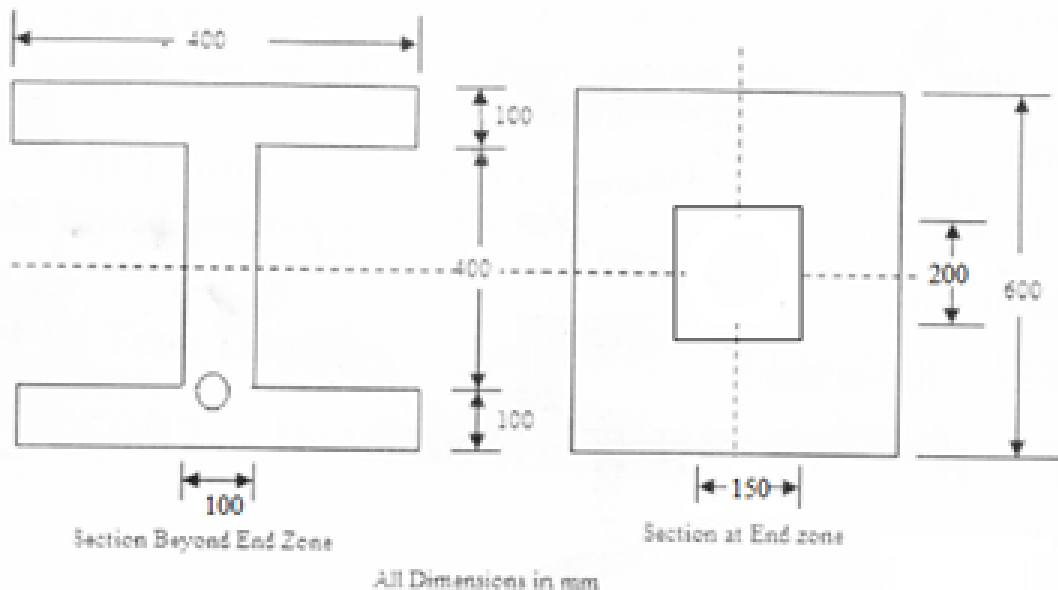
16. A post tensioned bridge girder with unbonded tendons is of box section of overall dimensions 1200 mm wide by 1800 mm deep, with wall thickness of 150 mm. The high tensile steel has an area of 4000 mm^2 and is located at an effective depth of 1600 mm. The effective prestress in steel after all losses is 1000 N/mm^2 and the effective span of girder is 24 m. If $f_{ck} = 40 \text{ N/mm}^2$ and $f_p = 1600 \text{ N/mm}^2$, estimate the ultimate flexural strength of the section.

MODULE 4

17. The end block of a post-tensioned prestressed member is 600 mm x 600 mm. Four cables, each made of 7 ply 8 mm dia strands and carrying a force of 1200 kN are anchored by a plate anchorage of 170 mm x 170 mm, located with their centres at 125 mm from the edge of the end block. Adopt M40 concrete yield strength of untensioned steel reinforcement is 250 N/mm^2 . Design suitable anchorages and the end block with necessary reinforcement. Sketch details.

OR

18. Design the bearing plate and the end zone reinforcement for the following bonded post-tensioned beam shown in Figure 3. The strength of concrete at transfer (f_{ci}) is 50 N/mm^2 . A prestressing force of 1055 kN is applied by a single tendon symmetrically placed over mild steel anchor of size 150 mm x 200 mm. Permissible bending stress for bearing plate is 165 N/mm^2 . There is no eccentricity of the tendon at the ends. Use Fe250 grade steel for reinforcement



MODULE 4

19. (a) What is meant by linear transformation? Mention the application of it (6 marks)
(b) Explain the methods of achieving continuity in prestressed concrete members. (14 marks)

OR

20. (a) State and explain Guyon's theorem. (6 marks)
(b) Explain the disadvantages of prestressed concrete continuous beams compared to RCC beams. (8 marks)
(c) Elaborate on the concept of concordant cable for the continuous beam (6 marks)



CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE3P26	SEISMOLOGY AND EARTHQUAKE ENGINEERING	2	1	0	4	3	2024

Preamble

This course provides a comprehensive introduction to seismology with an emphasis on the physics of earthquakes, seismic wave propagation, and Earth's structure, while bridging to practical applications in earthquake engineering. Students will explore earthquake generation, hazard assessment, and the design of resilient structures. The curriculum prioritizes seismological principles to build a strong foundation before transitioning to engineering concepts.

Prerequisites: NIL

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Explain the fundamental principles of seismology, including plate tectonics, seismic wave types, and earthquake source mechanisms. (Cognitive Knowledge Level: Apply)
CO 2	Analyze seismic data to infer Earth's interior structure and assess seismic hazards. (Cognitive Knowledge Level: Apply)
CO 3	Evaluate ground motion characteristics and their implications for structural integrity. (Cognitive Knowledge Level: Apply)
CO 4	Apply basic earthquake engineering principles to design simple structures for seismic resilience. (Cognitive Knowledge Level: Apply)
CO 5	Interpret real-world case studies of earthquakes and engineering responses. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	2	1	1		1					
CO 2	3	3	2	3	2	3	1				
CO 3	3	3	3	2	1	3	1	1			
CO 4	3	2	3	1	2	3	2	1	1	1	1
CO 5	2	3	2	3	1	3	2	1	2	2	1

Assessment Pattern

ENGINEERING GEOLOGY			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	20	20	20
Understand	40	40	40
Apply	40	40	40
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 10 marks
Self Study	: 5 marks

End Semester Examination Pattern

There will be two parts: Part A and Part B. Part A contain 10 questions, with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module, of which students should answer any one. Each question carries 14 marks and can have a maximum of 2 sub-divisions.

SYLLABUS

Module 1: Introduction to Seismology and Plate Tectonics (8 hours)

Overview of earthquakes: Definitions, scales (Richter, Moment Magnitude), and historical events (e.g., 1906 San Francisco, 2011 Tohoku). Theories on tectonics – Vertical Tectonics, Horizontal Tectonics – different schools (Continental Drift, Plate Tectonics, Global Wrench Tectonics, Surge Tectonics, Plasma Tectonics), Lithosphere boundaries (cratons and Mobile belts), stress regimes. Seismicity patterns: Global distribution and intraplate earthquakes.

Module 2: Seismic Waves and Earth's Interior Structure (7 hours)

Types of seismic waves: Body waves (P, S) vs. surface waves (Love, Rayleigh); wave speeds and attenuation. Elastic wave propagation: Ray theory, travel-time curves, and finite-frequency effects. Inferring Earth's structure: Crust, mantle, core from seismic discontinuities (e.g., Moho, Gutenberg).

Module 3: Earthquake Sources and Mechanics (7 Hours)

Fault mechanics: Brittle failure, friction laws, and stress drop. Earthquake source models: Point source, finite fault, and double-couple representation. Rupture propagation: Super-shear vs. subshear, and tsunami generation from megathrust events. Instrumentation: Seismometers, accelerometers, and broadband networks.

Module 4: Seismic Hazard Assessment and Ground Motion (7 Hours)

Ground motion prediction: Attenuation relations, site effects (basin amplification), and soil-structure interaction basics. Probabilistic seismic hazard analysis (PSHA): Recurrence models, deaggregation, and hazard curves. Strong-motion seismology: Near-fault effects, directivity, and fling step. Case studies: 1994 Northridge and 2008 Sichuan earthquakes.

Module 5: Fundamentals of Earthquake Engineering (7 Hours)

Seismic loading: Response spectra, design earthquakes (e.g., MCE, DBE). Structural analysis: Equivalent static, response spectrum, and time-history methods. Design principles: Ductility, base isolation, and damping devices for buildings/bridges. Performance-based engineering: Fragility curves and retrofit strategies.

Course Project

- Map global seismic hotspots; introductory lab on earthquake catalogs.
- Choose a city or region in a seismic zone and use online seismic data (e.g., from USGS or IMD) to plot epicenters, seismic waves propagation, and fault lines.
- Case study analysis of source parameters from recent events (e.g., 2023 Turkey-Syria).
- Seismic hazard mapping

Text Books:

1. Quantitative Seismology, Keiiti Aki and Paul G. Richards, 2nd Edition (2002).
2. Earthquake Engineering: From Engineering Seismology to Performance-Based Engineering, Yousef Bozorgnia and Vitelmo V. Bertero (2004).
3. An Introduction to Seismology, Earthquakes, and Earth Structure Seth Stein and Michael Wysession (2003).

References:

1. Seismology and Earthquake Engineering by B. K. Rastogi (Associated Publishing Company, 2004)
2. Fundamentals of Earthquake Engineering by S. K. Ghosh and V. G. Kalkar (PHI Learning, 2014).
3. Earthquake Resistant Design of Structures by S.K. Duggal (Oxford University Press, 2013).
4. Earthquake Resistant Design of Structures (2nd Ed.) Pankaj Agarwal & Manish Shrikhande (PHI Learning, 2021).
5. Introduction to Seismology (2nd Ed.) Peter M. Shearer (Cambridge University Press, 2009).

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	8 hours
1.1	Overview of earthquakes: Definitions, scales (Richter, Moment Magnitude), and historical events (e.g., 1906 San Francisco, 2011 Tohoku).	1
1.2	Theories on tectonics – Vertical Tectonics, Horizontal Tectonics.	1
1.3	Different schools (Continental Drift, Plate Tectonics, Global Wrench Tectonics, Surge Tectonics, Plasma Tectonics).	2
1.4	Lithosphere boundaries (cratons and Mobile belts).	1
1.5	Stress regimes.	1
1.6	Seismicity patterns: Global distribution and intraplate earthquakes.	2
2	Module 2	7 hours
2.1	Types of seismic waves: Body waves (P, S) vs. surface waves (Love, Rayleigh); wave speeds and attenuation.	2
2.2	Elastic wave propagation: Ray theory, travel-time curves, and finite-frequency effects.	3
2.3	Inferring Earth's structure: Crust, mantle, core from seismic discontinuities (e.g., Moho, Gutenberg).	2
3	Module 3	7 hours
3.1	Fault mechanics: Brittle failure, friction laws, and stress drop.	1
3.2	Earthquake source models: Point source, finite fault, and double-couple representation.	2
3.3	Rupture propagation: Supershear vs. subshear, and tsunami generation from megathrust events.	2

3.4	Instrumentation: Seismometers, accelerometers, and broad-band networks.	2
4	Module 4	7 hours
4.1	Ground motion prediction: Attenuation relations, site effects (basin amplification), and soil-structure interaction basics.	2
4.2	Probabilistic seismic hazard analysis (PSHA): Recurrence models, deaggregation, and hazard curves.	2
4.3	Strong-motion seismology: Near-fault effects, directivity, and fling step.	2
4.4	Case studies: 1994 Northridge and 2008 Sichuan earthquakes.	1
5	Module 5	7 hours
5.1	Seismic loading: Response spectra, design earthquakes. (e.g., MCE, DBE)	2
5.2	Structural analysis: Equivalent static, response spectrum, and time-history methods.	2
5.3	Design principles: Ductility, base isolation, and damping devices for buildings/bridges.	2
5.4	Performance-based engineering: Fragility curves and retrofit strategies.	1
Total		36 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Discuss the differences between Global Wrench Tectonics, Surge Tectonics, and Plasma Tectonics as alternative schools of thought to traditional Plate Tectonics.
2. Explain the three primary stress regimes (compressional, extensional, and shear) in the Earth's lithosphere.

Course Outcome 2 (CO 2):

1. Compare the propagation paths and detection methods of Love and Rayleigh surface waves versus P and S body waves.
2. Explain how travel-time curves from global earthquake data help map the seismic discontinuities inside the earth.

Course Outcome 3 (CO 3):

1. Elaborate on the concept of fault friction laws and their implications for predicting earthquake recurrence intervals.
2. Differentiate between point source and finite fault models in representing complex earthquake ruptures.

Course Outcome 4 (CO 4):

1. Explain the influence of soil-structure interaction on ground motion amplification during earthquakes, with examples of resonance effects in soft sediments.
2. Describe the process of deaggregation in Probabilistic Seismic Hazard Analysis.

Course Outcome 5 (CO 5):

1. Discuss the application of damping devices in enhancing structural performance under seismic loading.
2. Explain the development and use of fragility curves in performance-based earthquake engineering.

MODEL QUESTION PAPER

QP CODE:

Pages: 3

Reg.No.:

Name:

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

SIXTH SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CE3P26

SEISMOLOGY AND EARTHQUAKE ENGINEERING

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Define an earthquake and distinguish between the Richter scale and the Moment Magnitude scale.
2. Briefly explain the concept of Continental Drift theory and its relation to modern Plate Tectonics.
3. Differentiate between body waves (P and S) and surface waves (Love and Rayleigh) in terms of propagation and characteristics.
4. Describe the Mohorovicic discontinuity (Moho) and its significance in inferring Earth's crustal structure.
5. Explain the term "stress drop" in the context of fault mechanics during an earthquake
6. What is a double-couple representation of an earthquake source? Provide a brief sketch
7. Define Probabilistic Seismic Hazard Analysis (PSHA) and mention two key components of it.
8. Briefly describe the near-fault directivity effect in strong-motion seismology.
9. What are Response Spectra? Explain their role in seismic loading for structures.
10. Differentiate between Maximum Considered Earthquake (MCE) and Design Basis Earthquake (DBE).

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. a) Discuss the global distribution of seismicity and explain the occurrence of intraplate earthquakes with suitable examples. (7)
- b) Compare and contrast Vertical Tectonics and Horizontal Tectonics theories. (7)

OR

12. Describe the key historical earthquakes of 1906 San Francisco and 2011 Tohoku, highlighting their causes, impacts, and lessons learned. Elaborate on the role of cratons and mobile belts in lithosphere boundaries. (14)

MODULE 2

13. a) Explain the principles of elastic wave propagation using Ray theory and derive a basic travel-time curve for P-waves. (7)
- b) Discuss how seismic wave attenuation and finite-frequency effects influence wave speeds in the Earth's interior. (7)

OR

14. Detail the inference of Earth's internal structure (crust, mantle, core) from seismic discontinuities like Moho and Gutenberg. Include a discussion on the types of seismic waves and their speeds in different layers. (14)

MODULE 3

15. a) Explain brittle failure and friction laws on faults, and their relation to earthquake mechanics. (7)
- b) Describe rupture propagation in earthquakes, comparing supershear and subshear ruptures with an example of tsunami generation from a megathrust event. (7)

OR

16. Discuss earthquake source models, including point source and finite fault representations. Elaborate on the instrumentation involved, such as seismometers and broadband networks, in recording these events. (14)

MODULE 4

17. a) Explain ground motion prediction using attenuation relations and site effects, including basin amplification. (7)
- b) Describe the steps in Probabilistic Seismic Hazard Analysis (PSHA), including recurrence models and hazard curves. (7)

OR

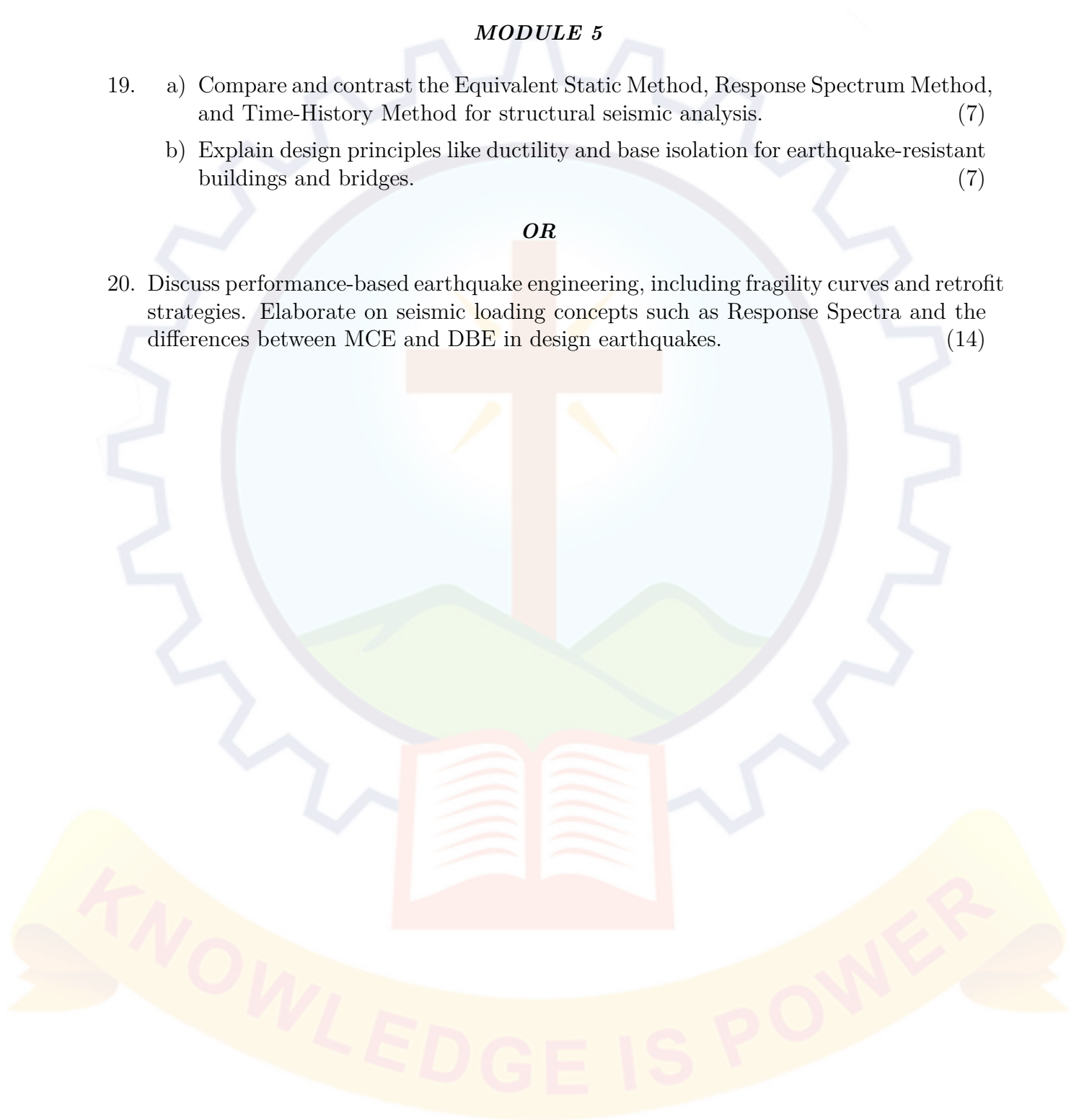
18. Analyze the case studies of the 1994 Northridge and 2008 Sichuan earthquakes, focusing on near-fault effects, directivity, and fling step. Discuss deaggregation in PSHA using these examples. (14)

MODULE 5

19. a) Compare and contrast the Equivalent Static Method, Response Spectrum Method, and Time-History Method for structural seismic analysis. (7)
b) Explain design principles like ductility and base isolation for earthquake-resistant buildings and bridges. (7)

OR

20. Discuss performance-based earthquake engineering, including fragility curves and retrofit strategies. Elaborate on seismic loading concepts such as Response Spectra and the differences between MCE and DBE in design earthquakes. (14)



CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE3G11	SUSTAINABLE CONSTRUCTION MATERIALS AND PRACTICES	2	1	0	4	3	2024

Preamble

Sustainable Construction Materials and Techniques is an elective course designed to provide comprehensive knowledge on environmentally responsible and resource-efficient construction practices. The course emphasizes the principles of sustainability, focusing on materials, methods, and technologies that minimize environmental impact. It covers life cycle assessment, eco-efficient materials, and modern sustainable construction techniques. Students will learn about green building certifications, waste management, and energy-efficient systems. The course also explores economic aspects, policy frameworks, and smart technologies in sustainable development. By the end, students will be equipped to integrate sustainability into real-world construction projects effectively.

Prerequisites: Energy Conservation and Environmental Sustainability

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Explain the fundamental concepts and principles of sustainability and their relevance to the built environment. (Cognitive Knowledge Level: Understand).
CO 2	Evaluate the life cycle performance, embodied energy, and environmental impact of various construction materials using LCA tools. (Cognitive Level: Apply)
CO 3	Describe sustainable construction techniques, including energy-efficient systems, prefabrication, and low-carbon technologies. (Cognitive Level: Understand)
CO 4	Analyze green building rating systems such as LEED, GRIHA, and IGBC, and interpret their evaluation criteria. (Cognitive Level: Analyze).
CO 5	Assess the economic feasibility, policy framework, and future trends in sustainable and smart construction practices. (Cognitive Level: Apply).

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	2						2			1	
CO 2	2		1				2				
CO 3	2		1		2						
CO 4	2			2							
CO 5	2										2

Assessment Pattern

SUSTAINABLE CONSTRUCTION MATERIALS AND PRACTISES			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	20	20	30
Understand	50	50	60
Apply	30	30	10
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course project : 10 marks

Self Study : 5 marks

End Semester Examination Pattern

There will be two parts: Part A and Part B. Part A contain 10 questions, with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module, of which students should answer any one. Each question carries 14 marks and can have a maximum of 2 sub-divisions.

SYLLABUS

Module 1: Fundamentals of Sustainability in Construction (7 hours)

Definition and Principles of Sustainability-Environmental, Social, and Economic Pillars, Sustainability in the Built Environment, Sustainable Development Goals, Introduction to Sustainable Construction Materials, Benefits and Challenges in Implementing Sustainability in the Built Environment. Sustainable Construction Materials-Definition and Classification, Eco-efficient Materials, Smart and Innovative Materials, Emerging Trends.

Module 2: Life Cycle Assessment (LCA) and Material Sustainability (7 hours)

Material Transparency and Compliance- Environmental Product Declarations, Green Certifications for Materials, Embodied Energy and Carbon Footprint Assessment, Circular Economy in Construction. Life Cycle Analysis (LCA) of Construction Materials- LCA Framework, Tools and Software, Case Studies of LCA in Concrete, Steel, and Timber.

Module 3: Sustainable Construction Techniques and Practices (7 Hours)

Energy-Efficient Construction Practices- Passive Design Strategies, Active Energy Systems. Advanced Construction Methods- MIVAN and Tunnel Forming Techniques, Prefabrication and Modular Construction, 3D Printing in Construction and Robotic Construction Methods, Low-Carbon Concrete. Construction Waste Management.

Module 4: Green Building Rating Systems (7 Hours)

Green Building Certifications- Introduction to LEED, BREEAM, IGBC, GRIHA. Certification Process, Criteria, and Documentation Requirements. Key Parameters and Categories of Evaluation. Digital Tools for Green Building Assessment.

Module 5: Economics and Future of Sustainable Construction (8 Hours)

Economic Analysis-Cost vs. Benefit Analysis of Sustainable Materials and Techniques, Return on Investment (ROI) in Green Construction, Government Incentives and Policy Framework for Sustainable Buildings. Smart and Net-Zero Technologies-Net-Zero Energy Buildings (NZEB) and Positive Energy Buildings, Integration of IoT, AI, and Smart Sensors in Sustainable Building Management. Case Studies and Future Trends-Successful Sustainable Projects (Indian and Global), Trends: Carbon Neutral Construction, ESG in Real Estate.

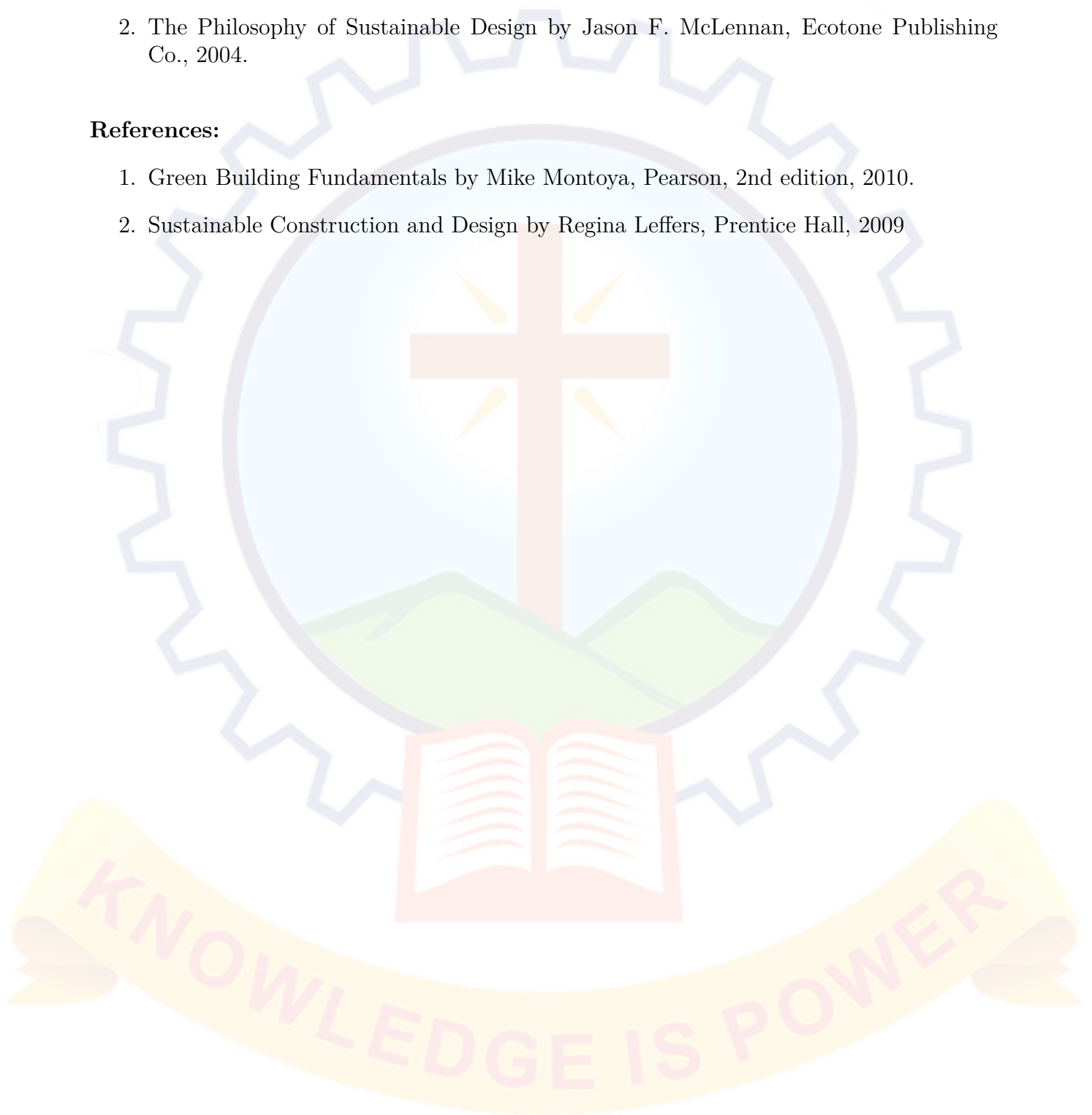
Coarse Project: LCA of a Selected Construction Material

Text Books:

1. Sustainable Construction - Green Building Design and Delivery by Charles J. Kibert, John Wiley & Sons, 2nd edition, 2008.
2. The Philosophy of Sustainable Design by Jason F. McLennan, Ecotone Publishing Co., 2004.

References:

1. Green Building Fundamentals by Mike Montoya, Pearson, 2nd edition, 2010.
2. Sustainable Construction and Design by Regina Leffers, Prentice Hall, 2009



COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	7 hours
1.1	Concept and Principles of Sustainability- Environmental, Social, and Economic Pillars (Triple Bottom Line)	1
1.2	Global Goals (UN SDGs) and their Relevance to Construction, Benefits and Challenges in Implementing Sustainability in the Built Environment	1
1.3	Introduction to Sustainable Construction Materials- Definition and Classification: Natural vs. Engineered Sustainable Materials	1
1.4	Eco-efficient Materials: Bamboo, Recycled Concrete, Fly Ash, GGBS, Recycled Plastic Composites,	1
1.5	Smart and Innovative Materials: Self-healing Concrete, Geopolymer Concrete, Phase Change Materials (PCMs)	2
1.6	Emerging Trends: Bio-based Materials (Hempcrete, Mycelium) and 3D Printing Materials	1
2	Module 2	7 hours
2.1	Material Transparency and Compliance- Environmental Product Declarations (EPDs) and Green Certifications for Materials	1
2.2	Embodied Energy and Carbon Footprint Assessment, Circular Economy in Construction: Material Reuse and Recycling	1
2.3	Life Cycle Analysis (LCA) of Construction Materials- LCA Framework: Goal Definition, Inventory, Impact Assessment, Interpretation	2
2.4	Tools and Software: SimaPro, GaBi, Tally (BIM-integrated LCA)	1
2.5	Case Studies of LCA in Concrete, Steel, and Timber	2

3	Module 3	7 hours
3.1	Passive Design Strategies: Orientation, Natural Ventilation, Insulation	1
3.2	Active Energy Systems: Solar PV, Building-Integrated Photovoltaics (BIPV)	1
3.3	Advanced Construction Methods- MIVAN and Tunnel Forming Techniques, Prefabrication and Modular Construction (DFMA – Design for Manufacturing and Assembly)- Concept only	2
3.4	3D Printing in Construction and Robotic Construction Methods, Low-Carbon Concrete (Geopolymer, Carbon Cure)	2
3.5	Construction Waste Management- On-site Waste Minimization and Recycling, Smart Sensors for Waste Tracking.	1
4	Module 4	7 hours
4.1	Green Building Certifications- Introduction to LEED, BREEAM, IGBC, GRIHA	2
4.2	Certification Process, Criteria, and Documentation Requirements	2
4.3	Key Parameters and Categories of Evaluation (Energy, Water, Materials, Indoor Air Quality, Innovation)	1
4.4	Digital Tools for Green Building Assessment- BIM for Green Design and Performance Simulation (Autodesk Insight, Design Builder)	2
5	Module 5	8 hours
5.1	Economic Analysis- Cost vs. Benefit Analysis of Sustainable Materials and Techniques	1
5.2	Return on Investment (ROI) in Green Construction, Government Incentives and Policy Framework for Sustainable Buildings	2
5.3	Net-Zero Energy Buildings (NZEB) and Positive Energy Buildings.	2

5.4	Integration of IoT, AI, and Smart Sensors in Sustainable Building Management	2
5.5	Successful Sustainable Projects (Indian and Global), Trends: Carbon Neutral Construction, ESG in Real Estate	1
Total		36 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Describe smart and innovative materials used in sustainable construction and discuss the challenges faced in implementing them.
2. Define sustainable construction materials and explain how eco-efficient materials contribute to resource conservation and waste reduction

Course Outcome 2 (CO 2):

1. Explain the purpose of Environmental Product Declarations and discuss their role in promoting transparency in material selection.
2. What are green certifications for materials? Describe how embodied energy and carbon footprint assessments help in achieving sustainable construction goals.

Course Outcome 3 (CO 3):

1. Differentiate between passive and active energy systems, and explain how they contribute to improving energy efficiency in buildings.
2. Describe MIVAN and Tunnel Forming techniques and discuss their advantages in achieving faster and more efficient construction.

Course Outcome 4 (CO 4):

1. Explain the purpose of green building certifications and briefly describe the major rating systems such as LEED, BREEAM, IGBC, and GRIHA.
2. List and explain the main parameters used to assess green buildings, such as energy efficiency, water conservation, and indoor environmental quality.

Course Outcome 5 (CO 5):

1. Explain how cost-benefit analysis and Return on Investment (ROI) are used to evaluate the economic feasibility of sustainable construction materials and techniques.
2. Discuss the importance of government incentives and policy frameworks in encouraging the adoption of sustainable building practices in India.

MODEL QUESTION PAPER

QP CODE:

Pages: 3

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

SIXTH SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CE3G11

SUSTAINABLE CONSTRUCTION MATERIALS AND PRACTICES

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Define the term sustainability and explain its three pillars.
2. List any three eco-efficient or smart construction materials with their applications.
3. What is an Environmental Product Declaration (EPD)? Mention its importance.
4. Explain the main stages in a Life Cycle Assessment (LCA) framework.
5. Differentiate between passive and active energy systems with examples.
6. Write short notes on prefabrication and modular construction.
7. What are the main evaluation categories in LEED or GRIHA rating systems?
8. State the role of Building Information Modelling (BIM) in green building assessment.
9. Define Net-Zero Energy Building (NZEB).
10. Mention any three government incentives or policies promoting sustainable construction in India.

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. a) Discuss the principles of sustainability and their importance in the construction industry. (7)
b) Explain the benefits and challenges of implementing sustainability in the built environment. (7)

OR

12. a) Classify sustainable construction materials with suitable examples. (7)
b) Write short notes on any two innovative materials used in sustainable construction:
(i) Self-healing concrete (ii) Geopolymer concrete (7)

MODULE 2

13. a) Explain the concept of embodied energy and carbon footprint of materials. (7)
b) Discuss the importance and applications of Life Cycle Assessment in sustainable construction. (7)

OR

14. a) Describe the steps in the LCA process using a case study of concrete or steel. (8)
b) Explain how the circular economy approach promotes material sustainability in construction. (6)

MODULE 3

15. a) Explain energy-efficient construction practices with suitable passive design strategies. (8)
b) Describe the role of 3D printing and robotic construction in achieving sustainability goals. (6)

OR

16. a) What is low-carbon concrete? Discuss any two recent innovations in low-carbon construction. (6)
b) Explain construction waste management techniques and the use of smart sensors for waste tracking. (8)

MODULE 4

17. a) Compare LEED, BREEAM, and GRIHA certification systems. (7)
b) Describe the process and documentation requirements for green building certification. (7)

OR

18. a) Explain the various key parameters used for evaluation in green building rating systems. (7)
b) Discuss the role of digital tools such as Autodesk Insight and Design Builder in assessing building performance. (7)

MODULE 5

19. a) Perform a cost-benefit analysis for adopting sustainable materials in construction. (7)
b) Discuss the economic and policy framework supporting sustainable construction in India. (7)

OR

20. a) Explain the features and functioning of Net-Zero and Positive Energy Buildings. (7)
b) Discuss the integration of IoT, AI, and smart sensors in sustainable building management. (7)

KNOWLEDGE IS POWER

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE3G12	NATURAL DISASTER AND MITIGATION	2	1	0	4	3	2024

Preamble

This course introduces the fundamental concepts of hazards and disaster management, fostering awareness and effective strategies for disaster preparedness and mitigation.

Prerequisites: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Understand key disaster-related concepts and terminologies, and relate Earth subsystems and urbanization to disaster vulnerability. (Cognitive Knowledge Level: Understand)
CO 2	Understand major geological and hydro-meteorological disasters, outlining their causes, impacts, and mitigation measures. (Cognitive Knowledge Level: Understand)
CO 3	Understand anthropogenic disasters and environmental degradation, highlighting their connection to climate change and disaster vulnerability. (Cognitive Knowledge Level: Understand)
CO 4	Apply disaster risk assessment principles and interpret India's disaster management frameworks through relevant case studies. (Cognitive Knowledge Level: Apply)
CO 5	Apply the technology and sustainable planning approaches to develop hazard-specific disaster mitigation and response strategies. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	2	2	1			2	3	1			
CO 2	2	3	2			2	3	1			
CO 3	2	2	2			3	3	2			
CO 4	2	3	2	2	1	3	3	2		1	1
CO 5	3	2	3	2	3	3	3	2	1	1	2

Assessment Pattern

NATURAL DISASTER AND MITIGATION			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	20	20	30
Understand	50	50	60
Apply	30	30	10
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 10 marks
Self Study	: 5 marks

End Semester Examination Pattern

There will be two parts: Part A and Part B. Part A contain 10 questions, with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module, of which students should answer any one. Each question carries 14 marks and can have a maximum of 2 sub-divisions.

SYLLABUS

Introduction to Disaster Management (6 hours)

Hazards and disasters. Classification of Disasters, Definitions: Vulnerability, Exposure, Risk, Crisis, Emergency, Capacity, Resilience.

Subsystems of Earth and Their Role in Hazards. Urbanization and Its Link to Disasters. Repercussions of Disasters: Economic Losses, Loss of Human and Animal Life, Environmental and Ecosystem Damage.

Module 2: Natural Disasters (7 hours)

Geological Disasters: Earthquakes – Causes, Seismic Zones, Impacts, Mitigation. Volcanoes – Types, Eruption Mechanisms, Consequences, Control strategies.

Hydro-Meteorological Disasters: Floods – Types, Causes, Floodplain Zoning, Mitigation. Cyclones and Storm Surges – Formation, Coastal Impacts. Tsunamis – Causes, Impacts. Landslides – Causes, Impacts, Risk reduction approaches. Forest Fire.

Module 3: Anthropogenic (Man-Made) Disasters and Environmental Degradation (7 Hours)

Soil Erosion and Desertification – Causes, Consequences, Control Measures. Soil Pollution and Degradation – Effects on Agriculture and Groundwater. Deforestation and Biodiversity Loss – Links to Ecosystem Imbalance and Disaster Vulnerability.

Climate Change and Global Warming.

Industrial Disasters: Major Industrial Disasters and Their Causes and Lessons learned.

Epidemics and Pandemics: Origins, Spread patterns, and Societal impacts.

Module 4: Disaster Risk Assessment and Management Frameworks (8 Hours)

Risk Assessment and Management Principles. Disaster Management Cycle: Mitigation, Preparedness, Response, Recovery.

Disaster Management in India: Hazard and Vulnerability Profile of India, Mega Disasters in India – Case Studies and Lessons Learned.

Disaster Management Act 2005, National Policy on Disaster Management 2009, State Disaster Management Authorities (SDMAs) – Role and Functions.

Module 5: Disaster Management Technologies (8 Hours)

Hazard-Specific Disaster Management Plans: Earthquakes, Floods, Storm Surges, Land-

slides, Phases: Pre-disaster, During-disaster, Post-disaster. Relief and Rehabilitation: Relief Camps, Organization.

Application of Science and Technology in Disaster Mitigation: Remote Sensing, GIS, GPS in Hazard Mapping, Early Warning Systems and Communication Technology, Disaster-Resistant Design and Construction (Structural & Non-structural Measures).

Text Books:

1. Gupta, H.K. (2013). Disaster Management (2nd Ed.). University Press, New Delhi.
2. Valdiya, K.S. (2013). Environmental Geology – Ecology, Resource and Hazard Management. McGraw-Hill Education (India).
3. Ghosh, G.K. (2015) Disaster Management. A.P.H. Publishing Corporation.
4. Kapur, A. (2010). Vulnerable India: A Geographical Study of Disasters. Sage Publications, New Delhi.

Reference Books:

1. Srivastava, H.N. & Gupta, G.D. (2007) Management of Natural Disasters in Developing Countries. Daya Publishing, Delhi.
2. Coppola, D.P. (2007). Introduction to International Disaster Management. Elsevier, London.
3. Modh, S. (2010). Managing Natural Disasters: Hydrological, Marine and Geological Disasters. Macmillan, New Delhi.
4. Pine, J.C. (2014). Hazards Analysis: Reducing the Impact of Disasters. CRC Press, New Delhi.
5. Smith, K. (2013). Environmental Hazards: Assessing Risk and Reducing Disaster. Routledge, London.
6. Murthy, D.B.N. (2007) Disaster Management: Text & Case Studies. Deep & Deep Publications Pvt. Ltd.
7. National Disaster Management Authority (NDMA) – Guidelines and Templates for Disaster Management.
8. Government of India – Disaster Management Act and National Disaster Management Policy.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	6 hours
1.1	Introduction to Disasters and Hazards & Classification of Disasters.	2
1.2	Key Concepts - Vulnerability, Exposure, Risk, Crisis, Emergency, Capacity, and Resilience.	1
1.3	Subsystems of the Earth and Their Role in Hazards.	1
1.4	Urbanization and Its Link to Disasters.	1
1.5	Repercussions of Disasters — Economic losses, Loss of Human and Animal Life, Environmental and Ecosystem Damage.	1
2	Module 2	7 hours
2.1	Earthquakes – Causes, Seismic Zones, Impacts, Mitigation.	2
2.2	Volcanoes – Types, Eruption Mechanisms, Impacts, Mitigation.	1
2.3	Floods – Types, Causes, Floodplain Zoning, Mitigation.	1
2.4	Cyclones and Storm Surges – Formation, Coastal Impacts.	1
2.5	Tsunamis – Causes, Impacts.	1
2.6	Landslides – Causes, Impacts, Mitigation. Forest fire.	1
3	Module 3	7 hours
3.1	Soil Erosion and Desertification – Causes, Consequences, Control Measures.	1
3.2	Soil Pollution and Degradation – Effects on Agriculture and Groundwater.	1
3.3	Deforestation and Biodiversity Loss – Links to Ecosystem Imbalance and Disaster Vulnerability.	1

3.4	Climate Change and Global Warming.	2
3.5	Industrial Disasters – Major Incidents, Causes, Consequences.	1
3.6	Epidemics and Pandemics – Causes and Consequences.	1
4	Module 4	8 hours
4.1	Risk Assessment and Management Principles.	1
4.2	Disaster Management Cycle – Mitigation, Preparedness, Response, Recovery.	2
4.3	Disaster Management in India: Hazard and Vulnerability Profile of India, Mega Disasters in India – Case Studies and Lessons Learned.	3
4.4	Disaster Management Act 2005, National Policy on Disaster Management 2009.	2
4.5	State Disaster Management Authorities (SDMAs) – Role and Functions.	1
5	Module 5	8 hours
5.1	Hazard-Specific Disaster Management Plans – Earthquakes, Floods, Storm Surges, Landslides.	2
5.2	Phases of Disaster Management – Pre-disaster, During-disaster, Post-disaster.	1
5.3	Relief and Rehabilitation: Relief Camps, Organization.	1
5.4	Application of Science and Technology in Disaster Mitigation: Remote Sensing, GIS, GPS in Hazard Mapping, Early Warning Systems and Communication Technology.	2
5.5	Disaster-Resistant Design and Construction (Structural & Non-structural Measures).	2
Total		36 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Explain the interrelationship between hazard, vulnerability, and risk in disaster management.
2. Explain how urbanization influence disaster vulnerability.

Course Outcome 2 (CO 2):

1. Explain the causes and mitigation measures of earthquakes.
2. Describe the formation and impacts of cyclones and storm surges.

Course Outcome 3 (CO 3):

1. Explain how deforestation and biodiversity loss increase disaster vulnerability.
2. Discuss the relationship between climate change and global warming.

Course Outcome 4 (CO 4):

1. Explain how the case studies have influenced improvements in India's disaster risk management frameworks.
2. Discuss the significance of the Disaster Management Act, 2005, in strengthening India's disaster management framework.

Course Outcome 5 (CO 5):

1. Assess how communication technologies strengthen coordination during large-scale emergencies.
2. Discuss the importance of disaster-resistant design and construction (structural and non-structural measures).

MODEL QUESTION PAPER

QP CODE:

Pages: 3

Reg.No.:

Name:

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

FIRST SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CE3G12

NATURAL DISASTER AND MITIGATION

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Define vulnerability, exposure, and resilience in the context of disasters.
2. List the major classifications of disasters.
3. Explain the types of volcanic eruptions.
4. List the major causes of landslides in hilly regions.
5. What are the major impacts of soil erosion?
6. Describe the link between industrialization and environmental degradation.
7. Define the four phases of the Disaster Management Cycle.
8. State two key functions of State Disaster Management Authorities (SDMAs).
9. List the major science and technology institutions in India involved in disaster management.
10. Define hazard-specific disaster management plans and mention two examples.

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. a) Explain the interrelationship between hazards, disasters, and risk with suitable examples. (7)
b) Explain the economic, social, and environmental repercussions of disasters. (7)

OR

12. a) Describe how subsystems of Earth contribute to the occurrence of disasters. (7)
b) Discuss how urbanization contributes to increased disaster vulnerability. (7)

MODULE 2

13. a) Explain the causes and impacts of earthquakes and describe the basic mitigation measures. (8)
b) Describe the types and causes of floods and outline the importance of floodplain zoning. (6)

OR

14. a) Differentiate between cyclones and storm surges with examples. (8)
b) Explain the formation and effects of tsunamis. (6)

MODULE 3

15. a) Describe how deforestation and biodiversity loss contribute to environmental degradation. (8)
b) Explain the causes and consequences of epidemics and pandemics with suitable examples. (6)

OR

16. a) Summarize the relationship between climate change, global warming, and disaster risk. (6)
b) Describe the major causes and effects of industrial disasters. (8)

MODULE 4

17. a) Explain the principles of disaster risk assessment and illustrate how they guide mitigation strategies. (7)
b) Discuss the major provisions of the Disaster Management Act 2005 and their significance in strengthening India's disaster preparedness. (7)

OR

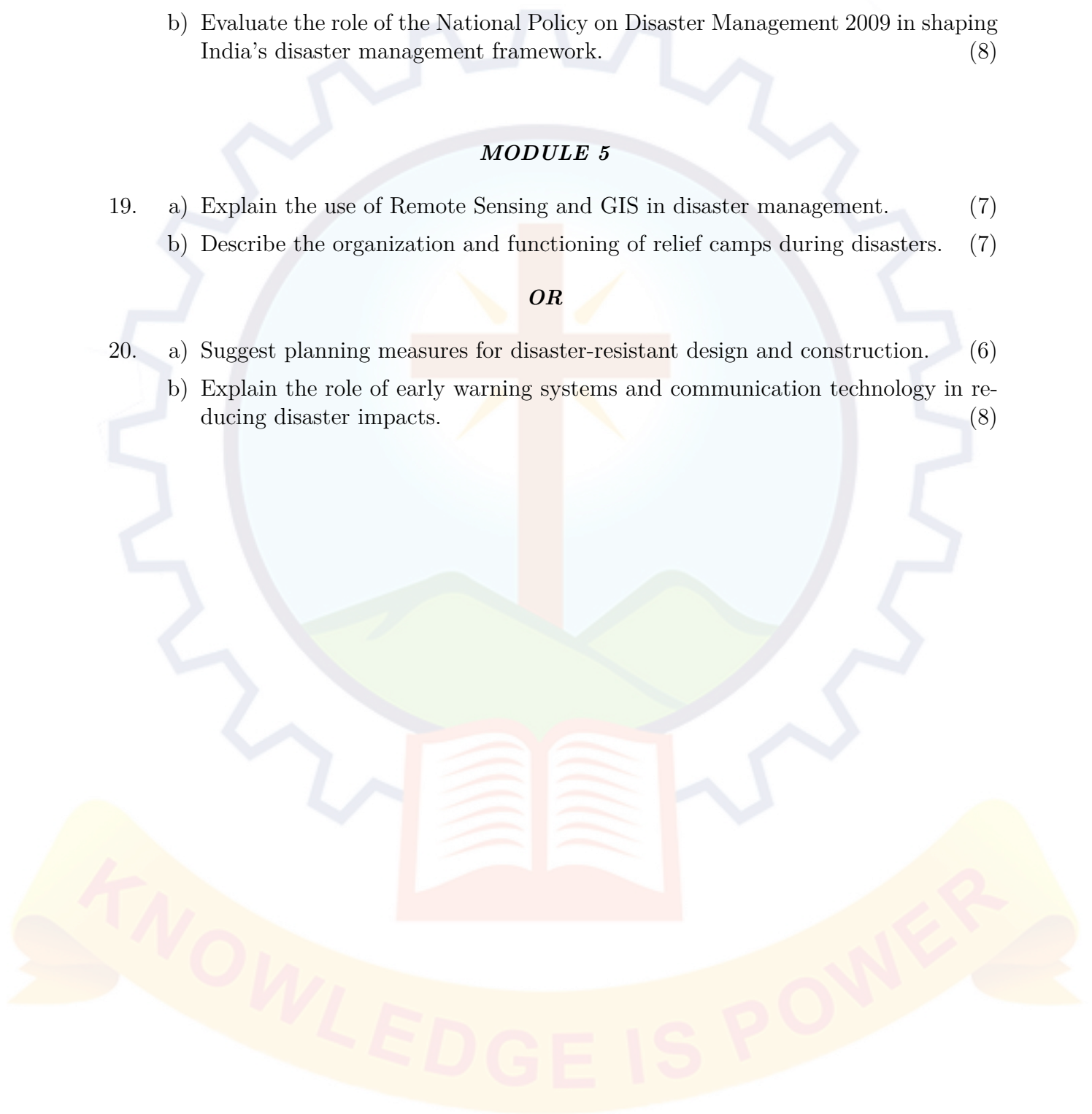
18. a) Discuss any one mega disaster happened in India and highlight lessons learned for future risk reduction.
b) Evaluate the role of the National Policy on Disaster Management 2009 in shaping India's disaster management framework. (8)

MODULE 5

19. a) Explain the use of Remote Sensing and GIS in disaster management. (7)
b) Describe the organization and functioning of relief camps during disasters. (7)

OR

20. a) Suggest planning measures for disaster-resistant design and construction. (6)
b) Explain the role of early warning systems and communication technology in reducing disaster impacts. (8)



CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE3G13	ENVIRONMENTAL RISK ASSESSMENT	2	1	0	4	3	2024

Preamble

The course introduces the principles and methods used to identify, evaluate, and manage environmental risks. It focuses on assessing the impacts of pollutants and hazardous activities on human health and ecosystems. Students gain skills to apply risk assessment tools for sustainable environmental management and informed decision-making.

Prerequisites: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Explain the fundamental concepts of environmental hazards, risks, and vulnerabilities, and their relevance in real-world environmental issues. (Cognitive Knowledge Level: Understand)
CO 2	Apply the systematic steps of risk assessment — hazard identification, dose-response, exposure, and risk characterization — to evaluate environmental risks. (Cognitive Knowledge Level: Apply)
CO 3	Apply suitable methods to estimate human health risks due to exposure to environmental contaminants. (Cognitive Knowledge Level: Apply)
CO 4	Explain the principles and procedure of ecological risk assessment for different environmental systems. (Cognitive Knowledge Level: Understand)
CO 5	Apply basic strategies for managing and communicating environmental risks in accordance with national and international guidelines. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	1				1					1
CO 2	3	1				1					1
CO 3	3	1				1					1
CO 4	3	1				1					1
CO 5	3	1				1					1

Assessment Pattern

Environmental Risk Assessment			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	40	40	40
Understand	40	40	40
Apply	20	20	20
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 10 marks
Self Study	: 5 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contains 10 questions carrying 3 marks each. Part B contains 2 questions from each module out of which anyone is to be answered. Each question carries 14 marks and can have maximum 2 sub-divisions.

SYLLABUS

Module 1: Introduction to Environmental Risk (8 hours)

Definition of hazard, risk, vulnerability, exposure; types of hazards – natural, anthropogenic, technological; risk perception; environmental risk scenarios – industrial accidents, waste-related hazards, climate change; role of Environmental Risk Assessment(ERA) in decision-making; integration with Environmental Impact Assessment(EIA) and disaster management; Indian and international regulatory frameworks; case studies – Bhopal Gas Tragedy, Chernobyl disaster.

Module 2: Process of Risk Assessment (8 hours)

Risk assessment framework – hazard identification, dose–response assessment, exposure assessment, risk characterization; deterministic and probabilistic approaches; toxicity data and sources; threshold and non-threshold effects, No-Observed-Adverse-Effect Level (NOAEL), Lowest-Observed-Adverse-Effect Level (LOAEL), Reference Dose (RfD), slope factor; exposure pathways – inhalation, ingestion, dermal; risk communication and uncertainty; case studies – Love Canal, Minamata mercury poisoning.

Module 3: Human Health Risk Assessment (6 Hours)

Principles of Human Health Risk Assessment – cancer and non-cancer risks; hazard quotient, hazard index, lifetime cancer risk; exposure scenarios – contaminated water, air pollutants, food chain contamination; quantitative risk estimation; Indian context – arsenic, fluoride, pesticides, biomedical waste; case studies – Endosulfan in Kasaragod, Ganga River water-borne disease risk.

Module 4: Ecological Risk Assessment (6 Hours)

Scope and principles of Ecological Risk Assessment; protection goals; problem formulation, analysis, risk characterization; assessment and measurement endpoints; bioaccumulation and biomagnification – mercury, polychlorinated biphenyls (PCBs), pesticides; aquatic and terrestrial ecosystem ERA; case studies – Deepwater Horizon oil spill, Brahmapuram landfill ecological impact.

Module 5: Risk Management and Communication (8 Hours)

Risk management framework – mitigation hierarchy; risk communication – principles, tools, public engagement; regulatory approaches – Indian laws, Basel, Minamata, Stockholm conventions; ERA in disaster and emergency planning; case studies – Indore municipal waste management, COVID-19 biomedical waste handling.

Text Books:

1. Asante-Duah, D.K., Public Health Risk Assessment for Human Exposure to Chemicals, 2nd Ed., CRC Press, 2017.
2. Kolluru, R.V., Bartell, S.M., Pitblado, R.M., Stricoff, R.S., Risk Assessment and Management Handbook for Environmental, Health, and Safety Professionals, 2nd Ed., McGraw-Hill, 2007.
3. Koller, K., Risk Assessment for Environmental Health, Jossey-Bass, 2007.
4. Suter, G.W., Ecological Risk Assessment, 2nd Ed., CRC Press, 2006.
5. Merrick, J.R.W., Environmental Risk Communication: Principles and Practices, CRC Press, 2022.

Reference Books:

1. USEPA, Guidelines for Ecological Risk Assessment, EPA/630/R-95/002F, updated 2004.
2. WHO, Principles and Methods for the Risk Assessment of Chemicals in Food, WHO/IPCS, 2009.
3. International Programme on Chemical Safety (IPCS), Environmental Health Criteria series – updated volumes (post-2000).
4. Van Leeuwen, C.J., Vermeire, T.G., Risk Assessment of Chemicals: An Introduction, 2nd Ed., Springer, 2007.
5. Government of India, CPCB, Environmental Risk Assessment Guidelines, New Delhi, 2011.
6. National Research Council, Science and Decisions: Advancing Risk Assessment, National Academies Press, 2009.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	8 hours
1.1	Definition of hazard, risk, vulnerability, exposure; types of hazards – natural, anthropogenic, technological; risk perception	2
1.2	Environmental risk scenarios – industrial accidents, waste-related hazards, climate change; role of Environmental Risk Assessment(ERA) in decision-making	3
1.3	Integration with Environmental Impact Assessment(EIA) and disaster management; Indian and international regulatory frameworks	2
1.4	Case studies – Bhopal Gas Tragedy, Chernobyl disaster	1
2	Module 2	8 hours
2.1	Risk assessment framework – hazard identification, dose–response assessment, exposure assessment, risk characterization	1
2.2	Deterministic and probabilistic approaches; toxicity data and sources; threshold and non-threshold effects	2
2.3	No-Observed-Adverse-Effect Level (NOAEL), Lowest-Observed-Adverse-Effect Level (LOAEL), Reference Dose (RfD), slope factor	3
2.4	Exposure pathways – inhalation, ingestion, dermal; risk communication and uncertainty; case studies – Love Canal, Minamata mercury poisoning.	2
3	Module 3	6 hours
3.1	Principles of Human Health Risk Assessment – cancer and non-cancer risks; hazard quotient, hazard index, lifetime cancer risk	2

3.2	Exposure scenarios – contaminated water, air pollutants, food chain contamination	1
3.3	Quantitative risk estimation; Indian context – arsenic, fluoride, pesticides, biomedical waste	2
3.4	Case studies – Endosulfan in Kasaragod, Ganga River water-borne disease risk	1
4	Module 4	6 hours
4.1	Scope and principles of Ecological Risk Assessment; protection goals	2
4.2	Problem formulation, analysis, risk characterization; assessment and measurement endpoints	2
4.3	Bioaccumulation and biomagnification – mercury, polychlorinated biphenyls (PCBs), pesticides; aquatic and terrestrial ecosystem ERA	1
4.4	Case studies – Deepwater Horizon oil spill, Brahmapuram landfill ecological impact	1
5	Module 5	8 hours
5.1	Risk management framework – mitigation hierarchy; risk communication – principles, tools, public engagement	2
5.2	Regulatory approaches – Indian laws, Basel, Minamata, Stockholm conventions	2
5.3	ERA in disaster and emergency planning	2
5.4	Case studies – Indore municipal waste management, COVID-19 biomedical waste handling	2
Total		36 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Define hazard, risk, and vulnerability with suitable environmental examples.
2. Explain the difference between natural and anthropogenic environmental risks.
3. Discuss the significance of environmental risk assessment in pollution control and disaster management.

Course Outcome 2 (CO 2):

1. List and briefly explain the major steps involved in environmental risk assessment.
2. Describe the concept of dose-response relationship with an example.
3. Explain the importance of exposure assessment in determining total environmental risk.

Course Outcome 3 (CO 3):

1. Define hazard quotient and hazard index used in human health risk assessment.
2. Describe the procedure for assessing health risks from contaminated drinking water.
3. Apply the risk assessment method to estimate exposure to airborne pollutants in an industrial area.

Course Outcome 4 (CO 4):

1. What is ecological risk assessment? Explain its purpose.
2. Describe the main steps involved in an ecological risk assessment.
3. Explain how bioaccumulation and biomagnification affect ecological risk.

Course Outcome 5 (CO 5):

1. Explain the key components of environmental risk management.
2. Describe the role of public participation in risk communication.
3. List some national and international regulations that guide environmental risk management.

MODEL QUESTION PAPER

QP CODE:

Pages: 3

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

SIXTH SEMESTER B TECH DEGREE EXAMINATION, MONTH YEAR

Course Code: B24CE3G13

ENVIRONMENTAL RISK ASSESSMENT

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Define hazard, risk, and vulnerability with suitable environmental examples.
2. Explain the importance of Environmental Risk Assessment (ERA) in environmental protection and management.
3. List and briefly describe the four major steps in environmental risk assessment.
4. What is meant by dose-response relationship? Explain its significance in risk assessment.
5. Define hazard quotient and hazard index used in human health risk assessment.
6. Explain how exposure assessment is carried out for contaminated drinking water.
7. What are the main stages of ecological risk assessment?
8. Explain the role of bioaccumulation and biomagnification in ecological risk.
9. List the main components of an environmental risk management framework.
10. What are the key principles of effective environmental risk communication?

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. Define environmental risk management and explain the need for and importance of risk management in environmental protection. (14)

OR

12. a) Explain the major components of environmental risk. (7)
b) Discuss with examples how natural and anthropogenic factors contribute to environmental risks. (7)

MODULE 2

13. Explain in detail the steps involved in environmental risk assessment and the role of each step in effective decision-making. (14)

OR

14. a) Describe hazard identification and exposure assessment in the context of risk assessment. (8)
b) Explain how uncertainty is managed during risk analysis. (6)

MODULE 3

15. Discuss different strategies used for environmental risk management. Illustrate with suitable case studies. (14)

OR

16. a) Explain the process of risk evaluation and the factors influencing acceptable risk levels. (7)
b) How are cost-benefit analysis and risk-benefit trade-offs used in environmental management decisions? (7)

MODULE 4

17. Describe various tools and techniques used in environmental risk assessment such as fault tree analysis, event tree analysis, and consequence analysis. (14)

OR

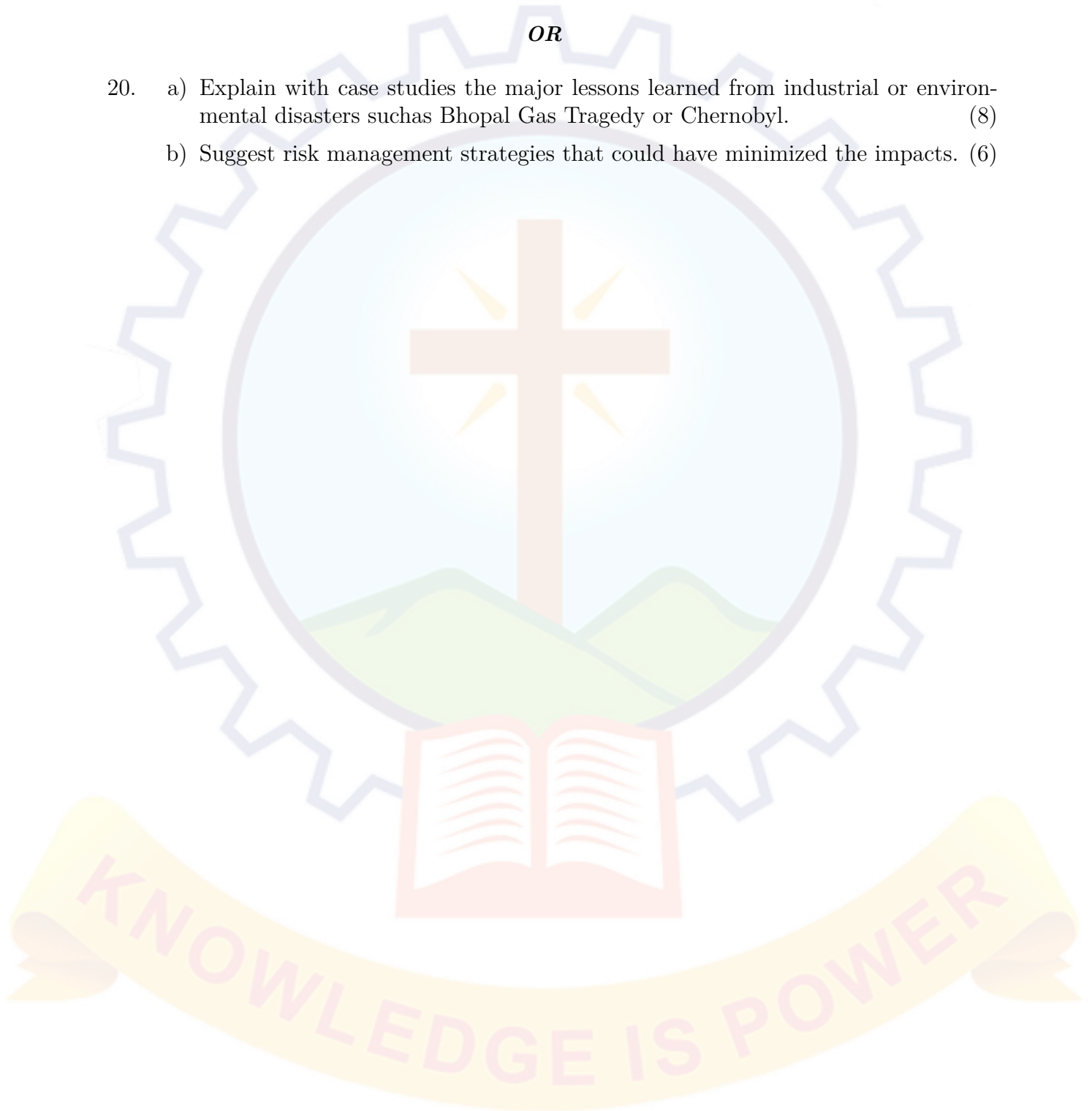
18. a) Explain the use of GIS and remote sensing in environmental risk analysis. (7)
b) Discuss the role of modelling in predicting and managing environmental risks. (7)

MODULE 5

19. Discuss the importance of risk communication and public participation in environmental decision-making with suitable examples. (14)

OR

20. a) Explain with case studies the major lessons learned from industrial or environmental disasters such as Bhopal Gas Tragedy or Chernobyl. (8)
b) Suggest risk management strategies that could have minimized the impacts. (6)



CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE3L09	MATERIAL TESTING LABORATORY- II	0	0	3	2	2	2024

Preamble

The course is designed to provide students with practical experience in performing laboratory tests on various construction materials, enabling them to assess material quality and performance effectively. By engaging in both destructive and non-destructive testing methods, students will learn to assess material quality and performance in accordance with Indian Standard (IS) codes.

Prerequisites: Material Testing Lab I

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Perform standard tests on cement to determine fineness, consistency, setting time, specific gravity, compressive strength, and soundness. (Cognitive Knowledge Level: Apply)
CO 2	Analyze physical and mechanical properties of coarse and fine aggregates including sieve analysis, water absorption, bulk density, void ratio, porosity, and crushing value. (Cognitive Knowledge Level: Apply)
CO 3	Assess workability of fresh concrete using slump cone, compacting factor, Vee-Bee, and flow tests. (Cognitive Knowledge Level: Evaluate))
CO 4	Design concrete mixes using IS code method and cast specimens for testing hardened properties such as compressive, split tensile, flexural strength, and modulus of elasticity. (Cognitive Knowledge Level: Apply)
CO 5	Demonstrate proficiency in non-destructive testing and quality assessment of concrete using rebound hammer, ultrasonic pulse velocity. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	2	3	2	3	1	1	3	2	2	1
CO 2	3	2	2	2	2	1	2	3	1	1	1
CO 3	3	3	3	2	3	1	1	2	2	1	
CO 4	3	3	2	3	3	1	2	3	1	1	1
CO 5	2	2	3	2	3	3	2	2	3	2	1

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	10 marks
Continuous Assessment	10 marks
Viva-Voce (Self Study)	10 marks
Test	15 marks
Lab Record	5 marks

End Semester Examination Pattern

The following guidelines should be followed regarding the award of marks:

Preliminary work	: 20 marks
Implementation / Conducting the experiment	: 20 marks
Performance, result and inference (usage of equipment and troubleshooting)	: 30 marks
Viva voce	: 30 marks

SYLLABUS

LIST OF EXPERIMENTS

No	Description
1	Testing of Cement: Fineness, normal consistency, initial and final setting time and compressive strength. (IS 4031 Part I, IV, V, VI)
2	Testing of Cement: Specific gravity (IS 4031 Part II)
3	Study on soundness of cement. (IS 4031 Part III)

No	Description
4	Testing of Coarse and Fine Aggregate: Sieve analysis. (IS 2386 Part I)
5	Testing of Coarse and Fine Aggregate: Water absorption, bulk density, void ratio, porosity and specific gravity. (IS 2386 Part III)
6	Test on bulking of sand.
7	Test on aggregate - Aggregate crushing value (IS 2386 Part IV)
8	Tests on fresh concrete: Measurement of workability of concrete by slump cone test (IS 1199 Part II)
9	Tests on fresh concrete: Measurement of workability of concrete by compaction factor test. (IS 1199 Part II)
10	Tests on fresh concrete: Measurement of workability of concrete by Vee-Bee test. (IS 1199 Part II)
11	Tests on fresh concrete: Measurement of workability of concrete by flow test.
12	Concrete mix design by IS code method and casting of cubes / cylinders with designed concrete mixes and test on compressive strength of cubes/cylinder. (IS 10262, IS 516)
13	Tests on hardened properties of concrete: Split tensile strength of cylinder and flexural strength of beams. (IS 5816, IS 516)
14	Tests on hardened properties of concrete: Modulus of elasticity of concrete.(IS 516)
15	Tests on brick (water absorption and compressive strength), floor / roof tiles (transverse strength and water absorption) as per IS codal provision. (IS 3495 Part I & Part II, IS 654, IS 13630)
16	Study on Non-destructive tests on hardened concrete (Rebound hammer and ultrasonic pulse velocity) (IS 516, IS 13311 Part I &Part II).

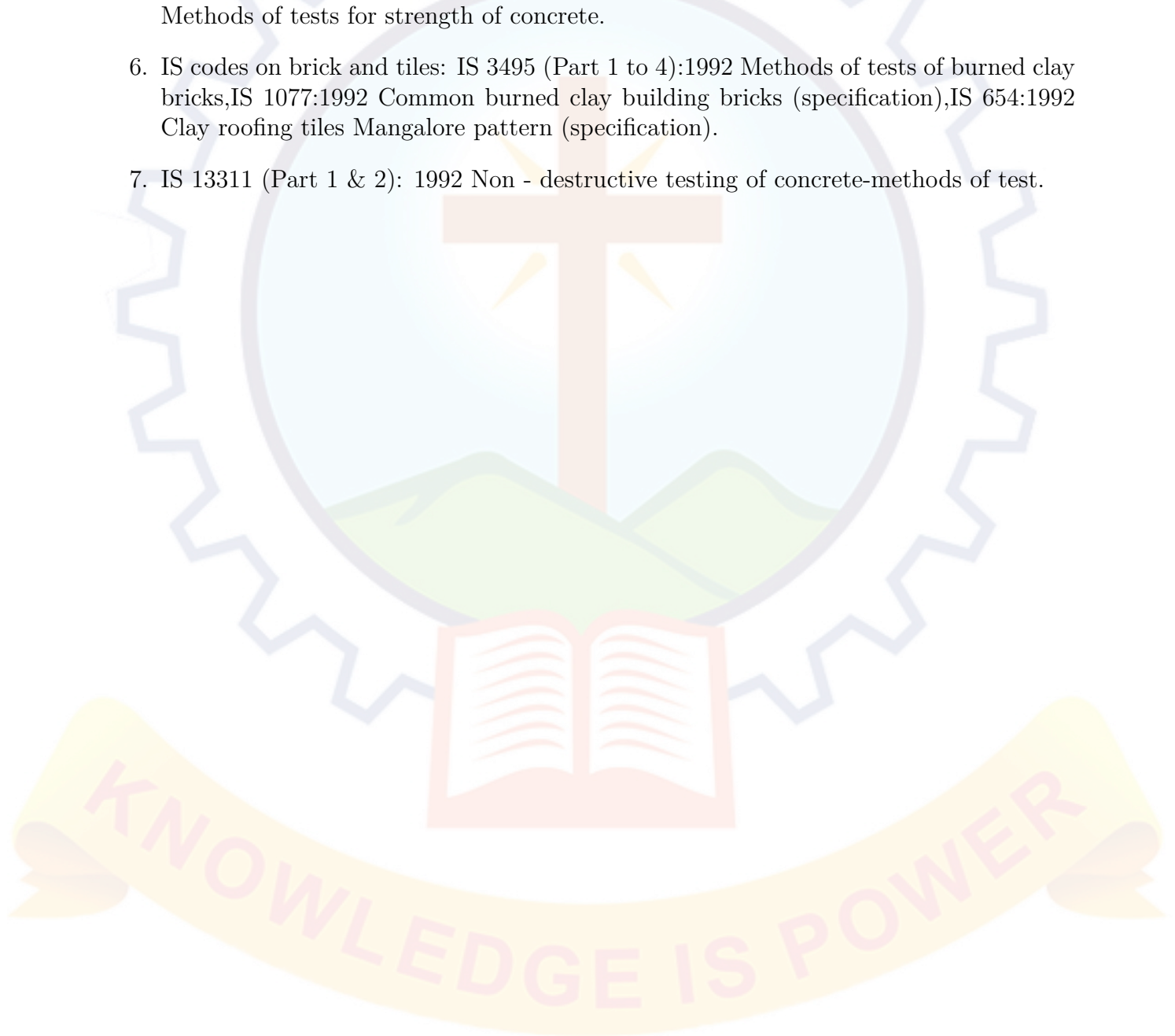
*Minimum twelve experiments are mandatory

References:

1. M.S.Shetty , Concrete Technology, Theory and Practice , S.Chand&Company, 2014.
2. A.M.Neville and J.J Brooks, Concrete Technology,Second edition, Pearson.
3. IS codes on cement: IS 1489(Part 1& 2):1991 Specification for Portland pozzolana cement,IS 269:1989 – Specification for ordinary Portland cement, 33 grade,IS 8112 :

2013- Specification for ordinary Portland cement, 43 grade, IS 12269 : 2013- Specification for ordinary Portland cement, 53 grade.

4. IS codes on aggregate: IS 2386(Part 1):1963 Methods of test for aggregates for concrete: Part 1 Particle size and shape, IS 2386(Part 3):1963 Methods of test for aggregates for concrete: Part 3 Specific gravity, density, voids, absorption and bulking, IS 383:1970 Specification for Coarse and Fine aggregate from natural sources of concrete.
5. IS codes on fresh and hardened concrete: IS 1199:1959 Methods of sampling and analysis of concrete, IS 10262:2019 Concrete mix proportioning- Guidelines, IS 516:1959 Methods of tests for strength of concrete.
6. IS codes on brick and tiles: IS 3495 (Part 1 to 4):1992 Methods of tests of burned clay bricks, IS 1077:1992 Common burned clay building bricks (specification), IS 654:1992 Clay roofing tiles Mangalore pattern (specification).
7. IS 13311 (Part 1 & 2): 1992 Non - destructive testing of concrete-methods of test.



CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE3L10	CIVIL ENGINEERING DESIGN STUDIO	0	0	3	2	2	2024

Preamble

The course aims to train the students to use different software tools needed for professional practice in civil engineering.

Prerequisites: Civil Engineering Planning & Drafting Lab

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Analyse and design steel and RC structural elements. (Cognitive Knowledge Level: Analyse)
CO 2	Analyse and design multistoried framed structure. (Cognitive Knowledge Level: Analyse)
CO 3	Prepare design details of different structural components, implementation plan for a project (Cognitive Knowledge Level: Apply)
CO 4	Understand the use of Building Information Modelling tools (Cognitive Knowledge Level: Understand)
CO 5	Schedule a given set of project activities using a software. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	2	1	3		2	1		2	1		1
CO 2	2	1	3		2	1		2	1		1
CO 3	2	1	3		2	1		2	1		1
CO 4	2	2	1	1	3	1		1		2	1
CO 5	2	2	1	1	3	1		1		2	1

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	10 marks
Continuous Assessment	10 marks
Viva-Voce (Self Study)	10 marks
Test	15 marks
Lab Record	5 marks

End Semester Examination Pattern

The following guidelines should be followed regarding the award of marks:

Preliminary work	: 20 marks
Implementation / Conducting the experiment	: 20 marks
Performance, result and inference (usage of equipment and troubleshooting)	: 30 marks
Viva voce	: 30 marks

SYLLABUS

LIST OF EXPERIMENTS

No	Description
	Analysis and design of steel and RCC elements using ETABS
1	Analysis and design of continuous and cantilever beams.
2	Analysis and design of plane truss and frames.

No	Description
3	Analysis and design of multi-storied RCC framed structures.
	Preparation of structural drawings of slabs and beams
4	Detailed structural drawing of one way/two way/continuous slabs.
5	Detailed structural drawing of singly reinforced/double reinforced Beams.
6	Detailed structural drawing of continuous/flanged beams.
7	Introduction to BIM tools (This section can be conducted as a demonstration)
	Introduction to project management -CPM and PERT
8	Preparation of Bar Chart/Gantt Charts/CPM/PERT Charts.
9	To find the critical Path based on the given set of activity / event data.
10	Practice on Resource allocation and Project Monitoring (Cost and Time).

References:

1. N Krishna Raju, Structural Design and Drawing, Second Edition, Universities Press (India), Private Limited, Hyderabad, 2009.
2. AutoCAD Essentials, Autodesk official Press, John Wiley & Sons, US, 2015.
3. Dr. Balagopal T.S. Prabhu, Building Drawing and Detailing, Spades Publishers, Calicut.
4. SP-34, Handbook on Concrete Reinforcement and Detailing.
5. S.M. ABID, ETABS FOR BEGINNERS: A Comprehensive Guide to Structural Analysis and Design

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CEM62	SUSTAINABILITY AND ENVIRONMENTAL HEALTH	3	1	0	5	4	2024

Preamble

The course is designed to provide an understanding of the interrelationship between sustainability, environmental quality and human health. It equips students with knowledge of occupational health, environmental and biological hazards, pollution and waste management, workplace safety practices and sustainable approaches that promote safe, clean and resilient systems in civil engineering and the built environment.

Prerequisites: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Explain the concepts of sustainability and environmental health, and relate the three pillars of sustainability and selected Sustainable Development Goals (SDGs) to human health and well-being. (Cognitive Knowledge Level: Understand)
CO 2	Describe major occupational health hazards in industries, basic toxicology, industrial hygiene and sustainable workplace practices that protect workers' health. (Cognitive Knowledge Level: Understand)
CO 3	Identify and analyse biological, noise, radiation, chemical and electrical hazards in workplaces and propose appropriate sustainable control and mitigation measures. (Cognitive Knowledge Level: Apply)
CO 4	Explain air and water pollution problems and evaluate sustainable pollution control, waste minimisation and circular-economy based management strategies. (Cognitive Knowledge Level: Apply)
CO 5	Apply principles of sustainability and environmental health to plan and assess safe workplaces, including inspections, personal protective equipment (PPE), first aid and integrated policy frameworks. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	2	2	1			2	3	1		1	
CO 2	2	2	2	1		3	2	2		1	
CO 3	2	3	2	2	1	3	2	2		1	
CO 4	2	3	2	2	1	2	3	1		1	
CO 5	2	2	3	2	1	3	3	2	1	2	1

Assessment Pattern

SUSTAINABILITY AND ENVIRONMENTAL HEALTH			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	50	20	30
Understand	50	50	50
Apply		30	20
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course Project	: 10 marks
Self Study	: 5 marks

End Semester Examination Pattern

There will be two parts: Part A and Part B. Part A contain 10 questions, with 2 questions

from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module, of which students should answer any one. Each question carries 14 marks and can have a maximum of 2 sub-divisions.

SYLLABUS

Module 1: Foundations of Sustainability and Environmental Health (7 hours)

Concept of sustainability: definition, principles and the three pillars (environmental, economic, social). Role of sustainability in human health and well-being. Global and national perspectives on sustainability with reference to the Sustainable Development Goals (SDGs), particularly SDG 3 (Good Health and Well-being), SDG 11 (Sustainable Cities and Communities) and SDG 12 (Responsible Consumption and Production).

Module 2: Occupational Health, Toxicology and Sustainable Workplaces (9 hours)

Health hazards in industries: musculoskeletal disorders, hearing loss, carcinogens, silicosis, asbestosis, pneumoconiosis and other occupational diseases. Toxicology: toxic materials and substances used at work, exposure limits, dose-response concepts, toxicological investigations. Industrial hygiene and monitoring of workplace exposures. Sustainable alternatives to hazardous materials, substitution and eco-friendly and safer workplace practices.

Module 3: Environmental Hazards (9 Hours)

Biological hazards: classification of biohazardous agents – bacterial, viral, fungal and parasitic agents; workplace infectious diseases and their prevention. Noise: health impacts, exposure limits, regulations and sustainable noise reduction methods. Radiation, Chemical and Electrical hazards: causes, effects and prevention.

Module 4: Pollution Effects and Control (10 Hours)

Air pollution: industrial sources and emissions, effects on human health, ecosystems and materials; concepts of clean coal and low-emission combustion technologies; role of renewable energy in air quality improvement. Water pollution: major pollutants, health hazards, effluent quality standards and regulatory frameworks; sustainable water management including recycling, reuse and zero-liquid-discharge concepts. Waste management: identification, classification and characterisation of solid wastes; sustainable practices including waste minimisation, segregation, recycling, circular economy, and waste-to-energy options.

Module 5: Safe and Sustainable Workplaces (10 Hours)

Safe workplaces: Objectives, Safety inspections, First aid appliances, Thermal comfort, Ventilation, Personal Protective Equipment (PPE). Integrated sustainability and health approaches: case studies of sustainable and healthy workplaces; policy and regulatory frameworks supporting environmental health and safety.

Text Books:

1. Cheremisinoff, N. P. and Graffia, M. L. (1995). Environmental Health and Safety Management. William Andrew Inc., New York.
2. Taylor, B. (2005). Effective Environmental, Health, and Safety Management Using the Team Approach. Culinary and Hospitality Industry Publications Services.
3. Gallant, B. (2007). The Facility Manager's Guide to Environmental Health and Safety. Government Institutes.
4. Jain, R. K. and Rao, S. S. (2006). Industrial Safety, Health and Environment Management Systems. Khanna Publishers, New Delhi.
5. Davis, M. L. Introduction to Environmental Engineering. McGraw Hill Education (India).
6. Allen, D. T. and Shonnard, D. R. Sustainability Engineering: Concepts, Design and Case Studies. Prentice Hall.
7. Bradley, A. S., Adebayo, A. O., and Maria, P. Engineering Applications in Sustainable Design and Development. Cengage Learning.
8. Environment Impact Assessment Guidelines, Notification of Government of India, 2006.

References:

1. Slote, L. Handbook of Occupational Safety and Health. John Wiley and Sons, New York.
2. Heinrich, H. W. (1980). Industrial Accident Prevention. McGraw Hill, New York.
3. Mahajan, S. P. (1993). Pollution Control in Process Industries. Tata McGraw Hill, New Delhi.
4. Purohit, S. S. Green Technology: An Approach for Sustainable Environment. Agrobios.
5. Twidell, J. W. and Weir, A. D. Renewable Energy Resources. ELBS.
6. Mackenthun, K. M. (1998). Basic Concepts in Environmental Management. Lewis Publishers, London.
7. Chang, N. Systems Analysis for Sustainable Engineering: Theory and Applications. McGraw-Hill Professional.
8. ECBC Code (2007). Bureau of Energy Efficiency, New Delhi.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	7 hours
1.1	Concept of sustainability – definition, principles and three pillars (environmental, economic, social).	2
1.2	Role of sustainability in human health and well-being.	2
1.3	Global and national perspectives on sustainability with reference to the Sustainable Development Goals (SDGs), particularly SDG 3 (Good Health and Well-being), SDG 11 (Sustainable Cities and Communities) and SDG 12 (Responsible Consumption and Production).	3
2	Module 2	9 hours
2.1	Overview of occupational health hazards in industries	2
2.2	Musculoskeletal disorders and hearing loss – causes, prevention.	1
2.3	Carcinogens, silicosis, asbestosis, pneumoconiosis and other occupational diseases.	1
2.4	Toxic materials and substances used at work; exposure limits, dose-response concepts and toxicological investigations.	1
2.5	Industrial hygiene and monitoring of workplace exposures.	1
2.6	Organisational arrangements and management systems for worker protection.	1
2.7	Sustainable alternatives to hazardous materials, substitution and eco-friendly and safer workplace practices.	2
3	Module 3	8 hours
3.1	Biological hazards – classification of biohazardous agents - bacterial, viral, fungal and parasitic agents.	2
3.2	Workplace infectious diseases and their prevention.	2

3.3	Noise: health impacts, exposure limits, regulations and sustainable noise reduction methods.	2
3.4	Radiation, Chemical and Electrical hazards: causes, effects and prevention.	2
4	Module 4	9 hours
4.1	Air pollution: industrial sources and emissions, effects on human health, ecosystems and materials.	2
4.2	Concepts of clean coal and low-emission combustion technologies; role of renewable energy in air quality improvement.	2
4.3	Water pollution: major pollutants, health hazards, effluent quality standards and regulatory frameworks.	1
4.4	Sustainable water management including recycling, reuse and zero-liquid-discharge concepts.	1
4.5	Solid waste identification, classification and characterisation.	1
4.6	Waste minimisation, segregation, recycling and circular-economy approaches.	1
4.7	Waste-to-energy options.	1
5	Module 5	10 hours
5.1	Safe workplaces: Objectives, Safety inspections.	2
5.2	First aid appliances, Thermal comfort, Ventilation, Personal Protective Equipment (PPE).	2
5.3	Integrated sustainability and health approaches.	1
5.4	Case studies of sustainable and healthy workplaces.	3
5.5	Policy and regulatory frameworks supporting environmental health and safety.	2
Total		45 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Explain the three pillars of sustainability and discuss how each pillar influences human health and well-being.
2. Discuss the socio-economic reasons for ensuring health and safety in construction and infrastructure projects.

Course Outcome 2 (CO 2):

1. List the major categories of occupational health hazards encountered in civil and industrial workplaces.
2. Explain the roles of industrial hygiene and toxicology in designing a healthy and sustainable workplace.

Course Outcome 3 (CO 3):

1. Identify typical chemical and biological hazards present in construction or industrial sites and outline suitable control measures.
2. Discuss the health impacts of noise and radiation exposure on workers and suggest sustainable strategies to minimise these risks.

Course Outcome 4 (CO 4):

1. Explain how air pollution from industrial sources affects human health and the environment, giving suitable examples.
2. Discuss the role of effluent standards and sustainable water management practices in protecting public health.

Course Outcome 5 (CO 5):

1. Describe the main steps involved in conducting a workplace safety inspection and explain its benefits.
2. Using a case study (real or hypothetical), illustrate how integrated sustainability and environmental health measures can create a safer and healthier workplace.

MODEL QUESTION PAPER

QP CODE:

Pages: 3

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

FIRST SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CEM62

SUSTAINABILITY AND ENVIRONMENTAL HEALTH

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Define sustainability with example.
2. State any three ways in which Sustainable Development Goal (SDG) 11 – Sustainable Cities and Communities – is related to civil engineering works.
3. List any three common occupational diseases observed among construction or industrial workers.
4. Define industrial hygiene and mention any two of its main functions.
5. List any three typical chemical hazards that workers may be exposed to at a construction site.
6. State any three sources of workplace noise that can affect human health.
7. List any three major air pollutants emitted from industrial activities.
8. State any three sustainable practices that can reduce water pollution from industrial or municipal sources.
9. Mention any three important aspects checked during a workplace safety inspection.
10. List any three types of personal protective equipment (PPE) commonly used in civil engineering works.

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. a) Explain in detail the three pillars of sustainability with examples from the built environment. (7)
b) Describe how SDGs 3, 11 and 12 can guide civil engineers to integrate health and sustainability into project planning and design. (7)

OR

12. a) Discuss the interrelationship between environmental quality, sustainability and human health with suitable examples. (8)
b) Explain the socio-economic reasons for implementing strong health and safety measures in construction and industrial projects. (6)

MODULE 2

13. a) Describe the major occupational health hazards in industries and construction sites and explain the causes and preventive measures for any three of them. (8)
b) Discuss the basic concepts of toxicology and the significance of exposure limits in protecting worker health. (6)

OR

14. a) Explain the role of industrial hygiene in identifying and controlling occupational health hazards, with reference to monitoring and control techniques. (7)
b) Describe the organisational arrangements required in a company to ensure a healthy and sustainable workplace. (7)

MODULE 3

15. a) Classify chemical and biological hazards commonly present in workplaces and discuss sustainable control measures for each category. (8)
b) Explain the effects of excessive noise exposure on human health and outline engineering and administrative controls to reduce noise at source and receiver (6)

OR

16. a) Discuss the health impacts of ionising radiation and describe the basic principles used to protect workers from radiation exposure. (7)
b) Identify typical electrical hazards at a construction site and propose a set of safety measures to prevent accidents. (7)

MODULE 4

17. a) Explain the major sources of air pollutants from industrial processes and discuss their effects on human health and the environment. (8)
b) Describe how clean coal technologies and renewable energy can contribute to improved air quality. (6)

OR

18. a) Discuss the key pollutants and hazards associated with water pollution and outline the role of effluent quality standards in environmental protection. (7)
b) Explain how waste minimisation, recycling and circular-economy principles can be applied in solid-waste management. (7)

MODULE 5

19. a) Describe the steps involved in planning and conducting a workplace safety inspection, highlighting how it supports sustainability and environmental health goals. (8)
b) Discuss the role of first aid appliances, thermal comfort, and ventilation in ensuring safe and sustainable workplaces. Explain how each contributes to protecting worker health and productivity. (6)

OR

20. a) Discuss the role of personal protective equipment (PPE) in protecting workers from environmental and occupational hazards and suggest ways to make PPE selection and use more sustainable. (7)
b) With a suitable case study, illustrate how integrated sustainability and environmental health strategies can create a safe and resilient workplace. (7)

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CEM63	TRANSPORTATION SYSTEMS	3	1	0	5	4	2024

Preamble

This course provides a comprehensive understanding of multimodal transportation systems, covering infrastructure design, traffic flow principles, mobility planning, and sustainable practices. It examines highways, railways, airports, seaports, and urban transit while exploring policy frameworks and emerging technologies essential for developing efficient, integrated, and future-ready transportation networks.

Prerequisites: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Understand the role of transportation in societal development and the characteristics of different transportation modes and highway elements (Cognitive Knowledge Level: Understand).
CO 2	Understand the fundamental relationships of traffic flow and the functions of traffic control devices and data collection methods.(Cognitive Level: Understand)
CO 3	Understand the basic components, functions, and operational features of railway systems, airports, seaports, and inland waterways (Cognitive Level: Understand)
CO 4	Understand urban transportation planning concepts, land-use interactions, and principles of sustainable and smart mobility (Cognitive Level: Understand).
CO 5	Understand national transportation policies, frameworks, and emerging mobility technologies to recommend integrated and future-ready transportation solutions (Cognitive Level: Understand).

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	2	2			3	2		1		
CO 2	3	3	2	2	2	2			1		
CO 3	2	2	3	2		2			1		
CO 4	2	3	3	2		3	3	1	2		2
CO 5	2	2	3	2	2	3	2		2		3

Assessment Pattern

TRANSPORTATION SYSTEMS			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	50	50	50
Understand	50	50	50
Apply			
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course project : 10 marks

Self Study : 5 marks

End Semester Examination Pattern

There will be two parts: Part A and Part B. Part A contain 10 questions, with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module, of which students should answer any one. Each question carries 14 marks and can have a maximum of 2 sub-divisions.

SYLLABUS

Module 1: Overview of Transportation Systems (10 hours)

Overview of Transportation Systems: Role of transportation in development – social, economic, environmental aspects. Classification of transportation modes: road, rail, air, water, and tunnel

Highway Engineering: Classification of roads, Introduction to road geometrics, Highway Cross sectional elements, pavement types, pavement materials

Module 2: Traffic Flow and Management (8 hours)

Elements of traffic flow: speed, volume, density – basic relationship. Types of traffic control devices: signals, signs, markings. Traffic data collection and surveys. Role of technology in traffic management (sensors, GPS, AI-based applications)

Module 3: Railway, Airport, Seaports and inland waterways (11 Hours)

Railway Engineering: Components, functions, gauges, coning of wheels

Airport Engineering: layout and components: Runways, terminals, air traffic control, aprons, Terminal Building (Introduction only), Runway Orientation

Seaports and inland waterways: Significance and components, Case studies on integrated multimodal systems.

Module 4: Urban Transportation and Sustainable Mobility (8 Hours)

Transportation Planning – Need for Transportation Planning, Transport-land use Interaction- Four Stage Travel Demand Modelling (Introduction only), Sustainable Transportation: Issues and Challenges, Emerging Concepts in Sustainable Transportation, Smart cities and mobility as a service (MaaS), Merging shared mobility solutions

Module 5: Policy Frameworks and Government Initiatives in India (8 Hours)

Policy frameworks and government initiatives in India (e.g., PM Gati Shakti, Bharatmala, Metro policies) Emerging trends: Autonomous vehicles, Hyperloop, electric and hydrogen vehicles, Role of data analytics, IoT, and AI in transportation systems, Future of mobility and global best.

Text Books:

1. Khanna, S.K., Justo, C.E.G. & Veeraragavan, A. — Highway Engineering, Nem Chand & Bros, 2021
2. Fred L. Mannering, Scott S. Washburn & Walter P. Kilareski — Principles of Highway Engineering and Traffic Analysis, Wiley India, 2011
3. Subhash C. Saxena (and S. P. Arora) — A Course in Railway Engineering, Dhanpat Rai & Sons, 1998
4. S.K. Khanna & M.G. Arora (and S.S. Jain) — Airport Planning and Design, Nem Chand & Bros, 1994
5. Quinn, A.D. — Design and Construction of Ports and Marine Structures, McGraw-Hill, 1998
6. C.S. Papacostas & P.D. Prevedouros — Transportation Engineering and Planning, Prentice Hall India Learning Pvt. Ltd., 2001
7. Geetam Tiwari & Dinesh Mohan (eds.) — Transport and Safety: Systems, Approaches, and Implementation, Springer Singapore, 2021

References:

1. Kadiyali, L. R. — Principles and Practice of Highway Engineering, Khanna Publishers.
2. C.J. Khisty & B.K. Lall — Transportation Engineering: An Introduction, Prentice Hall India Learning Pvt. Ltd
3. Venkatramaiah, C. — Transportation Engineering – Vol. 2 Railways, Airports, Docks and Harbours, Bridges and Tunnels, Universities Press (India).

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	10 hours
1.1	Introduction to Transportation Systems: role and importance, Classification of Transportation Modes (road, rail, air, water, tunnel) ,	2
1.2	Introduction to highway geometrics: basic cross-sectional elements (carriageway, shoulders, formation width, camber, right-of-way, typical cross-sections for urban/rural roads)	3
1.3	Pavement types: Flexible vs. Rigid pavements — definitions, components, advantages/disadvantages	2
1.4	Pavement materials and subgrade / base: soil, aggregates, bituminous materials; desirable properties (overview only)	1
1.5	Highway geometrics – Introduction to alignment, horizontal/vertical alignment, sight distance concepts	2
2	Module 2	8 hours
2.1	Definition of traffic engineering; importance of traffic flow study, Fundamental Traffic Flow Parameters: Speed, Flow (Volume), Density, Fundamental Relationship between parameters,	3
2.2	Types of control devices: traffic signals, signs, road markings, Requirements of Traffic Control Device,	2
2.3	Traffic Data Collection and Surveys Methods- Volume, speed, accident study, parking studies, Role of technology in traffic management (sensors, GPS, AI-based applications)	3
3	Module 3	11 hours
3.1	Introduction to Railway Transport and Permanent Way Components,	2
3.2	Coning of Wheels, Gauges- Different types of gauges, factors affecting choice of gauges	1

3.3	Introduction to Airport Engineering: Components, Airport Facilities: Taxiways, Aprons, Terminal Building, Air Traffic Control (Overview only)	2
3.4	Airport Runway Design: Runway Length, Orientation, Wind Rose, Basic Layout	1
3.5	Importance of water transport, types of ports/harbours/ waterways, Basic port/harbour structural elements — piers, wharves, jetties, breakwaters.	4
3.6	Integrated Multimodal Systems, Case Studies: Linking Rail, Air, Sea, Water Transport	1
4	Module 4	8 hours
4.1	Introduction to Transportation Planning, Need for Planning, Transport–Land Use Interaction: Concepts and Importance	2
4.2	Introduction to Travel Demand Forecasting, Four-Stage Model Overview	3
4.3	Introduction to Sustainable Transportation: Issues, Challenges and Need, Sustainable Mobility Strategies : Smart cities and mobility as a service (MaaS), Merging shared mobility solutions	3
5	Module 5	8 hours
5.1	Transport Policy Frameworks in India – Introduction, Policy frameworks and government initiatives in India (e.g., PM Gati Shakti, Bharatmala, Metro policies)	3
5.2	Emerging trends: Autonomous vehicles, Hyperloop, electric and hydrogen vehicles	2
5.3	Role of data analytics, IoT, and AI in transportation systems, Future of mobility and global best practice: Singapore Smart Mobility	3
Total		45 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Define and describe the following cross-sectional elements of a highway: carriageway, shoulder, formation width, and right-of-way (ROW). Explain the functional importance of each element.
2. Explain the purpose of camber in road design, and how does it contribute to road safety and durability?

Course Outcome 2 (CO 2):

1. Define and describe the following traffic flow parameters: speed, flow (volume), and density
2. Name and briefly describe two common survey or data-collection methods

Course Outcome 3 (CO 3):

1. Describe the basic components of an airport
2. Describe two fundamental port/harbour structures and explain their purpose

Course Outcome 4 (CO 4):

1. Explain the concept of Transport–Land Use Interaction. How does land-use influence travel demand and transportation needs in a city?
2. Define Sustainable Transportation. What challenges does urban transport face that make sustainability important?

Course Outcome 5 (CO 5):

1. Name two other major government transport infrastructure initiatives in India (apart from PM Gati Shakti) and briefly state their objectives
2. List some of the emerging trends or technologies in the future of mobility globally and in India?

MODEL QUESTION PAPER

QP CODE:

Pages: 3

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

SIXTH SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CEM63

TRANSPORTATION SYSTEMS

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. List and briefly describe four cross sectional elements of a highway (e.g. carriageway, shoulder, right of way, formation width)
2. What are the two main types of pavements? Give one advantage and one limitation for each type.
3. What are the main types of traffic control devices? Give two examples.
4. Why is traffic data collection important? Name one method of traffic survey.
5. What is meant by “gauge” of a railway track? Why is gauge selection important in railway engineering?
6. Name three basic components or facilities of an airport (layout/facility).
7. Briefly define “sustainable transportation.” Mention one challenge that sustainable transport planning attempts to address.
8. What does “Mobility as a Service (MaaS)” imply in the context of urban mobility and shared mobility solutions?
9. What is the objective of a national multimodal connectivity plan (for example, a policy for integrated transport infrastructure)?
10. Why is adoption of new technologies (e.g. data analytics, IoT, AI) important in modern transportation planning and management?

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. a) Discuss the importance of geometric design in highways. What are the main design controls/criteria that influence highway geometrics (7)
b) Explain the structure and role of subgrade, sub base, base and surface layers in a flexible pavement. (7)

OR

12. a) Draw a typical cross section of a two lane rural highway (without kerbs). Label and define the main cross sectional elements (7)
b) Explain the concepts of alignment (horizontal and vertical) and sight distance in highway geometric design. (7)

MODULE 2

13. a) Explain the basic relationship between them (including the equation) and illustrate using a diagram (7)
b) Describe signals, signs, road markings. Explain the purpose of each and list key requirements for a traffic control device to be effective (7)

OR

14. a) Explain why traffic data collection and surveys are essential in traffic engineering. Describe common methods of speed survey (8)
b) Discuss how modern technology (sensors, GPS, AI based traffic management systems) can aid traffic management (6)

MODULE 3

15. a) Explain “coning of wheels” and its significance. How does coning help trains negotiate curves, and why is it important for track and wheel interaction? (6)
b) What factors determine runway design, specifically runway length and orientation? Explain the role of wind direction (wind rose), runway layout, and other site considerations in determining an appropriate runway. (8)

OR

16. a) Explain the concept of an integrated multimodal transport system. (6)
b) Discuss why linking rail, air, sea, and inland waterways is beneficial for national or regional transportation, including advantages in efficiency, connectivity, and resource utilization. (8)

MODULE 4

17. a) Describe the four stages of the Four Stage Travel Demand Model (7)
b) Explain briefly what each stage estimates and why this model is useful in transportation planning (7)

OR

18. a) Explain how modern technologies (e.g. data analytics, IoT, digital integration) support sustainable and efficient urban mobility. (6)
b) Discuss how shared mobility and on-demand transport services (e.g., ridesharing, microtransit) can complement traditional public transport in a city (8)

MODULE 5

19. a) Describe the role of major initiatives like Bharatmala Pariyojana in India's transport infrastructure development. (7)
b) Discuss the importance of integrating modern technology (like AI, data analytics, IoT) into national transport planning platforms. (7)

OR

20. a) Examine the challenges and considerations that must be addressed when adopting futuristic transport solutions (like EVs, hyperloop, AI based transport). Consider aspects like infrastructure, policy, environment, and social impact. (6)
b) Define the concept of a "smart mobility ecosystem" in the global context. How can India benefit by adopting global best practices in smart mobility and multimodal integration with respect to economy, sustainability, and urban planning? (8)

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CEH61	PRECAST STRUCTURES	3	1	0	5	4	2024

Preamble

This course provides the practical aspects of precast concrete design starting from the selection of the appropriate structural system considering design criteria at various stages, calculation of different loads & load combination in the building, modelling, analysis and design of large panel, frame systems, detailing of elements and the design of associated connections. The course also explains the plant production process, moulding & casting, curing, storage, transportation, handling, erection and quality inspection of precast elements.

Prerequisites: Structural Analysis, Design of concrete structures

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Understand the fundamental concepts, need, and principles of precast construction, and differentiate between precast and conventional construction methods based on features, materials, and applications. (Cognitive Knowledge Level: Understand)
CO 2	Identify and apply the functional behaviour of different precast structural elements such as slabs, beams, columns, and wall systems, and explain their role in resisting gravity and lateral loads. (Cognitive Knowledge Level: Apply)
CO 3	Apply the principles of structural behaviour and connection design to ensure load transfer, stability, and diaphragm action in precast systems under various loading conditions. (Cognitive Knowledge Level: Apply)
CO 4	Understand and implement production, storage, and erection techniques for precast components, including logistics, hoisting methods, and quality control measures in fabrication and assembly. (Cognitive Knowledge Level: Apply)
CO 5	Analyze notable precast projects and innovations to evaluate performance under extreme events and apply lessons learned to improve safety, efficiency, and sustainability in precast construction. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	2	1			2						
CO 2	3	2	2			1				1	
CO 3	3	2	3			1		1		1	
CO 4	2	2	1								2
CO 5	3	3	1	1		1	1				

Assessment Pattern

PRECAST STRUCTURES			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember			
Understand	50	40	40
Apply	50	60	60
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course project : 10 marks

Self Study : 5 marks

End Semester Examination Pattern

There will be two parts: Part A and Part B. Part A contain 10 questions, with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module, of which students should answer any one. Each question carries 14 marks and can have a maximum of 2 sub-divisions.

SYLLABUS

Module 1: Introduction to Precast and its elements (9 hours)

Introduction – current scenario and constraints, the difference between precast and conventional construction methods, need for prefabrication, principles of prefabrication, features, advantages and limitations, classification, selection, application, materials used.

Module 2: Precast Concrete Building Elements (9 hours)

Precast concrete slabs - hollow core slabs, composite floors, ribbed/ hollow slabs, post tensioned slab. Beams – non composite reinforced concrete elements, composite beams, prestressed beams. Columns - RC columns, composite columns, columns with corbel. Wall systems - Types of precast concrete walls (infill shear walls), Distribution of horizontal loadings.

Module 3: Structural behaviour and connections (9 Hours)

Structural behaviour of precast components under gravity and lateral loads, Load transfer mechanisms and stability of precast systems. Connections: dry joints, wet joints, mechanical connectors, post-tensioning. Use of dowel bars and ties. Diaphragm action in precast floor systems.

Module 4: Production, Storage, & Logistics (9 Hours)

Manufacturing methods, stationary and mobile production, planning of production setup, storage of precast elements, dimensional tolerances, acceleration of concrete hardening. Hoisting Technology - Equipment for hoisting and erection, techniques for erection of different types of members like beams, slabs, wall panels and columns, vacuum lifting pads.

Module 5: Case Studies and innovations (9 Hours)

Review of notable precast concrete projects in India and worldwide. Lessons from failures and performance under extreme events (earthquakes, fire, corrosion). Innovations in precast concrete: 3D printing, modular integrated construction, hybrid system.

Text Books:

1. Precast Concrete Structures, Kim S. Elliot, Second Edition, CRC Press, 2016.
2. Structural design manual, Precast concrete connection details, Society for the studies in the use of precast concrete, Netherland Beton Verlag.
3. The Structural Precast Concrete Handbook, Second Edition, ISBN : 981-04-3609-2, Building and Construction Authority, May 2001.
4. Mokka. L, (1964), Prefabricated Concrete for Industrial and Public Structures, Publishing House of the Hungarian Academy of Sciences, Budapest.
5. IS: 11384-1985, Code of Practice for Composite Construction in Structural Steel and Concrete.

Reference Books:

1. NBC (2005), Part I to Part VII, BIS Publications, New Delhi.
2. R.P. Johnson, Composite Structure of Steel and Concrete (Volume 1), Blackwell Scientific Publication (Second Edition), U.K., 1994.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	9 hours
1.1	Introduction – current scenario and constraints, the difference between precast and conventional construction methods	2
1.2	Need for prefabrication, principles of prefabrication, features	3
1.3	Advantages and limitations, classification	2
1.4	Selection, application, materials used	2
2	Module 2	9 hours
2.1	Precast concrete slabs - hollow core slabs, composite floors	2
2.2	Ribbed/ hollow slabs, post tensioned slab	1
2.3	Beams – non composite reinforced concrete elements, composite beams, prestressed beams	2
2.4	Columns- RC columns, composite columns, columns with corbel	2
2.5	Wall systems-Types of precast concrete walls (infill shear walls), Distribution of horizontal loadings	2
3	Module 3	9 hours
3.1	Structural behaviour of precast components under gravity and lateral loads	2
3.2	Load transfer mechanisms and stability of precast systems	2
3.3	Connections: dry joints, wet joints	2
3.4	Mechanical connectors, post-tensioning	1
3.5	Use of dowel bars and ties. Diaphragm action in precast floor systems	2

4	Module 4	9 hours
4.1	Manufacturing methods, stationary and mobile production	2
4.2	Planning of production setup, storage of precast elements	2
4.3	Dimensional tolerances, acceleration of concrete hardening	1
4.4	Hoisting Technology - Equipment for hoisting and erection	2
4.5	Techniques for erection of different types of members like beams, slabs, wall panels and columns, vacuum lifting pads	2
5	Module 5	9 hours
5.1	Review of notable precast concrete projects in India and worldwide	3
5.2	Lessons from failures and performance under extreme events (earthquakes, fire, corrosion)	2
5.3	Innovations in precast concrete: 3D printing, modular integrated construction	2
5.4	Hybrid system	2
Total		45 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Differentiate between precast and cast-in-situ construction.
2. Explain any three advantages of precast construction over conventional methods.
3. Interpret the significance of material selection in precast construction.

Course Outcome 2 (CO 2):

1. Explain the load-resisting mechanism of a hollow core slab.
2. Discuss the structural behaviour of composite beams and non-composite reinforced concrete beams.
3. Explain how infill precast shear walls resist and distribute the horizontal load to the foundation.

Course Outcome 3 (CO 3):

1. Discuss the load transferring mechanisms and stability of precast systems.
2. Select and justify the use of wet joint vs mechanical connectors for connecting two precast columns in a high-rise building.
3. Explain diaphragm action in precast floor systems.

Course Outcome 4 (CO 4):

1. Discuss stationary and mobile production of precast elements.
2. Outline various techniques for the erection of beams, slabs, wall panels and columns.
3. Explain the planning, production and storage of precast elements

Course Outcome 5 (CO 5):

1. Describe the concept of 3D printing in precast concrete and its potential for customized element production.
2. Explain the hybrid precast system combining precast beams with cast-in-situ slabs, and its benefits for load distribution.
3. Discuss the performance of precast systems under extreme events like earthquakes, fire and corrosion.

MODEL QUESTION PAPER

QP CODE:

Pages: 2

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

SIXTH SEMESTER B TECH DEGREE EXAMINATION, 2024

Course Code: B24CEH61

PRECAST STRUCTURES

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Differentiate between precast and conventional construction methods.
2. State the main advantages and limitations of prefabricated construction systems.
3. List the different types of precast concrete slabs.
4. What are the functions of corbels in precast columns? What are the key considerations in damage assessment for structures affected by earthquakes and floods?
5. What is the importance of diaphragm action in precast floor systems?
6. Define dry and wet joints with examples used in precast construction.
7. Mention the differences between stationary and mobile precast production systems.
8. What are the dimensional tolerances commonly maintained in precast element manufacturing? .
9. List two innovative technologies currently used in precast concrete construction.
10. What lessons can be learned from failures of precast structures under earthquakes?

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. Explain the principles and steps involved in prefabrication. Illustrate with examples of suitable applications in building construction.

OR

12. Discuss the criteria for selecting precast construction systems and materials for different types of structures, citing practical examples. With the help of flow chart explain assessment procedure for evaluating a damaged structure.

MODULE 2

13. Apply the concept of load distribution in precast wall systems to analyze how horizontal loads are resisted in multi-storey buildings.

OR

14. Compare the structural behaviour and design considerations of composite and non-composite precast beams using suitable sketches and examples. Brief out various causes of deterioration of a structure.

MODULE 3

15. Explain the load transfer mechanisms and overall stability of a precast structural frame subjected to lateral loads.

OR

16. Apply connection design principles to propose suitable joint details for a precast beam-column junction under combined gravity and seismic loading.

MODULE 4

17. Explain the stages in planning, production, storage, and transportation of precast concrete elements with relevant diagrams.

OR

18. Outline the procedure for installing precast beams, slabs, and wall panels safely and efficiently using hoisting and erection techniques.

MODULE 5

19. Analyze a notable precast project (in India or abroad) in terms of design, execution, and performance under service and extreme conditions.

OR

20. Apply modern precast innovations such as modular integrated construction or 3D printing to propose a sustainable precast system for urban housing development.

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CEH62	REPAIR AND REHABILITATION	3	1	0	5	4	2024

Preamble

This course provides a detailed understanding of the deterioration, assessment, and maintenance of civil engineering structures. It explores the causes of structural damage, methods for evaluating condition, and modern techniques and materials for repair, corrosion protection, and strengthening. The course also covers safe and effective methods for the systematic dismantling of deteriorated structures.

Prerequisites: Construction Technology & Management

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Understand the importance of maintenance in civil engineering structures, identify types and causes of structural deterioration (Cognitive Knowledge Level: Understand)
CO 2	Carry out condition assessment of structures using visual inspection, non-destructive and semi-destructive tests, and evaluate structural durability and safety through appropriate testing methods. (Cognitive Knowledge Level: Apply)
CO 3	Select and apply suitable materials and methods for repair, strengthening, and protection of concrete structures. (Cognitive Knowledge Level: Apply)
CO 4	Apply appropriate corrosion protection and crack repair to ensure the durability and safety of concrete structures. (Cognitive Knowledge Level: Apply)
CO 5	Analyse the suitability and effectiveness of various stabilization and strengthening techniques for different structural conditions to ensure safety and performance. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	2				1	2		1		
CO 2	2	3	2	3	3	1				1	
CO 3	2	2	3	2	2	1	1	2	2	1	2
CO 4	2	2	3	2	2	1	1	3	2	1	2
CO 5	3	3	3	3	3	2	2	1	2	2	3

Assessment Pattern

REPAIR AND REHABILITATION			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	10	10	10
Understand	50	50	50
Apply	40	40	40
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 10 marks
Self Study	: 5 marks

End Semester Examination Pattern

There will be two parts: Part A and Part B. Part A contain 10 questions, with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module, of which students should answer any one. Each question carries 14 marks and can have a maximum of 2 sub-divisions.

SYLLABUS

Module 1: Introduction and Deterioration of Structures (9 hours)

Introduction: importance of maintenance in civil engineering structures - types of maintenance including routine, preventive, corrective, special - causes and classification of cracks in reinforced concrete and masonry structures: structural, non-structural, thermal, shrinkage, settlement, corrosion-induced cracks.

Module 2: Condition Assessment and Testing Methods (9 hours)

Condition assessment of structures: objectives and procedures - visual inspection methods, checklist and systematic documentation - non-destructive tests: including ultrasonic pulse velocity, rebound hammer tests - semi-destructive tests: pull-out test, core test, probe test - durability assessment - half-cell potential test, chloride penetration testing, carbonation studies, carbonation depth measurement, corrosion activity monitoring - load testing as a method of evaluating the strength and safety of distressed structures.

Module 3: Repair Materials (9 Hours)

Importance of substrate and surface preparation: general methods and procedures for preparation and cleaning of reinforcing steel - repair materials: classification, properties, selection criteria, methodology of application - special mortars and concretes: polymer concrete, polymer mortar, quick-setting compounds, high strength concrete, high-performance concrete, self-compacting concrete - grouting materials: cementitious grouts, gas forming grouts, sulfoaluminate grouts, polymer grouts, acrylate grouts urethane grouts - bonding agents: latex emulsions, epoxy-based agents - protective coatings for concrete and steel including waterproofing systems - use of fibre reinforced polymer (FRP) sheets in strengthening and protection of structural elements.

Module 4: Repair and Corrosion Protection Techniques (9 Hours)

Methods of corrosion protection: corrosion inhibitors, corrosion resistant steels, protective coatings, cathodic protection - crack repair techniques: grouting, routing and sealing, stitching, dry packing, autogenous healing, gunite and shotcrete, epoxy injection, localized mortar repair for cracks.

Module 5: Stabilization and Strengthening Techniques (9 Hours)

Structural stabilization measures: shoring and underpinning to ensure safety during repair works. Jacketing methods: column jacketing, beam jacketing, beam-column joint jacketing, reinforced concrete jacketing, steel jacketing, fibre reinforced polymer (FRP) jacketing.

Text Books:

1. Concrete Repair and Maintenance, Peter H. Emmons, Galgotia Publications Pvt. Ltd., 2001.
2. Repair and Protection of Concrete Structures, Noel P. Mailvaganam, CRC Press, 1991.
3. Earthquake-Resistant Design of Structures, Pankaj Agarwal, Manish Shrikande, PHI, 2006.
4. Concrete Structures: Materials, Maintenance, and Repair, Denison Campbell, Allen, Harold Roper, Longman Scientific and Technical, UK, 1991.
5. Rehabilitation of Concrete Structures, Vidivelli B, Standard Publishers, 2009.

References:

1. Diagnosis and Treatment of Structures in Distress, R. N. Raikar, R & D Centre of Structural Designers and Consultants Pvt. Ltd, Mumbai, 1994.
2. Handbook on Repair and Rehabilitation of RCC Buildings, CPWD, Government of India, 2002.
3. Handbook on Seismic Retrofit of Buildings, A. Chakrabarti et al., Narosa Publishing House, 2010.
4. Structural Health Monitoring, Repair and Rehabilitation of Concrete Structures, K. Ravishankar, T. S. Krishnamoorthy, Allied Publishers, 2004.
5. Handbook on Seismic Retrofit of Buildings, CPWD and Indian Buildings Congress, Narosa Publishers, 2008.
6. Concrete Technology, M. L. Gambhir, McGraw Hill, 2013.
7. Self-Healing Concrete, David J. Fisher, Materials Research Forum LLC, 20 May 2021.
8. Demolition: Practices, Technology, and Management, Richard J. Diven, Mark Shaurette, 2011.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	9 hours
1.1	Importance of maintenance in civil engineering structures	2
1.2	Types of maintenance - routine maintenance, preventive maintenance	2
1.3	Types of maintenance - corrective maintenance, special maintenance	2
1.4	Causes and classification of cracks in reinforced concrete and masonry structures: structural, non-structural, thermal, shrinkage, settlement, corrosion-induced cracks	3
2	Module 2	9 hours
2.1	Condition assessment of structures: objectives and procedures	1
2.2	Visual inspection methods and systematic documentation	1
2.3	Non-destructive tests: ultrasonic pulse velocity, rebound hammer tests	1
2.4	Semi-destructive tests: pull-out test, core test, probe test	2
2.5	Durability assessment - chloride penetration testing, carbonation studies, carbonation depth measurement, corrosion activity monitoring	2
2.6	Load testing as a method of evaluating the strength and safety of distressed structures	2
3	Module 3	9 hours
3.1	Importance of substrate and surface preparation: general methods and procedures for preparation and cleaning of reinforcing steel	1
3.2	Repair materials: classification, properties, selection criteria, methodology of application	2

3.3	Special mortars and concretes: polymer concrete, polymer mortar, quick-setting compounds, high strength concrete, high-performance concrete, self-compacting concrete	2
3.4	Grouting materials: cementitious grouts, gas forming grouts, sulfoaluminate grouts, polymer grouts, acrylate grouts urethane grouts	2
3.5	Bonding agents: latex emulsions, epoxy-based agents - protective coatings for concrete and steel including waterproofing systems	1
3.6	Use of fibre reinforced polymer (FRP) sheets in strengthening and protection of structural elements	1
4	Module 4	9 hours
4.1	Methods of corrosion protection: corrosion inhibitors, corrosion resistant steels, protective coatings, cathodic protection	3
4.2	Crack repair techniques: grouting, routing and sealing, stitching, dry packing	3
4.3	Crack repair techniques: autogeneous healing, gunite, shotcrete, epoxy injection, localized mortar repair for cracks	3
5	Module 5	9 hours
5.1	Structural stabilization measures: shoring and underpinning	3
5.2	Jacketing methods: column jacketing, beam jacketing	2
5.3	Beam-column joint jacketing, reinforced concrete jacketing	2
5.4	Steel jacketing, fibre reinforced polymer (FRP) jacketing	2
Total		45 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Describe routine maintenance and preventive maintenance.
2. Explain three methods for controlling cracks in buildings.

Course Outcome 2 (CO 2):

1. How does the ultrasonic pulse velocity value relate to the quality of concrete?
2. Explain the detailed procedure for core sampling and testing of existing concrete structures.

Course Outcome 3 (CO 3):

1. Why is surface preparation important before applying repair materials to concrete structures?
2. During the rehabilitation of a corroded reinforced concrete beam, describe the step-by-step procedure for preparing the corroded reinforcing steel surface and selecting a suitable bonding agent before applying a polymer-modified repair mortar.

Course Outcome 4 (CO 4):

1. A reinforced concrete column shows active corrosion. Explain how you would select and apply corrosion protection methods to ensure durability.
2. A concrete structure shows signs of deterioration. Which tests would you use to assess the corrosion potential of the reinforcing steel, and describe the procedure and result interpretation for any two of these tests?

Course Outcome 5 (CO 5):

1. A concrete column is too weak to carry the load. Which type of jacketing can be used to strengthen it, and what are the steps to apply it?
2. Explain the concept of beam jacketing and its applications.

MODEL QUESTION PAPER

QP CODE:

Pages: 2

Reg.No.:

Name:

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

SIXTH SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CEH62

REPAIR AND REHABILITATION

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Differentiate between routine maintenance and preventive maintenance.
2. Explain any three techniques used to prevent and repair cracks in concrete structures.
3. Differentiate non-destructive and semi-destructive testing methods with examples.
4. Explain the major factors which cause corrosion to reinforcement in concrete.
5. What are the applications of quick setting compounds?
6. List three properties to consider when selecting a repair material for reinforced concrete.
7. Differentiate between guniting and shortcreting.
8. Explain cathodic protection of reinforcement bars.
9. Explain the concept of beam jacketing and its applications.
10. A concrete column is too weak to carry the load. Which type of jacketing can be used to strengthen it, and what are the steps to apply it?

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. Explain the various types of cracks in reinforced concrete structures and their causes.

OR

12. Explain how to ensure durability and strength of a concrete structure in hot climate and suggest measures to prevent reinforcement corrosion.

MODULE 2

13. Describe and compare the two types of pull out tests for concrete.

OR

14. Explain the working principle of Rapid Chloride Penetration Test, with a neat sketch.

MODULE 3

15. Explain surface preparation for concrete and steel reinforcement repairing works.

OR

16. Discuss the repair of a deteriorated concrete member, focusing on surface preparation, crack filling and protective coating application. Justify the choice of repair materials.

MODULE 4

17. A concrete structure shows signs of deterioration. Which tests would you use to assess the corrosion potential of the reinforcing steel, and describe the procedure and result interpretation for any two of these tests?

OR

18. A reinforced concrete wall has developed cracks. Describe the main crack repair techniques and explain how to select and apply the appropriate method for long-term durability.

MODULE 5

19. Explain jacketing method of strengthening columns and beams. Explain any three types of with neat figures.

OR

20. Explain different types of shoring with neat sketches.

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CEH63	ECO CONSCIOUS CONSTRUCTION	3	1	0	5	4	2024

Preamble

Eco-Conscious Construction familiarizes students with sustainable practices in water and energy efficiency, waste management, and circular economy approaches. The course covers modern construction techniques and green building frameworks for sustainable development. Students will gain an understanding of life cycle thinking, case studies, and emerging trends to design resilient and resource-efficient infrastructure.

Prerequisites: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Understand the need, scope, and relevance of sustainability in civil engineering and identify the role of the construction industry in achieving sustainable development goals (SDGs) (Cognitive Knowledge Level: Understand).
CO 2	Apply concepts of water and waste water efficiency to promote sustainable resource management. (Cognitive Knowledge Level: Apply)
CO 3	Apply modern and digital construction techniques such as prefabrication, 3D printing, and BIM for achieving sustainability and energy efficiency. (Cognitive Knowledge Level: Apply)
CO 4	Understand the concepts of life cycle assessment and embodied carbon to identify low-carbon and eco-friendly construction materials and implement circular economy principles in construction. (Cognitive Knowledge Level: Understand)
CO 5	Apply green building rating systems, net-zero design principles, and smart building concepts to evaluate sustainable construction projects and emerging trends. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	2	2	1			2	3	1		1	
CO 2	2	2	2	1	1	2	3	1		1	
CO 3	2	2	3	2	3	2	3	1	1	2	2
CO 4	2	3	2	2	2	2	3	1		1	
CO 5	2	2	3	2	2	2	3	2	1	2	2

Assessment Pattern

ECO CONSCIOUS CONSTRUCTION			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	20	20	30
Understand	50	50	60
Apply	30	30	10
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course project : 10 marks

Self Study : 5 marks

End Semester Examination Pattern

There will be two parts: Part A and Part B. Part A contain 10 questions, with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module, of which students should answer any one. Each question carries 14 marks and can have a maximum of 2 sub-divisions.

SYLLABUS

Module 1: Fundamentals of Eco-Conscious Construction (8 hours)

Sustainability in civil engineering: need, scope, and relevance to SDGs. Role of construction industry in carbon emissions and climate change. Green construction principles and guidelines. Local and global policies promoting sustainable construction.

Module 2: Resource Efficiency (9 hours)

Water and Waste Water efficiency: rainwater harvesting, grey water recycling, water reuse in buildings, Efficiency in building operations, Smart buildings for thermal comfort, Smart sensors for lighting and air conditioning. Energy efficient systems and materials.

Module 3: Modern Construction Techniques for Sustainability (9 Hours)

Prefabricated and modular construction – reducing waste and improving efficiency, 3D printing of concrete and composites, Advanced reinforcement systems: FRP, TRC (Textile Reinforced Concrete), hybrid reinforcement, Digital and smart technologies in construction, Building Information Modelling (BIM), AI, IoT for sustainable design.

Module 4: Life Cycle Assessment (9 Hours)

Life Cycle Assessment (LCA) and carbon footprint analysis in construction, Embodied energy and carbon emissions of construction materials and methods, Emissions during operation of the building, Emerging carbon capture technologies, Responsible material sourcing. Circular economy in construction – reuse, repair, recovery, and material upcycling.

Module 5: Green Building Systems, Case Studies & Emerging Trends(10 Hours)

Green building rating systems: Objectives and Basic certification frameworks (IGBC, GRIHA, LEED, BREEAM), Introduction to net-zero energy and net-zero water buildings, Smart & Healthy building concepts, Emerging trends in sustainable construction, Case studies - sustainable construction projects in India and worldwide.

Text Books:

1. Kibert, C.J. (2016). Sustainable Construction: Green Building Design and Delivery. Wiley.
2. Pacheco-Torgal, F., Cabeza, L.F., Labrincha, J., & De Magalhães, A. (2014). Eco-efficient Construction and Building Materials. Woodhead Publishing.

3. Jagadish, K.S., Venkatarama Reddy, B.V., & Nanjunda Rao, K.S. (2007). *Alternative Building Materials and Technologies*. New Age International Publishers, India.
4. GRIHA Council (2019). *GRIHA Manual – Guidelines for Green Buildings in India*. The Energy and Resources Institute (TERI), New Delhi.
5. Indian Green Building Council (IGBC) *Manuals and Guidelines*, Confederation of Indian Industry (CII).
6. Newman, J., & Choo, B.S. (2003). *Advanced Concrete Technology: Processes*. Elsevier.
7. Jagadish, K.S. (2019). *Sustainable Building Technologies*. I.K. International Publishing House Pvt. Ltd, India.

Reference Books:

1. Bureau of Indian Standards (2016). *National Building Code of India 2016 – Sustainable Building Practices Section*. BIS, New Delhi.
2. TERI (2004). *Sustainable Building – Design Manual, Part 1 & 2*. The Energy and Resources Institute, New Delhi.
3. Kibert, C.J. (2016). *Sustainable Construction: Green Building Design & Delivery*, 4th Edition. Wiley Publishers.
4. Jagadish, K.S. (2008). *Alternative Building Materials and Technologies*. New Age International Pvt Ltd Publishers.
5. Rider, T.R., Glass, S., & McNaughton, J. (2011). *Understanding Green Building Materials*. W.W. Norton and Company.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	8 hours
1.1	Sustainability in civil engineering – need, scope, and relevance to SDGs.	2
1.2	Role of the construction industry in carbon emissions and climate change.	2
1.3	Green construction principles and guidelines – concepts, objectives, and best practices.	2
1.4	Local and global policies, codes, and initiatives promoting sustainable construction.	2
2	Module 2	9 hours
2.1	Water and Waste Water efficiency: rainwater harvesting, greywater recycling, water reuse in buildings.	2
2.2	Efficiency in building operations.	2
2.3	Smart buildings for thermal comfort, Smart sensors for lighting and air conditioning.	2
2.4	Energy efficient systems and materials.	3
3	Module 3	9 hours
3.1	Prefabricated and modular construction – reducing waste, improving efficiency.	2
3.2	3D printing of concrete and composites	2
3.3	Advanced reinforcement systems – FRP (Fibre Reinforced Polymer), TRC (Textile Reinforced Concrete), and hybrid reinforcement concepts.	2
3.4	Digital and smart technologies – Building Information Modelling (BIM), Artificial Intelligence (AI), and Internet of Things (IoT) for sustainable design.	3

4	Module 4	9 hours
4.1	Life Cycle Assessment (LCA) and carbon footprint analysis in construction.	2
4.2	Embodied energy and carbon emissions of construction materials and methods.	2
4.3	Emissions during operation of the building.	1
4.4	Emerging carbon capture technologies, Responsible material sourcing.	2
4.5	Circular economy in construction – reuse, repair, recovery, and material upcycling.	2
5	Module 5	10 hours
5.1	Green building rating systems: Objectives and Basic certification frameworks (IGBC, GRIHA, LEED, BREEAM)	1
5.2	Introduction to net-zero energy and net-zero water buildings.	2
5.3	Smart and healthy buildings.	2
5.4	Emerging trends in sustainable construction.	2
5.5	Case studies - sustainable construction projects in India and worldwide.	3
Total		45 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Define sustainability in the context of civil engineering and explain its relevance to the Sustainable Development Goals (SDGs).
2. Explain the role of construction in minimizing the environmental footprint of construction projects.

Course Outcome 2 (CO 2):

1. Apply the principles of water and waste water efficiency to design a sustainable resource management plan.
2. Explain the role of smart sensors for lighting and air conditioning in improving energy efficiency and thermal comfort in buildings.

Course Outcome 3 (CO 3):

1. Explain how prefabrication, modular construction, and 3D printing contribute to waste reduction and resource optimization in modern construction.
2. Apply BIM and digital technologies to enhance the sustainability and energy efficiency of a building project.

Course Outcome 4 (CO 4):

1. Describe how Life Cycle Assessment (LCA) helps in evaluating the environmental impact of building materials and construction processes.
2. Explain how the circular economy concept can be implemented in construction to minimize waste and promote material reuse and upcycling.

Course Outcome 5 (CO 5):

1. Apply the principles of green building rating systems (LEED, GRIHA, or IGBC) to assess the sustainability performance of a construction project.
2. Explain the design strategies used in net-zero energy and water buildings with reference to case studies of smart and resilient urban infrastructure.

MODEL QUESTION PAPER

QP CODE:

Pages: 3

Reg.No.:

Name:

**MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM**

FIRST SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CEH63

ECO CONSCIOUS CONSTRUCTION

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. What is the relevance of sustainability in civil engineering?
2. Differentiate between traditional construction and green construction practices.
3. Define greywater recycling and mention two benefits of its application in buildings.
4. List three features of smart buildings that contribute to thermal comfort.
5. Define prefabricated construction and state two advantages in terms of waste reduction and efficiency.
6. What is Textile Reinforced Concrete (TRC)? Mention one key application in sustainable construction.
7. Define carbon footprint analysis and explain its significance in the construction sector.
8. Why is embodied carbon an important factor in material selection?
9. What are the main objectives of green building rating systems like GRIHA or LEED?
10. How do net-zero buildings contribute to sustainable development?

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. a) Explain the need and scope of sustainability in civil engineering with suitable examples. (7)
b) Discuss the role of the construction industry in contributing to carbon emissions and climate change. (7)

OR

12. a) Describe the key principles and guidelines of green construction. (7)
b) Illustrate how local and global policies promote sustainable construction practices.. (7)

MODULE 2

13. a) Explain the process of rainwater harvesting in urban buildings. Discuss its role in sustainable water management.
b) Evaluate the importance of energy-efficient construction materials in reducing operational energy demand. Give examples.

OR

14. a) Discuss how smart sensors for lighting and air conditioning improve resource efficiency in modern buildings. Provide suitable case examples. (8)
b) Describe strategies for integrating water reuse systems in building operations to achieve sustainability goals. (6)

MODULE 3

15. a) Explain how modular construction contributes to sustainability. Discuss its role in reducing material waste and improving efficiency. (7)
b) Describe the process and benefits of 3D printing in concrete construction. How does it support eco-conscious design? (7)

OR

16. a) Discuss the role of Building Information Modelling (BIM), AI, and IoT in achieving sustainable construction practices. Provide examples of their applications. (6)
b) Evaluate the advantages of advanced reinforcement systems such as FRP and hybrid reinforcement compared to conventional steel reinforcement. (8)

MODULE 4

17. a) Explain the steps involved in conducting a Life Cycle Assessment (LCA) for a building project. (8)
- b) Discuss the environmental impacts arising from emissions during the operational phase of a building. Suggest strategies to minimize these impacts through sustainable design and management practices. (6)

OR

18. a) Apply the concept of a circular economy to propose strategies for sustainable resource utilization in construction. (6)
- b) Illustrate the role of carbon capture technologies and responsible material sourcing in sustainable construction. (8)

MODULE 5

19. a) Explain the main criteria and certification process of any one green building rating system (LEED, GRIHA, or IGBC). (7)
- b) Explain how case studies of sustainable construction projects demonstrate the principles of resource efficiency. (7)

OR

20. a) Discuss the features and benefits of smart and healthy buildings in promoting occupant well-being. (6)
- b) Illustrate the emerging trends in sustainable construction with suitable examples. (8)

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CEH64	ADVANCED CONSTRUCTION TECHNIQUES	3	1	0	5	4	2024

Preamble

The course covers advanced methods and technologies used in modern construction, focusing on innovative techniques for substructure and superstructure development. Topics include box jacking, tunnelling, piling, and dewatering methods for underground works, as well as concreting, formwork, and erection techniques for tall and large - span structures. Construction of special structures such as cooling towers, chimneys, silos, and cable-stayed bridges is also discussed, along with their specific construction sequences. The course further introduces inspection, repair, and rehabilitation techniques using non-destructive testing, drone and IoT-based monitoring systems, and modern strengthening methods. Demolition practices, including machine, explosive, and robotic demolition, and related safety measures are also covered. By the end of the course, students will be able to plan, execute, and manage advanced construction operations efficiently and safely using contemporary technologies.

Prerequisites: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Understand the need for safety culture and summarize the roles and responsibilities of stakeholders in ensuring construction site safety and accident prevention (Cognitive Knowledge Level: Understand).
CO 2	Apply modern concreting, formwork, and erection techniques in the construction of tall and large-span superstructures.(Cognitive Level: Apply)
CO 3	Explain and analyze the construction sequence and techniques used in special structures like cooling towers, chimneys, silos, bridges, and space decks. (Cognitive Level: Analyze)
CO 4	Utilize modern inspection, monitoring, and repair techniques including NDT, drone and IoT-based systems, and rehabilitation methods for structural maintenance.(Cognitive Level: Understand).
CO 5	Recognize and apply various demolition and dismantling techniques, ensuring safety and efficiency in deconstruction processes. (Cognitive Level: Apply).

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	2		1		3						
CO 2	2		1		2						
CO 3	2		1		1						
CO 4	2				3						
CO 5	2				2						

Assessment Pattern

REMOTE SENSING & GIS			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	20	20	30
Understand	50	50	60
Apply	30	30	10
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course project : 10 marks

Self Study : 5 marks

End Semester Examination Pattern

There will be two parts: Part A and Part B. Part A contain 10 questions, with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module, of which students should answer any one. Each question carries 14 marks and can have a maximum of 2 sub-divisions.

SYLLABUS

Module 1: Construction of Sub Structures (9 hours)

Techniques of Box jacking – Pipe Jacking -under water construction of diaphragm walls and basement – Tunnelling techniques – Piling techniques – well and caisson –sinking cofferdam – cable anchoring and grouting-driving diaphragm walls, sheet piles – shoring for deep cutting –well points Dewatering and stand by Plant equipment for underground open excavation.

Module 2: Construction of Super Structures (10 hours)

Vacuum dewatering of concrete flooring-Concrete paving technology, Techniques of construction for continuous concreting operation in Tall buildings of various shapes and Varying sections, Launching Techniques-Types of formwork-erection techniques of tall structures, Large span structures-Launching techniques for heavy decks- in-situ pre-stressing in high rise structures.

Module 3: Construction Of Special Structures(10 Hours)

Construction Sequences- in cooling towers, Silos Chimney, Sky scrapers, bow string bridges, cable stayed bridges; Launching and pushing of box decks, support structure for heavy Equipment and conveyor and machinery in heavy industries, erection of articulated structures, braced domes and space decks.

Module 4: Inspection and Repair in Construction(9 Hours)

Inspection and Structural Health Monitoring: Non-Destructive Testing (NDT) Techniques, Drone-based inspection, AI-assisted defect detection, IoT sensor monitoring. Repair and Rehabilitation Techniques: Crack Repair, Slab and Foundation Repair, Strengthening. Waterproofing and Soil Stabilization.

Module 5: Demolition & Recycling (7 Hours)

Demolition Techniques, Demolition by Machines, Demolition by Explosives, Advanced techniques using Robotic Machines, Demolition Sequence, Dismantling Techniques, Safety precaution in Demolition and Dismantling. Recycling of construction and Demolition waste - Types of C & D waste, segregation, reuse and recycling practices and environmental benefits.

Course Project: As part of this course, students will undertake a case study based project focusing on real-world construction challenges and innovations. Each group will analyze

a landmark project such as the Piper Alpha / Deepwater Horizon Disasters, L'Ambiance Plaza Collapse, Virtual Site Inspection, "Big Blue" Crane Collapse, FIU Pedestrian Bridge Collapse (Planning Perspective), or other relevant cases, to understand applied techniques in construction, safety, and management.

Text Books:

1. "Construction Planning, Equipment and Methods" by R.L. Peurifoy, Clifford J. Schexnayder, Aviad Shapira
2. "Advanced Construction Technology" by Roy Chudley and Roger Greeno (4th Edition)

Reference Books:

1. "Maintenance, Repair & Rehabilitation of Structures" by B.L. Gupta & Amit Gupta
2. "Construction Technology – Vol. 4" by Roy Chudley and Roger Greeno

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	12 hours
1.1	Introduction to Substructure Construction – Importance, scope, and challenges in deep foundation and underground works.	2
1.2	Techniques of Box jacking – Principle, equipment, construction procedure, and applications	2
1.3	Pipe Jacking – Methodology, alignment control, and comparison with box jacking	2
1.4	under water construction of diaphragm walls and basement	1
1.5	Tunnelling techniques – Piling techniques – well and caisson –sinking cofferdam	2
1.6	cable anchoring and grouting - driving diaphragm walls, sheet piles	1
1.7	shoring for deep cutting – well points - Dewatering and stand by Plant equipment for underground open excavation	2

2	Module 2	8 hours
2.1	Vacuum dewatering of concrete flooring - Concrete paving technology	2
2.2	Techniques of construction for continuous concreting operation in Tall buildings of various shapes and Varying sections	2
2.3	Launching Techniques - Types of formwork - erection techniques of tall structures	2
2.4	Large span structures-Launching techniques for heavy decks -	1
2.5	In-situ pre-stressing in high rise structures	1
3	Module 3	7 hours
3.1	Construction Sequences - in cooling towers, Silos Chimney	2
3.2	Sky scrapers, bow string bridges, cable stayed bridges	2
3.3	Launching and pushing of box decks	1
3.4	support structure for heavy Equipment and conveyor and machinery in heavy industries	2
3.5	erection of articulated structures, braced domes and space decks	2
4	Module 4	8 hours
4.1	Inspection and Structural Health Monitoring: Non-Destructive Testing (NDT) Techniques	2
4.2	Drone-based inspection, AI-assisted defect detection, IoT sensor monitoring	2
4.3	Repair and Rehabilitation Techniques: Crack Repair, Slab and Foundation Repair	2
4.4	Strengthening. Waterproofing and Soil Stabilization.	2
5	Module 5	8 hours
5.1	Demolition Techniques, Demolition by Machines	2

5.2	Demolition by Explosives, Advanced techniques using Robotic Machines	2
5.3	Demolition Sequence, Dismantling Techniques	2
5.4	Safety precaution in Demolition and Dismantling	2
Total		45 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Explain the working principles and applications of box jacking and pipe jacking techniques used in underground construction.
2. Describe the process of constructing diaphragm walls and caissons under water and explain their importance in basement and foundation works.

Course Outcome 2 (CO 2):

1. Explain the process of vacuum dewatering of concrete flooring and discuss its advantages in achieving durable and smooth concrete surfaces.
2. Describe the techniques adopted for continuous concreting operations in tall buildings with varying shapes and sections.

Course Outcome 3 (CO 3):

1. Explain the typical construction sequence followed in tall industrial structures such as cooling towers, silos, and chimneys.
2. Describe the step-by-step sequence involved in the erection of skyscrapers and cable-stayed bridges.

Course Outcome 4 (CO 4):

1. Explain the importance of Non-Destructive Testing (NDT) in assessing the condition of structures. Describe any two commonly used NDT techniques.
2. Discuss how drones, AI-assisted defect detection, and IoT-based sensors are used for real-time structural health monitoring.

Course Outcome 5 (CO 5):

1. Explain the different types of demolition techniques and the factors influencing the selection of an appropriate demolition method.
2. Describe the process and equipment involved in demolition by machines and demolition by explosives. Discuss their advantages and limitations.

MODEL QUESTION PAPER

QP CODE:

Pages: 2

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

SIXTH SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CEH64

ADVANCED CONSTRUCTION TECHNIQUES

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Define box jacking and mention its applications in substructure construction.
2. What are the advantages of diaphragm walls in deep basement construction.
3. Explain the principle of vacuum dewatering of concrete floors.
4. List the major types of formwork used in tall buildings.
5. What are the major stages in the construction of a cooling tower.
6. Differentiate between cable-stayed bridges and bow string bridges.
7. List any three Non-Destructive Testing (NDT) methods used for concrete structures.
8. What are the common causes of cracks in reinforced concrete structures.
9. What are the safety precautions to be taken during explosive demolition.
10. Differentiate between demolition and dismantling.

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. a) Explain in detail the construction procedure of a diaphragm wall. (7)

- b) Describe the methods of dewatering and the equipment used for deep excavations. (7)

OR

12. a) Describe the process of box jacking with neat sketches. (8)
b) Write short notes on piling techniques used for foundations. (6)

MODULE 2

13. a) Explain the technique of continuous concreting in tall buildings. (7)
b) Discuss the different launching techniques used for large-span structures. (7)

OR

14. a) Describe the various types of formwork used in modern high-rise buildings. (8)
b) Explain in-situ pre-stressing in high-rise structures. (6)

MODULE 3

15. a) Explain the construction sequence of a cable-stayed bridge. (8)
b) Write short notes on erection of braced domes and space decks. (6)

OR

16. a) Discuss the construction methods adopted for cooling towers and silos. (7)
b) Explain the launching and pushing of box decks in bridge construction. (7)

MODULE 4

17. a) Explain the applications of IoT and drone-based monitoring in structural inspection. (7)
b) Describe the steps involved in strengthening of deteriorated concrete structures. (7)

OR

18. a) Discuss various NDT techniques used in assessing the condition of existing structures. (8)
b) Explain different methods of waterproofing in construction. (6)

MODULE 5

19. a) Explain the methods and sequence involved in explosive demolition. (8)
b) Write short notes on robotic demolition machines. (6)

OR

20. a) Describe various demolition techniques for reinforced concrete buildings. (7)
b) Explain the safety measures and planning considerations in demolition works. (7)

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CEH65	LAND USE AND MOBILITY	3	1	0	5	4	2024

Preamble

Land Use and Mobility examines the interaction between spatial development and transportation systems within the framework of urbanization and sustainability. The course introduces key concepts of land use, accessibility, and mobility, emphasizing integrated planning approaches and analytical tools such as GIS and remote sensing. Through theory and case studies, students learn to develop sustainable, technology-driven strategies for efficient urban mobility and development.

Prerequisites: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Explain the fundamental relationship between land use, transportation systems, and urban form, including the concepts of mobility and accessibility. (Cognitive Level: Understand).
CO 2	Analyze the interaction between transportation infrastructure and urban development patterns, including transit-oriented and mixed-use developments. (Cognitive Level: Understand)
CO 3	Differentiate various types of mobility patterns and transport modes, and evaluate their implications on urban travel behavior and sustainability. (Cognitive Level: Apply)
CO 4	Apply planning tools and techniques such as GIS, remote sensing, and accessibility analysis for integrated land use and mobility planning. (Cognitive Level: Apply)
CO 5	Evaluate sustainable and innovative mobility strategies, including policy frameworks, smart mobility interventions, and low-carbon urban transport solutions. (Cognitive Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	2	1			1	2				
CO 2	2	3	2			2	3				
CO 3	2	3	2	1		2	3				
CO 4	2	2	3	3	2		2				
CO 5	1	2	2	3	3	2	3	1	1	2	1

Assessment Pattern

LAND USE AND MOBILITY			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	25	25	25
Understand	25	25	25
Apply	50	50	50
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course project	: 10 marks
Self Study	: 5 marks

End Semester Examination Pattern

There will be two parts: Part A and Part B. Part A contain 10 questions, with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module, of which students should answer any one. Each question carries 14 marks and can have a maximum of 2 sub-divisions.

SYLLABUS

Module 1: Introduction to Land Use and Transportation (9 hours)

Introduction to Land Use and Transportation: Fundamentals of land use: types, zoning, urban form and structure. Mobility and accessibility concepts, Interaction between transportation and land use, Land use Transportation Models, Urbanization trends and transportation demands.

Module 2: Transportation and Urban Development (9 hours)

Transit-Oriented Development (TOD): Principles and examples, Impact of transportation on land value and development patterns, Land use intensity and transportation demand, Mixed-use development and walkability, Case study: Metro rail influence zones (e.g., Delhi, Bengaluru)

Module 3: Mobility Patterns and Transport Modes (10 Hours)

Types of mobility: motorized, non-motorized, public, shared, Urban travel patterns: trip generation, distribution, mode choice, Multi-modal transportation systems and integration, First-mile/last-mile connectivity issues, micro mobility

Module 4: Planning Tools and Techniques (10 Hours)

Surveys for mobility and land use data, Introduction to Geographic Information Systems (GIS), GIS, remote sensing and urban analytics in planning, Accessibility analysis using GIS tools, Travel diaries, GPS tracking, Role of simulation and digital twins in mobility planning

Module 5: Innovations and Sustainable Practices in Land Use-Mobility Planning (7 Hours)

Urban mobility policies in India: NUTP, Metro Policy, Smart Cities Mission, Sustainable mobility strategies, Green infrastructure and low-carbon urban mobility, climate resilience in mobility planning, Smart mobility and digital interventions (ITS, Mobility-as-a-Service), Role of AI, IoT, in shaping future mobility, Case studies.

Text Books:

1. National Urban Transport Policy
2. Black, William R. Sustainable transportation: problems and solutions, The Guilford

Press, 2010.

3. Edward, J.K., David, R.G., Stuart, F., Urban Land use Planning, 4th edition, Urbana, University of Illinois Press, 1995.
4. Hall, P., Cities of tomorrow: An intellectual history of urban planning and design in the twentieth century, Blackwell, London, 2001.
5. Preston, L. Schiller, Eric, C. Brunn and Jeffrey, R. Kenworthy. An Introduction to Sustainable Transportation: Policy, Planning and Implementation, Earthscan, 2010.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	9 hours
1.1	Fundamentals of land use: Definition and importance of land use in urban planning, Types of land uses: residential, commercial, industrial, institutional, recreational, Principles of zoning and land-use regulation, Hierarchy of land uses	2
1.2	Urban Form and Structure :Concepts of urban form: mono-centric, polycentric, and dispersed cities, Urban structure models: concentric zone, sector, multiple nuclei, Spatial organization and density distribution, Relationship between built form and mobility patterns	2
1.3	Definitions and differences: mobility vs. accessibility, Factors influencing accessibility (distance, time, cost, connectivity) , Measuring accessibility: cumulative opportunity, gravity, contour methods (Introduction only)	1
1.4	Interaction between Land Use and Transportation,: Two-way relationship between land use and transport, Accessibility–land value feedback loop	1
1.5	Land use–transportation models: Lowry model , Alonso’s Bid-Rent Theory, LUTI framework, Input–output relationship between activities, land use, and transport demand	2
1.6	Urbanization trends: In Indian context, Challenges of rapid motorization and spatial sprawl	1

2	Module 2	9 hours
2.1	Transit-Oriented Development (TOD): Density, diversity, design, distance to transit, demand management (“5 Ds”), Benefits of TOD: compact growth, reduced congestion, improved accessibility, Global examples: Hong Kong, Singapore, Portland, Curitiba	3
2.2	Impact of transportation on land value and development patterns: Transport accessibility and property price gradients, Land value capture (LVC) tools: betterment levy, impact fees, joint development - Metro corridor case insights from Delhi, Hyderabad, and Bengaluru	2
2.3	Land use intensity and transportation demand: FAR (Floor Area Ratio) and density controls, Relationship between land use mix and trip generation, Balancing residential, commercial, and institutional activities near transit, Infrastructure demand management through zoning and land policy	2
2.4	Mixed-use development and walkability : Importance of mixed-use zoning in TOD, Street, pedestrian infrastructure, and active mobility, Accessibility hierarchy: pedestrians first, Case study: Metro rail influence zones (Delhi, Bengaluru)	2
3	Module 3	10 hours
3.1	Types of mobility: motorized, non-motorized, public, shared	1
3.2	Urban travel patterns: Concepts of trip purpose, frequency, and distance, Relationship between land use and mobility	1
3.3	Four Stage Travel Demand Model : Trip Generation, Distribution, Mode Choice and Route Assignment : Factors influencing, Models, Role of behavioral models in transport planning (logit, stated preference)	3
3.4	Multi-modal transportation systems and integration : Concept of integrated transport systems, Physical, operational, and fare integration, Role of interchanges and transport hubs	2
3.5	First-mile / last-mile connectivity issues, micro mobility: Challenges of access to major transit nodes, Solutions: e-rickshaws, shared bikes, feeder buses, walkability, Planning for micro-mobility (regulation, safety), Integrating micro-mobility into existing systems	2

4	Module 4	10 hours
4.1	Surveys for Mobility and Land Use Data : Importance of data in planning, Data collection methods, Sampling design and bias, Validation	1
4.2	Introduction to Geographic Information Systems (GIS): Spatial data types (vector, raster), Coordinate systems and projections, Data sources: open data portals, government datasets, Basic GIS operations: mapping, spatial joins, buffering	2
4.3	GIS, Remote Sensing, and Urban Analytics in Planning: Remote sensing fundamentals, Urban land cover and land use classification, Integration of GIS and satellite data, Urban analytics: big data, IoT, spatial statistics	2
4.4	Accessibility Analysis Using GIS Tools: Concept of accessibility and mobility equity, Types of accessibility measures (cumulative, gravity-based), Network analysis: shortest paths, travel time, service areas, Public transport accessibility levels (PTALs)	2
4.5	Travel Diaries and GPS Tracking: Role of travel diaries in behavioral data collection, Mobile apps and GPS data collection, Data cleaning and visualization, Privacy and ethical considerations	1
4.6	Role of Simulation and Digital Twins in Mobility Planning: Simulation models: agent-based, activity-based, microscopic/macrosopic models, Digital twins: concept and architecture, Real-time data integration, Use cases: traffic management, urban design, policy testing	2
5	Module 5	7 hours
5.1	Urban Mobility Policies in India: Overview of National Urban Transport Policy (NUTP) 2006 and 2014 revisions, Metro Rail Policy 2017: financing, TOD, last-mile connectivity, Smart Cities Mission: mobility innovations and area-based development, AMRUT and Gati Shakti initiatives for integrated infrastructure	2
5.2	Sustainable Mobility Strategies: Shifting from car-centric to people-centric mobility, Non-motorized transport (NMT): walking, cycling, e-bikes, Public transport integration and intermodality	1

5.3	Green Infrastructure and Low-Carbon Mobility: Electric mobility, renewable energy integration, Urban green corridors, permeable surfaces, urban cooling, Emissions assessment and carbon footprinting in transport planning	1
5.4	Climate Resilience: Assessing vulnerability of transport networks, Adaptation measures: flood-proofing, heat-resilient infrastructure	1
5.5	Smart Mobility and Digital Interventions: Intelligent Transport Systems (ITS) applications in India, Mobility-as-a-Service (MaaS) and integrated digital ticketing, Smart parking, traffic management, real-time data analytics	1
5.6	Role of AI and IoT in Shaping Future Mobility : Data-driven decision-making for congestion, safety, and emissions, Predictive analytics and demand-responsive transport, Connected and autonomous vehicle systems	1
5.7	Case Studies and Global Best Practices, Singapore Smart Mobility 2030, Helsinki MaaS, Surat ITS project, Lessons for Indian cities	1
Total		45 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Explain the evolution of urban transportation and its impact on public mobility.
2. Compare monocentric and polycentric urban structures with examples.

Course Outcome 2 (CO 2):

1. Discuss how TOD contributes to compact urban growth and reduced congestion.
2. Compare global TOD examples such as Hong Kong, Singapore, Portland, and Curitiba. What lessons can Indian cities learn?.

Course Outcome 3 (CO 3):

1. Analyze travel choices of different socio-economic groups in an Indian city and recommend measures to promote sustainable mobility
2. Apply the concept of integration to design a multimodal transport plan for a medium-sized city incorporating bus, metro, and micro-mobility options.

Course Outcome 4 (CO 4):

1. How to apply cumulative opportunity or gravity-based measures to compare accessibility between two neighborhoods.
2. Discuss how GIS and remote sensing data can be integrated to analyze changes in urban sprawl or green cover.

Course Outcome 5 (CO 5):

1. Evaluate the role of the Metro Rail Policy 2017 in promoting Transit-Oriented Development (TOD) and last-mile connectivity — illustrate with a case study (e.g., Bengaluru, Delhi)
2. Evaluate the benefits of EV charging networks powered by renewable energy on reducing lifecycle emissions.

MODEL QUESTION PAPER

QP CODE:

Pages: 3

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

SIXTH SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CE3P11

LAND USE AND MOBILITY

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Define zoning and mention two of its main objectives.
2. Differentiate between cumulative opportunity and gravity-based accessibility measures
3. Mention three benefits of Transit-Oriented Development.
4. What are metro influence zones? Give one example.
5. List two types of public transport integration in a multi-modal system.
6. Define route assignment in the Travel Demand Model
7. What is a travel diary, and how is it used in mobility data collection?
8. Define Public Transport Accessibility Level (PTAL).
9. Define Non-Motorized Transport (NMT) and give two examples.
10. Mention two applications of Artificial Intelligence (AI) in future mobility systems

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. a) Describe the characteristics of monocentric, polycentric, and dispersed city forms. Which type is most sustainable and why (7)
b) Describe the LUTI framework and how it integrates land use and transport planning (7)

OR

12. a) Explain the Lowry model of land use–transport interaction with its main assumptions and limitations. (7)
b) Explain the types of land uses commonly found in urban areas and discuss their spatial organization within a city. (7)

MODULE 2

13. a) Describe how mixed-use development near transit stations promotes walkability and reduces dependence on private vehicle (7)
b) Discuss the planning principles for achieving a balanced mix of residential, commercial, and institutional uses in TOD zones (7)

OR

14. a) How do walkability and active mobility infrastructure influence the success of TOD projects? Suggest ways to improve pedestrian experience near transit stations (7)
b) Describe the impact of metro corridors on urban land values and development patterns with suitable Indian case studies (7)

MODULE 3

15. a) Describe the Four-Stage Travel Demand Model in detail, highlighting the factors influencing each stage. (7)
b) Discuss the concept of multi-modal transportation systems and explain how physical, operational, and fare integration improve urban mobility. (7)

OR

16. a) Analyze the challenges of first-mile/last-mile connectivity in Indian cities and suggest strategies to improve access to major transit nodes (6)
b) Evaluate the role of micro-mobility solutions (e-rickshaws, shared bikes, feeder buses) in enhancing urban transport integration and sustainability. (8)

MODULE 4

17. a) Explain the different methods of data collection for mobility and land use studies, including sampling design and bias issues (7)
- b) Analyze how remote sensing and GIS integration helps in urban land cover and land use classification. (7)

OR

18. a) Describe different accessibility measures (cumulative, gravity-based) and their application in transport planning. (6)
- b) Evaluate the use of travel diaries and GPS tracking in collecting behavioral data for urban mobility studies, including privacy considerations. (8)

MODULE 5

19. a) Analyze the role of national missions such as Smart Cities Mission, AMRUT, and Gati Shakti in promoting integrated urban infrastructure and mobility innovations. (7)
- b) Describe sustainable mobility strategies that shift the focus from car-centric to people-centric planning, highlighting the importance of walking, cycling, and public transport integration. (7)

OR

20. a) Evaluate the significance of green infrastructure and low-carbon mobility solutions like electric mobility, urban green corridors, and carbon footprint assessment in achieving climate-friendly transport systems. (7)
- b) Examine how Intelligent Transport Systems (ITS), MaaS, and real-time analytics are transforming urban transport management and user experience in Indian cities. (7)

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CEH66	STRUCTURAL DESIGN OF FOUNDATIONS AND EARTH RETAINING STRUCTURES	3	1	0	5	4	2024

Preamble

The course provides a comprehensive understanding of the structural design principles of foundations and earth retaining systems. It covers analysis and design methodologies for shallow and deep foundations, retaining walls, and combined systems under various loading conditions. Emphasis is placed on integrating geotechnical and structural aspects, applying relevant design codes, and developing the ability to design safe and economical foundation and retaining systems. The course aims to prepare students to handle complex design challenges encountered in real-world civil engineering projects.

Prerequisites: Soil Mechanics, Geotechnical Engineering, Strength of Materials, Structural Analysis.

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Explain the principles of foundation design and the interaction between soil and structural elements.
CO 2	Design shallow and deep foundations considering bearing capacity, settlement, and load transfer mechanisms.
CO 3	Analyze and design various types of earth retaining structures ensuring stability and safety under earth pressures.
CO 4	Apply structural design principles, code provisions, and quality control measures in foundation and retaining wall design.
CO 5	Integrate advanced design methods, analyze case studies, and propose sustainable solutions for complex foundation systems.

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	2	2	1	1	0	1	0	0	2	0
CO 2	3	3	3	2	2	0	1	0	0	1	0
CO 3	3	3	3	3	2	1	2	0	0	2	0
CO 4	3	2	3	3	3	1	2	1	0	3	1
CO 5	3	3	3	3	3	2	3	2	1	3	2

Assessment Pattern

STRUCTURAL DESIGN OF FOUNDATIONS AND EARTH RETAINING STRUCTURES			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	20	20	20
Understand	40	40	30
Apply	40	40	50
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course project : 10 marks

Self Study : 5 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question carries 14 marks and can have maximum 2 sub-divisions.

SYLLABUS

Module 1: Introduction to Foundation Design (7 hours)

Overview of foundation design and its importance in civil engineering – Types of foundations: shallow, deep, and special – Load distribution and bearing capacity of soils. Soil–foundation interaction – Methods for assessing bearing capacity and settlement – Design considerations for different soil conditions. Shallow foundations: types, design principles, and methods (Terzaghi–Meyerhof) – Calculation of settlement and bearing capacity.

Module 2: Deep Foundations (8 hours)

Types of deep foundations: piles, drilled shafts, caissons – Design principles and construction methods. Load transfer mechanisms in piles – static and dynamic load tests – Pile group behavior and settlement analysis. Special foundations: design under challenging soil conditions – Case studies in large-scale projects.

Module 3: Earth Retaining Structures (7 Hours)

Types of retaining structures: gravity, cantilever, anchored, reinforced soil walls – Applications and design considerations. Design of gravity retaining walls using Rankine's and Coulomb's earth pressure theories – Stability analysis for overturning, sliding, and bearing. Reinforced soil and MSE walls – Design principles, use of geosynthetics, case studies.

Module 4: Structural Design for Foundations and Retaining Walls (7 Hours)

Structural design principles – Load considerations (dead, live, seismic) – Limit state and working stress design. Design of combined and integrated systems (e.g., basement walls, retaining walls with footings) – Application of IS codes. Construction, inspection, and quality control measures in foundation and retaining wall systems. **Module 5: Advanced**

Topics and Case Studies (7 Hours)

Advanced design for dynamic loads and high-rise structures – Nonlinear and finite element methods in foundation design. Case studies: success and failure analyses of foundation and retaining wall systems. Emerging trends, sustainable design practices, and innovative construction methods.

Case Studies and Project Applications: Detailed case studies showcasing the local examples of failures, Lessons learned from them and solutions.

Text Books:

1. Bowles, J. E. *Foundation Analysis and Design*, McGraw Hill
2. Das, B. M. *Principles of Foundation Engineering*, Cengage Learning
3. Teng, W. C. *Foundation Design*, Prentice Hall of India

Reference Books:

1. Varghese, P. C. *Foundation Engineering*, Prentice Hall of India.
2. Murthy, V. N. S. *Soil Mechanics and Foundation Engineering*, CRC Press.
3. Relevant IS Codes: IS 6403, IS 2911 (Part 1–4), IS 3370, IS 456, IS 800.
4. Latest publications and case studies from professional bodies such as ASCE, ICE, and IRC.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	7 hours
1.1	Importance of foundation design and types of foundations.	1
1.2	Soil–foundation interaction and settlement analysis.	1
1.3	Methods for determining bearing capacity of soils.	1
1.4	Design of shallow foundations – Terzaghi and Meyerhof methods.	2
1.5	Design considerations for different soil conditions.	2
2	Module 2	8 hours
2.1	Types and functions of deep foundations – piles, caissons, drilled shafts	2
2.2	Load transfer mechanisms and pile capacity estimation	1
2.3	Pile group design and settlement analysis.	1
2.4	Design of special foundations under complex soil conditions	2
2.5	Case studies on deep foundation projects.	2
3	Module 3	7 hours
3.1	Types of retaining structures and design considerations.	1
3.2	Earth pressure theories – Rankine and Coulomb methods	1
3.3	Stability analysis of retaining walls.	1
3.4	Design and detailing of reinforced soil and MSE walls.	2
3.5	Case studies and applications of retaining wall systems.	2

4	Module 4	7 hours
4.1	Load considerations and design principles as per IS codes.	1
4.2	Structural analysis of foundation and retaining wall components	1
4.3	Design of combined and integrated systems.	2
4.4	Construction practices and quality control measures.	1
4.5	Inspection and maintenance aspects.	2
5	Module 5	7 hours
5.1	Advanced foundation design for dynamic and complex loading.	1
5.2	Nonlinear and finite element analysis applications	2
5.3	Case studies of foundation and retaining wall systems	1
5.4	Sustainable and innovative design approaches	2
5.5	Recent trends and research in foundation design	1
Total		36 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Describe the importance of foundation design and its influence on overall structural performance.
2. Explain how soil–foundation interaction affects the design of shallow foundations.

Course Outcome 2 (CO 2):

1. Illustrate the difference between shallow and deep foundations with design examples.
2. Explain the factors influencing pile group design and settlement.

Course Outcome 3 (CO 3):

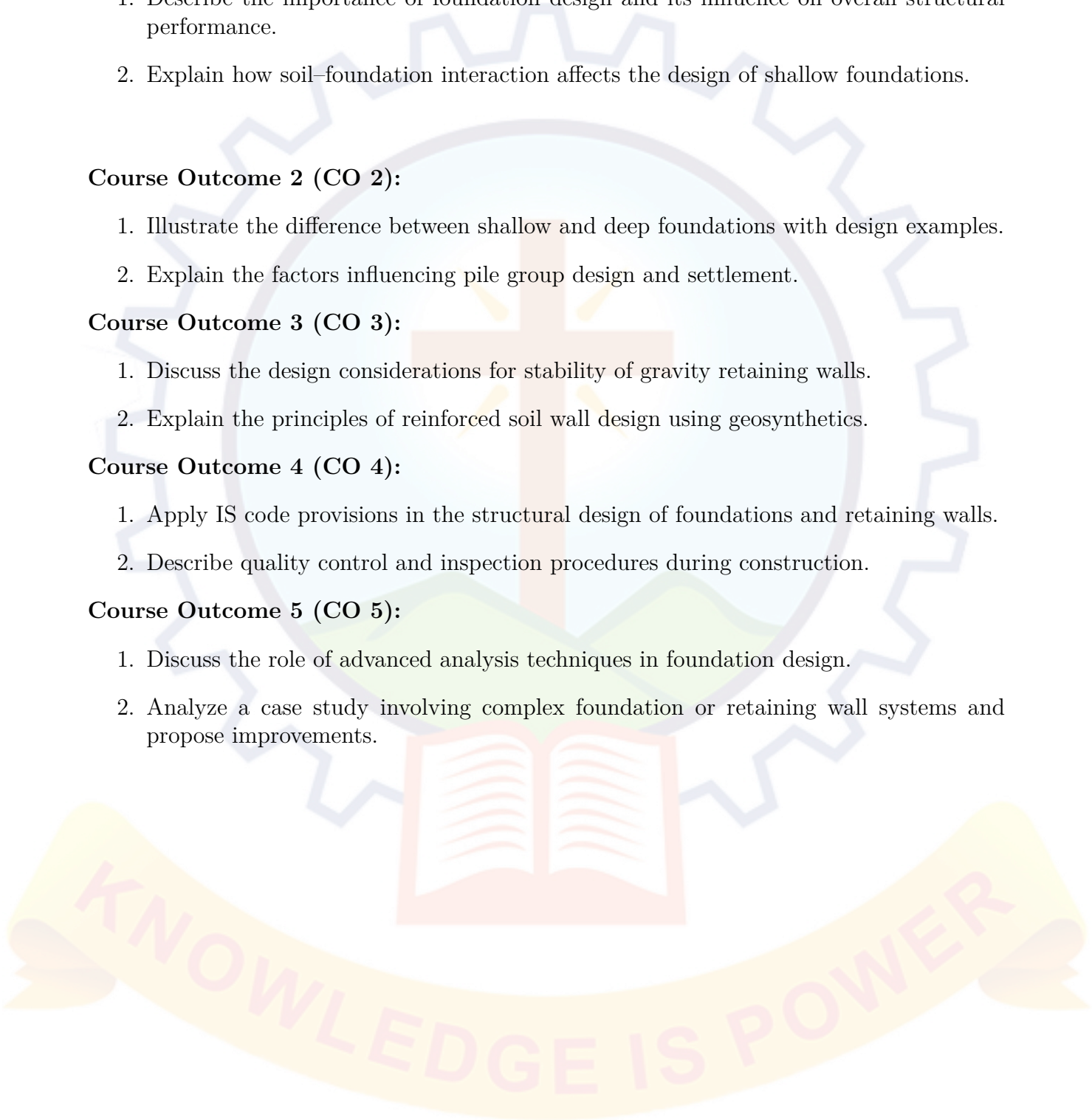
1. Discuss the design considerations for stability of gravity retaining walls.
2. Explain the principles of reinforced soil wall design using geosynthetics.

Course Outcome 4 (CO 4):

1. Apply IS code provisions in the structural design of foundations and retaining walls.
2. Describe quality control and inspection procedures during construction.

Course Outcome 5 (CO 5):

1. Discuss the role of advanced analysis techniques in foundation design.
2. Analyze a case study involving complex foundation or retaining wall systems and propose improvements.



KNOWLEDGE IS POWER

MODEL QUESTION PAPER

QP CODE:

Pages: 3

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

FIFTH SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CEH66

STRUCTURAL DESIGN OF FOUNDATIONS AND EARTH RETAINING STRUCTURES

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Define the importance of foundation design in civil engineering.
2. Explain the types of shallow foundations with examples.
3. Describe the main load transfer mechanisms in piles.
4. What are the differences between end-bearing and friction piles?
5. Explain the concept of earth pressure and its importance in retaining wall design.
6. What are the stability checks performed for a gravity retaining wall?
7. List the major loads considered in foundation design.
8. State the purpose of providing proper drainage behind retaining walls.
9. Mention two modern numerical methods used in foundation design.
10. List any two emerging trends in foundation and retaining wall technologies.

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. a) Design a square isolated footing for a column carrying a load of 1000 kN (service load). Assume SBC = 200 kN/m², concrete grade = M25, steel = Fe 500. Determine the size and reinforcement details as per IS 456. (7)
- b) Explain Terzaghi's bearing capacity theory and its assumptions. (7)

OR

12. a) Design a rectangular combined footing for two columns 4 m apart carrying loads of 600 kN and 800 kN. Take SBC = 250 kN/m², concrete = M30, steel = Fe 500. Draw the pressure distribution and compute footing dimensions. (7)
- b) Explain the concept of soil–foundation interaction with examples. (7)

MODULE 2

13. a) Design a single reinforced concrete pile 450 mm diameter and 12 m long to carry a working load of 400 kN. Check structural capacity of the pile section and provide longitudinal and lateral reinforcement as per IS 2911 (Part 1/Sec 2). (8)
- b) Discuss the design principles for pile groups. (6)

OR

14. a) A group of 9 piles (450 mm × 12 m) are arranged in a 3 × 3 pattern at 3 D spacing. Compute the load distribution on each pile and design the pile cap thickness and reinforcement (assume M25, Fe500, pile spacing = 1.35 m). (8)
- b) Present a case study of a deep foundation project in weak soil. (6)

MODULE 3

15. a) Design the stem and base slab of a cantilever retaining wall 4 m high supporting dry backfill ($\gamma = 18$ kN/m³, $\phi = 30^\circ$). Use M25 concrete and Fe 500 steel. Check for overturning, sliding, and bearing capacity. (8)
- b) Discuss stability checks for a cantilever retaining wall. (6)

OR

16. a) Design the reinforcement for the stem of a reinforced concrete counterfort retaining wall 6 m high. Assume uniform backfill, M30 concrete, Fe 500 steel, and relevant IS 456/IS 3370 guidelines. (8)
- b) Discuss the role of geosynthetics in reinforced soil structures. (6)

MODULE 4

17. a) Design a basement wall acting as both retaining structure and foundation for a building. Height = 3 m, backfill = 18 kN/m^3 , $\phi = 30^\circ$. Provide thickness and reinforcement for the wall and foundation slab (M30, Fe500). (8)
- b) Explain the procedure for designing a combined footing. (6)

OR

18. a) Design a strap footing connecting two isolated footings under 800 kN and 600 kN column loads. Column spacing = 4 m, SBC = 250 kN/m^2 , concrete = M25, steel = Fe500. Compute strap beam size and reinforcement. (8)
- b) Explain quality control measures during the construction of retaining walls. (6)

MODULE 5

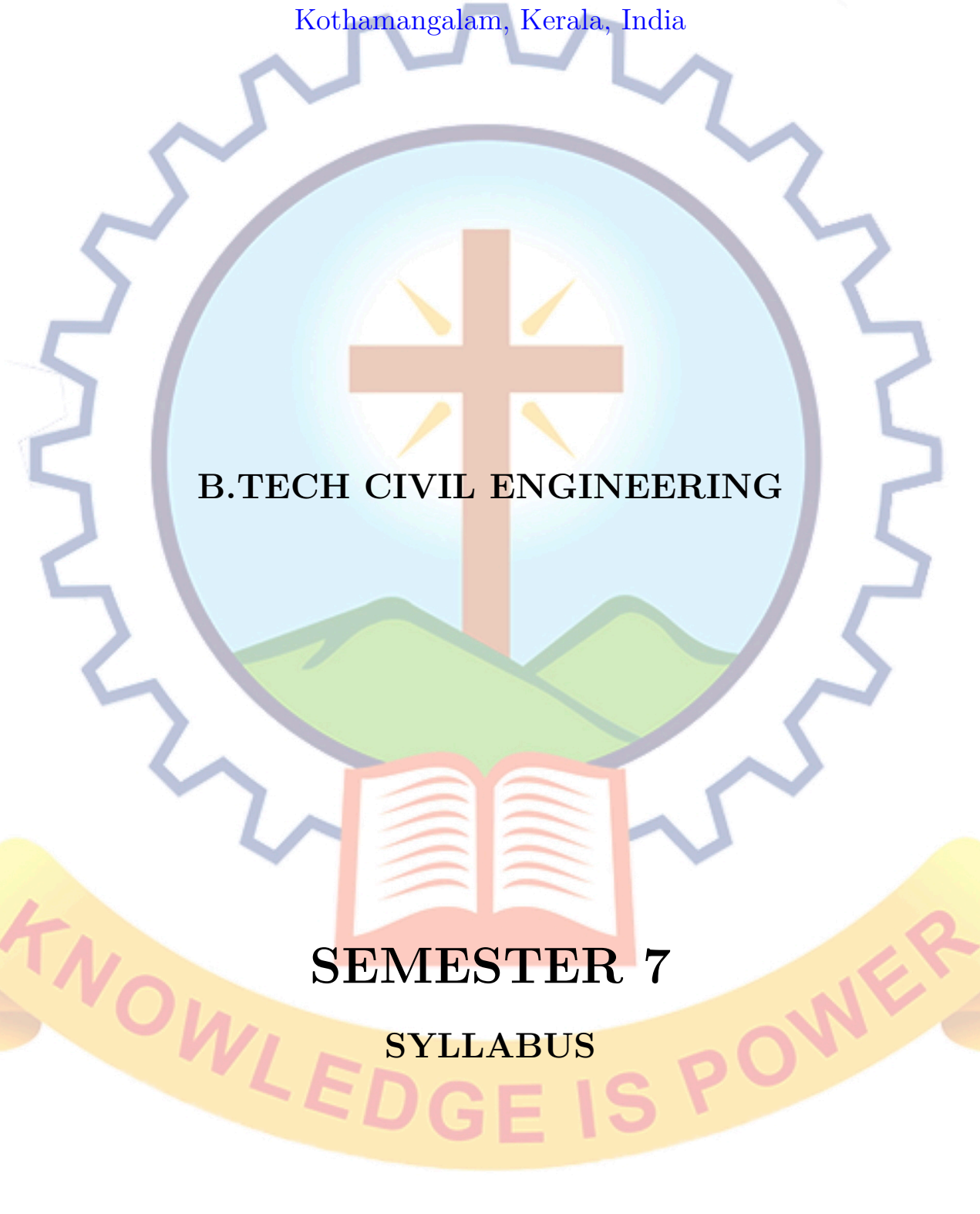
19. a) Design the reinforcement for a machine foundation block ($1.8 \text{ m} \times 1.8 \text{ m} \times 0.6 \text{ m}$) carrying a 100 kN vertical load and moment = $20 \text{ kN}\cdot\text{m}$. Check for bending and shear as per IS 456. (8)
- b) Explain the use of finite element methods in foundation analysis. (6)

OR

20. a) Analyze a retaining wall failure due to inadequate toe reinforcement. Propose a redesigned base slab thickness and reinforcement for stability and durability using M25 concrete and Fe500 steel. (8)
- b) Discuss recent advances and sustainable approaches in foundation design. (6)

MAR ATHANASIOUS COLLEGE OF ENGINEERING

Government Aided, Autonomous Institution
Kothamangalam, Kerala, India



B.TECH CIVIL ENGINEERING

SEMESTER 7

SYLLABUS

KNOWLEDGE IS POWER

SEMESTER 7

SLOT	COURSE NO.	COURSES	L-T-P-S	HOURS	CREDIT
A	B24CE4T01	TRANSPORT INFRASTRUCTURE ENGINEERING	2-1-0-4	3	3
B	B24CE4P3x	PROGRAM ELECTIVE III	2-1-0-4	3	3
C	B24CE4P4x	PROGRAM ELECTIVE IV	2-1-0-4	3	3
D	B24CE4G2x	OPEN ELECTIVE II	2-1-0-4	3	3
E	B24HU4T04	DISASTER MANAGEMENT AND INDUSTRIAL SAFETY	2-1-0-4	3	3
F	B24CE4L11	ENVIRONMENTAL ENGINEERING LABORATORY	0-0-3-2	3	2
G	B24CE4L12	PROJECT PHASE I	0-0-6-2	6	3
H	B24CE4L13	SEMINAR	0-0-4-1	4	2
I	B24CE4T02	VIVA-VOCE	0-0-0-0	—	1
M	B24CEM7x	MINOR	3-1-0-5	4	4
N	B24CEH7x	HONOURS	3-1-0-5	4	4
TOTAL				36	23

PROGRAMME ELECTIVE III

COURSE NO.	COURSES
B24CE4P31	ARCHITECTURE AND INTERIOR DESIGNING
B24CE4P32	AIR QUALITY MANAGEMENT
B24CE4P33	SOIL STRUCTURE INTERACTION
B24CE4P34	ADVANCED DESIGN OF CONCRETE STRUCTURES
B24CE4P35	AI APPLICATIONS IN CIVIL ENGINEERING
B24CE4P36	PAVEMENT ANALYSIS

PROGRAMME ELECTIVE IV

COURSE NO.	COURSES
B24CE4P41	INTRODUCTION TO BIM 2D DRAFTING AND ARCHITECTURAL MODELLING FUNDAMENTALS
B24CE4P42	TRANSPORTATION ECONOMICS
B24CE4P43	ENVIRONMENTAL IMPACT ASSESSMENT
B24CE4P44	ADVANCED FOUNDATION DESIGN
B24CE4P45	STRUCTURAL DYNAMICS
B24CE4P46	SUSTAINABLE CONSTRUCTION MATERIALS AND PRACTICES

OPEN ELECTIVE II

COURSE NO.	COURSES
B24CE4G21	ENERGY MANAGEMENT AND INTEGRATION
B24CE4G22	CLIMATE CHANGE AND SUSTAINABILITY
B24CE4G23	INTELLIGENT TRANSPORT SYSTEMS

HONOURS COURSES

COURSE NO.	COURSES
B24CEH71	ADVANCED STEEL DESIGN
B24CEH72	HERITAGE STRUCTURES
B24CEH73	URBAN PLANNING
B24CEH74	LEAN CONSTRUCTION
B24CEH75	INTELLIGENT TRANSPORTATION SYSTEMS
B24CEH76	SOIL DYNAMICS AND MACHINE FOUNDATION

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE4T01	TRANSPORT INFRASTRUCTURE ENGINEERING	2	1	0	4	3	2024

Preamble

This course provides an overview of the planning, design, construction, and management of major transportation infrastructure systems including highways, railways, airports, and waterways. It introduces the functional components of each mode and their operational requirements, along with concepts of infrastructure maintenance and management. The course also covers economic principles, financing mechanisms, and project appraisal methods essential for sustainable transportation infrastructure development.

Prerequisites: B24CE2T06 -Highway and Pavement Engineering

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Explain the components, construction methods, maintenance practices, and pavement management principles of highway infrastructure systems. (Cognitive Knowledge Level: Understand)
CO 2	Explain the components and functional requirements of railway track systems and apply basic geometric concepts such as cant and gauge in railway operations.(Cognitive Knowledge Level: Apply)
CO 3	Apply basic principles of airport planning including site selection, runway orientation, and layout components in airport infrastructure development. (Cognitive Knowledge Level: Apply)
CO 4	Explain the classification, components, and functional requirements of harbour and dock infrastructure systems used in water transportation. (Cognitive Knowledge Level: Understand)
CO 5	Apply basic economic concepts, financing mechanisms, and project appraisal principles in transportation infrastructure development. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	2	2	-	2	-	1	-	-	-	2
CO2	3	2	2	-	1	-	1	-	-	-	1
CO3	3	2	2	-	1	-	1	-	-	-	1
CO4	3	2	2	-	1	-	2	-	-	-	1
CO5	2	3	2	-	-	2	2	2	-	-	3

Assessment Pattern

TRANSPORT INFRASTRUCTURE ENGINEERING			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	30	30	30
Understand	50	50	50
Apply	20	20	20
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course Project	: 10 marks
Self Study	: 5 marks

End Semester Examination Pattern

There will be two parts: Part A and Part B. Part A contain 10 questions, with 2 questions

from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module, of which students should answer any one. Each question carries 14 marks and can have a maximum of 2 sub-divisions.

SYLLABUS

Module 1: Highway Infrastructure Engineering (7 hours)

Introduction to highway systems; classification and components of highways; subgrade, sub-base, base, and surface courses; materials used in highway construction; flexible and rigid pavement construction methods; pavement maintenance techniques; distress identification; pavement management systems; rehabilitation and strengthening methods.

Module 2: Railway Infrastructure Engineering (7 hours)

Railway track components and functions; rails, sleepers, ballast, and formation; gauges and selection of gauge; coning of wheels; cant and cant deficiency; compensation of curves; points and crossings; basics of railway signalling systems and their functions.

Module 3: Airport Infrastructure Engineering (7 Hours)

Introduction to airport engineering; components of an airport; airport site selection factors; runway orientation; basic runway length determination and corrections; taxiways and aprons; airport layout considerations; basic maintenance aspects of airport pavements.

Module 4: Waterway and Harbour Infrastructure Engineering(7 Hours)

Harbours: classification, features, and requirements; natural and artificial harbours; breakwaters—necessity, functions, and types; docks—functions and classification; dry docks and wet docks; inland water transport systems; port infrastructure components.

Module 5: Transportation Infrastructure Economics and Management(8 Hours)

Demand and supply concepts in transportation; elasticity of transport demand; funding mechanisms and financing types

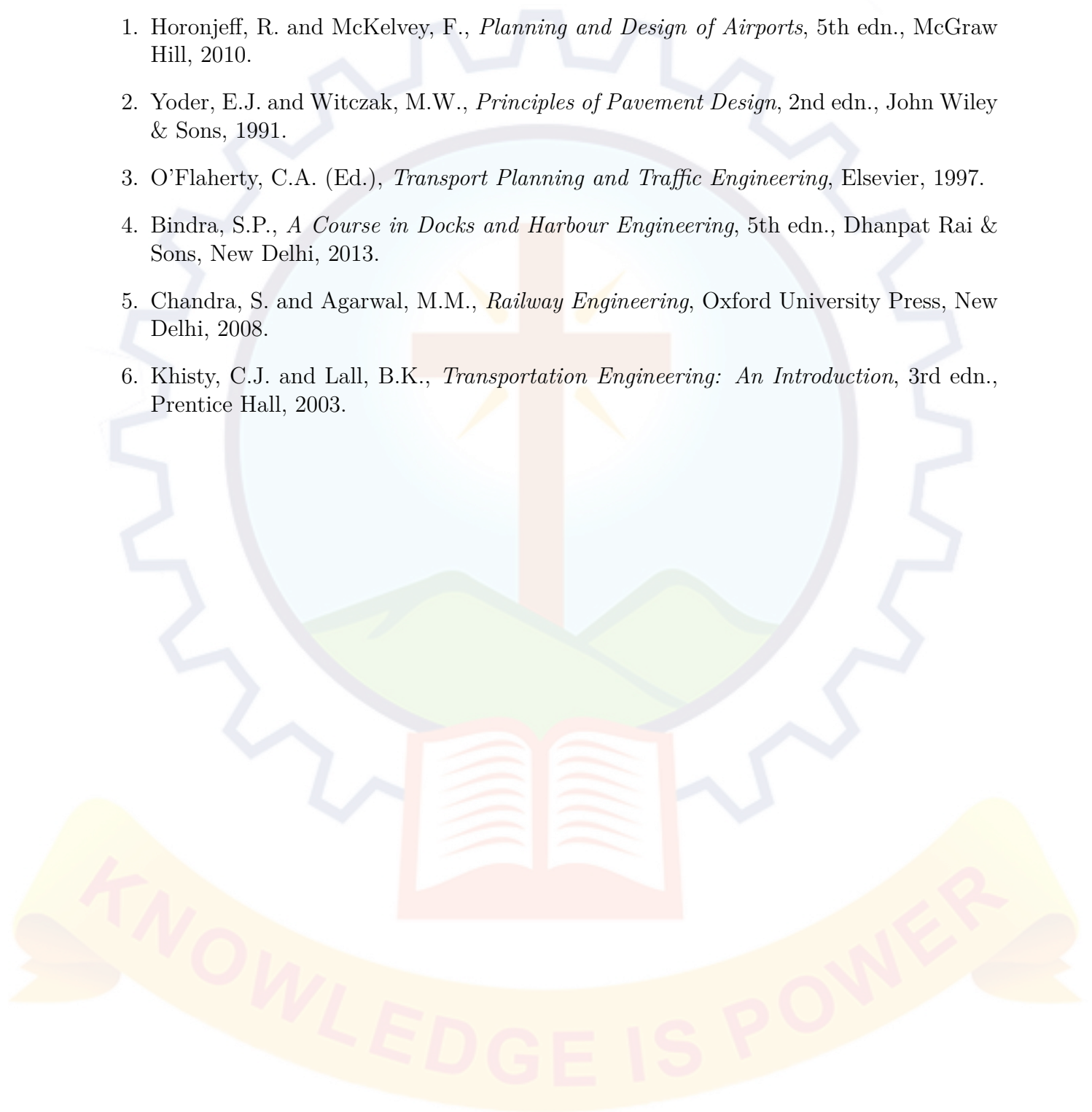
Text Books:

1. Khanna, S.K. and Justo, C.E.G., *Highway Engineering*, 10th edn., Nem Chand & Bros., New Delhi, 2015.
2. Kadiyali, L.R. and Lal, N.B., *Principles and Practice of Highway Engineering*, 8th edn., Khanna Publishers, New Delhi, 2013.
3. Khanna, S.K. and Arora, M.G., *Airport Planning and Design*, 6th edn., Nem Chand & Bros., New Delhi, 2012.
4. Mundrey, J.S., *Railway Track Engineering*, 7th edn., Tata McGraw Hill, New Delhi, 2009.

5. Srinivasan, R., *Harbour, Dock and Tunnel Engineering*, 28th edn., Charotar Publishing House, Anand, 2016.

References:

1. Horonjeff, R. and McKelvey, F., *Planning and Design of Airports*, 5th edn., McGraw Hill, 2010.
2. Yoder, E.J. and Witczak, M.W., *Principles of Pavement Design*, 2nd edn., John Wiley & Sons, 1991.
3. O'Flaherty, C.A. (Ed.), *Transport Planning and Traffic Engineering*, Elsevier, 1997.
4. Bindra, S.P., *A Course in Docks and Harbour Engineering*, 5th edn., Dhanpat Rai & Sons, New Delhi, 2013.
5. Chandra, S. and Agarwal, M.M., *Railway Engineering*, Oxford University Press, New Delhi, 2008.
6. Khisty, C.J. and Lall, B.K., *Transportation Engineering: An Introduction*, 3rd edn., Prentice Hall, 2003.



COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1: Highway Infrastructure Engineering	7 hours
1.1	Classification of highways; components of highway system; subgrade, sub-base, base, and surface courses	2
1.2	Flexible and rigid pavement construction methods; materials used in pavement construction	3
1.3	Pavement maintenance techniques; distress identification; pavement management systems and rehabilitation methods	2
2	Module 2: Railway Infrastructure Engineering	2 hours
2.1	Component parts of railway track; rails, sleepers, ballast, and formation; functions of track components	2
2.2	Gauges and selection of gauge; coning of wheels; cant and cant deficiency; compensation of curves	3
2.3	Points and crossings; introduction to railway signalling systems and their functions	2
3	Module 3: Airport Infrastructure Engineering	7 hours
3.1	Introduction to airport engineering; components of airport; factors affecting airport site selection	3
3.2	Runway orientation; determination of basic runway length and correction factors	2
3.3	Taxiways and aprons; airport layout considerations	2
4	Module 4: Waterway and Harbour Infrastructure Engineering	7 hours
4.1	Harbours: classification, features, and requirements; natural and artificial harbours	2
4.2	Breakwaters: necessity, functions, and classification	2

4.3	Docks: functions and types; dry docks and wet docks; inland water transport systems	3
5	Module 5: Transportation Infrastructure Economics and Management	8 hours
5.1	Demand and supply concepts in transportation; elasticity of demand; demand–supply interaction	3
5.2	Transportation financing mechanisms; public–private partnership (PPP) models and funding types	3
5.3	Project appraisal and economic evaluation of transportation infrastructure projects	2
Total		36 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Explain the components of highway pavements and describe the functions of each layer in pavement performance.
2. Describe flexible and rigid pavement construction methods and identify the materials used in each type.
3. Explain the importance of pavement maintenance and discuss the role of pavement management systems in improving highway performance.

Course Outcome 2 (CO 2):

1. Explain the components of a railway track and describe the functions of rails, sleepers, and ballast.
2. Apply the concepts of gauge selection, coning of wheels, and cant to explain their role in safe railway operation.
3. Describe the purpose of points, crossings, and basic signalling systems used in railway infrastructure.

Course Outcome 3 (CO 3):

1. Explain the components of an airport and discuss the factors influencing airport site selection.
2. Apply the concept of runway orientation to determine suitable runway alignment based on wind conditions.
3. Describe the functions of taxiways and aprons and explain their role in airport operations.

Course Outcome 4 (CO 4):

1. Classify harbours and explain the essential features required for efficient harbour operation.
2. Describe the necessity and functions of breakwaters and classify different types of breakwaters.
3. Explain the functions and types of docks, including dry docks and wet docks, used in harbour engineering.

Course Outcome 5 (CO 5):

1. Explain the concepts of demand and supply in transportation infrastructure and discuss factors affecting transport demand.
2. Describe various transportation infrastructure financing methods including public-private partnership (PPP) models.
3. Explain the steps involved in project appraisal and economic evaluation of transportation infrastructure projects.

MODEL QUESTION PAPER

QP CODE:

Pages: 2

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

SEVENTH SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CE4T01

TRANSPORT INFRASTRUCTURE ENGINEERING

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. List the components of a highway pavement and state the function of any two layers.
2. Define pavement management system and state its importance in highway maintenance.
3. Define railway gauge and list the different types of gauges used in railway engineering.
4. What is cant deficiency? State its significance in railway track design.
5. List the major components of an airport and state the function of any one component.
6. Define runway orientation and state the factors affecting its selection.
7. Classify harbours based on their formation.
8. What are breakwaters? State any two functions of breakwaters.
9. Define elasticity of demand in transportation.
10. List any two sources of financing transportation infrastructure projects.

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. Explain the classification of highways and describe the components of highway pavements, including their functions.

OR

12. Describe flexible and rigid pavement construction methods and explain the importance of maintenance and pavement management systems in highway infrastructure.

MODULE 2

13. Describe the component parts of a railway track and explain the functions of rails, sleepers, ballast, and formation.

OR

14. Explain the concepts of gauge, coning of wheels, cant, cant deficiency, and compensation of curves with suitable illustrations.

MODULE 3

15. Explain the components of an airport and discuss the factors influencing the selection of a suitable airport site.

OR

16. Describe the procedure for determining runway orientation and explain the factors affecting basic runway length and necessary corrections.

MODULE 4

17. Classify harbours based on their formation and functions, and describe the essential features required for harbour planning.

OR

18. Explain the necessity and functions of breakwaters and describe the different types of docks including dry docks and wet docks.

MODULE 5

19. Explain the concepts of demand and supply in transportation infrastructure and discuss the factors affecting transport demand and elasticity.

OR

20. Describe various financing methods used in transportation infrastructure projects and explain the role of Public-Private Partnership (PPP) models in project development.

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE4P31	ARCHITECTURE AND INTERIOR DESIGNING	2	1	0	4	3	2024

Preamble

This course introduces the relationship between visual arts, architecture, and design, focusing on form, space, and aesthetics. It explores architecture as a blend of art, culture, technology, and sustainability through theory and contemporary practices. The course also provides basic insights into interior design and professional practice for real-world application.

Prerequisites: Functional Planning of Buildings

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Apply the principles and elements of visual arts in developing basic architectural drawings and two-dimensional compositions. (Cognitive Knowledge Level: Apply)
CO 2	Relate architectural design to cultural context, natural environment, and technological aspects and apply it in preparing architectural drawings. (Cognitive Knowledge Level: Apply)
CO 3	Use architectural theories, form–function relationships, and spatial elements in organizing basic architectural spaces. (Cognitive Knowledge Level: Apply)
CO 4	Incorporate contemporary and sustainable architectural concepts in developing environmentally responsive design ideas. (Cognitive Knowledge Level: Apply)
CO 5	Apply principles of interior design and professional practices in planning functional interior spaces. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	2	1	2		2	1		1	2		1
CO 2	2	2	2		2	3		1	1		1
CO 3	2	2	3	1	1	1		1	1		1
CO 4	2	1	2		1	3	2	1	1		2
CO 5	2	1	3		2	2	2	2	1	1	2

Assessment Pattern

ARCHITECTURE AND INTERIOR DESIGNING			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	20	20	30
Understand	50	50	50
Apply	30	30	20
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course Project	: 10 marks
Self Study	: 5 marks

End Semester Examination Pattern

There will be two parts: Part A and Part B. Part A contain 10 questions, with 2 questions

from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module, of which students should answer any one. Each question carries 14 marks and can have a maximum of 2 sub-divisions.

SYLLABUS

Module 1: Visual Arts and Architectural Expression (7 hours)

Role of visual art in architecture, Principles and elements of visual art, Basics of drawing: line, tone, shading and texture, balance, rhythm, proportion, unity, harmony. Two-dimensional forms: objects, patterns and spaces. Art appreciation and visual perception, Overview of art movements: Classical, Renaissance, Cubism, Art Deco, Indian art traditions.

Module 2: Architecture, Culture and Nature (7 hours)

Meaning and scope of architecture, Architecture as a fine art-Aesthetics, Form, Expression, a technological field-materials, structure, construction and as a profession-planning, design and execution, Language- Form, space, scale, material and medium of architecture- Drawings, models, digital tools, Architecture as manifestation of culture, Traditional and vernacular architecture, Design as a theme in nature and culture.

Module 3: Architectural Theory, Form and Space (7 Hours)

Introduction to architectural theories, Form-function relationship, Gestalt principles and visual perception, Elements of space: point, line, plane and volume, Types of forms: Platonic and hybrid, Spatial configurations and relationships, scale and proportion: Generic scale, human scale and Le Modulor.

Module 4: Contemporary and Sustainable Architecture (7 Hours)

Modern architectural concepts and trends, Adaptive reuse and biomimicry, Introduction to parametric design, New building materials in architecture, Seismic safety in the buildings and their integration with architectural problems, Energy efficient and green buildings, Zero energy buildings (case studies).

Module 5: Interior Design and Professional Practice (7 Hours)

Introduction to interior design, Principles and elements of interior design-Space-making elements: walls, floors, furniture and partitions, Colour, light and texture in interiors, Interior materials and basic construction methods, Case studies of residential and commercial interiors, professional practice: interior services, bylaws and fees.

Text Books:

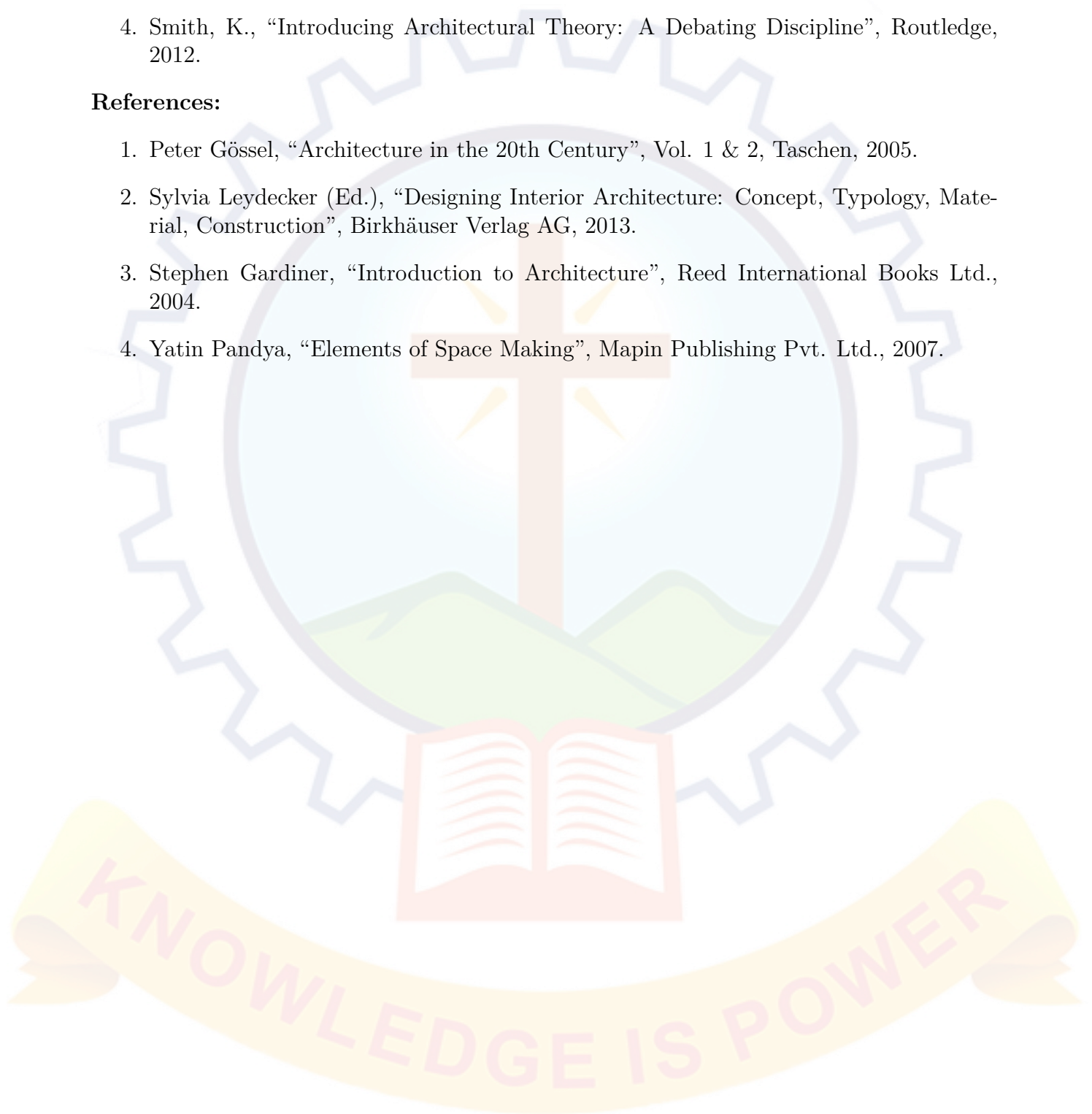
1. Francis D. K. Ching, "Architecture: Form, Space and Order", 5th Edition, John Wiley & Sons, 2023.
2. Hugh Honour and John Fleming, "The Visual Arts: A History", Pearson Prentice

Hall, 2009.

3. Brian Edwards, “Understanding Architecture Through Drawing”, 2nd Edition, Routledge, 2009.
4. Smith, K., “Introducing Architectural Theory: A Debating Discipline”, Routledge, 2012.

References:

1. Peter Gössel, “Architecture in the 20th Century”, Vol. 1 & 2, Taschen, 2005.
2. Sylvia Leydecker (Ed.), “Designing Interior Architecture: Concept, Typology, Material, Construction”, Birkhäuser Verlag AG, 2013.
3. Stephen Gardiner, “Introduction to Architecture”, Reed International Books Ltd., 2004.
4. Yatin Pandya, “Elements of Space Making”, Mapin Publishing Pvt. Ltd., 2007.



COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	7 hours
1.1	Role of visual art in architecture, principles and elements of visual art.	2
1.2	Basics of drawing: line, tone, shading and texture; balance, rhythm, proportion, unity and harmony.	2
1.3	Two-dimensional forms: objects, patterns and spaces.	1
1.4	Art appreciation and visual perception.	1
1.5	Overview of art movements: Classical, Renaissance, Cubism, Art Deco, Indian art traditions.	1
2	Module 2	7 hours
2.1	Meaning and scope of architecture.	1
2.2	Architecture as a fine art (aesthetics, form, expression) and as a technological field (materials, structure, construction).	2
2.3	Architecture as a profession (planning, design and execution); language of architecture: form, space, scale, material and medium (drawings, models, digital tools).	2
2.4	Architecture as manifestation of culture; traditional and vernacular architecture.	1
2.5	Design as a theme in nature and culture.	1
3	Module 3	8 hours
3.1	Introduction to architectural theories; form–function relationship.	2
3.2	Gestalt principles and visual perception.	1
3.3	Elements of space: point, line, plane and volume.	2

3.4	Types of forms: Platonic and hybrid.	1
3.5	Spatial configurations and relationships; scale and proportion: generic scale, human scale and Le Modulor.	2
4	Module 4	7 hours
4.1	Modern architectural concepts and trends.	1
4.2	Adaptive reuse and biomimicry.	1
4.3	Introduction to parametric design, new building materials in architecture.	2
4.4	Seismic safety in buildings and their integration with architectural problems.	1
4.5	Energy efficient and green buildings, zero energy buildings (case studies).	2
5	Module 5	7 hours
5.1	Introduction to interior design; principles and elements of interior design.	1
5.2	Space-making elements: walls, floors, furniture and partitions.	1
5.3	Colour, light and texture in interiors.	1
5.4	Interior materials and basic construction methods.	2
5.5	Case studies of residential and commercial interiors; professional practice: interior services, bylaws and fees.	2
Total		36 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

4. Explain the principles of balance, rhythm, and proportion with suitable examples from architecture.
5. Describe line, tone, shading, and texture with neat sketches of basic geometric forms.
6. Explain the features of any one art movement (Cubism/Art Deco) and illustrate with a simple pattern.

Course Outcome 2 (CO 2):

1. Explain the influence of climate on architectural design with suitable examples.
2. Describe the characteristics of vernacular architecture in any region.
3. Explain the concepts of form and space with simple sketches.

Course Outcome 3 (CO 3):

1. Explain the form-function relationship in architecture with examples.
2. Describe the elements of space (point, line, plane, volume) with neat sketches.
3. Explain the concept of scale and proportion with reference to human scale.

Course Outcome 4 (CO 4):

1. Explain the principles of sustainable architecture with suitable examples.
2. Describe energy-efficient building features used in design.
3. Explain the concept of adaptive reuse with an example.

Course Outcome 5 (CO 5):

1. Explain the principles and elements of interior design.
2. Describe the role of colour, light, and texture in interior spaces.
3. Explain commonly used interior materials and their applications.

MODEL QUESTION PAPER

QP CODE:

Pages: 3

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

SEVENTH SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CE4P31

ARCHITECTURE AND INTERIOR DESIGNING

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Define visual art in architecture and give one example.
2. List any three principles of visual art used in architectural design.
3. Define architecture and mention its scope.
4. List any three characteristics of vernacular architecture.
5. Define form and function in architecture.
6. List the elements of space used in architectural design.
7. Define adaptive reuse with one example.
8. List any three features of energy-efficient buildings.
9. Define interior design and its scope.
10. List any three space-making elements used in interior design.

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. a) Explain the principles of balance, rhythm, and proportion with suitable architectural examples. (8)
b) Describe line, tone, shading, and texture and illustrate their application using neat sketches of basic geometric forms. (6)

OR

12. a) Explain the role of visual arts in architectural expression with examples. (8)
b) Discuss any one art movement and illustrate its influence on architecture with a simple sketch or example. (6)

MODULE 2

13. a) Explain architecture as an integration of art, culture, and technology with suitable examples. (8)
b) Describe the role of drawings, models, and digital tools in architectural representation with examples. (6)

OR

14. a) Discuss the characteristics of traditional and vernacular architecture with examples from a specific region. (8)
b) Explain how natural and cultural factors influence architectural design with examples. (6)

MODULE 3

15. a) Explain the form–function relationship in architecture with examples from buildings. (8)
b) Describe the elements of space (point, line, plane, volume) and illustrate each with neat sketches. (6)

OR

16. a) Explain Gestalt principles and their role in architectural perception with examples. (8)
b) Discuss scale and proportion with reference to human scale and Le Modulor, using suitable diagrams. (6)

MODULE 4

17. a) Explain the modern architectural trends and concepts with at least two examples. (8)
b) Describe the principles of energy-efficient and green building design with examples. (6)

OR

18. a) Explain adaptive reuse and biomimicry in architecture with one example each. (8)
b) Discuss the importance of seismic safety in architectural design with suitable examples. (6)

MODULE 5

19. a) Explain the principles and elements of interior design with examples. (8)
b) Describe the role of colour, light, and texture in interior spaces with suitable illustrations. (6)

OR

20. a) Discuss interior materials and basic construction methods used in buildings with examples. (8)
b) Explain professional practices in interior design including services, bylaws, and fees with examples. (6)

KNOWLEDGE IS POWER

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE4P32	AIR QUALITY MANAGEMENT	2	1	0	4	3	2024

Preamble

This course provides fundamental knowledge of air pollution sources, characteristics, and impacts on human health and the environment. It covers atmospheric meteorology and dispersion mechanisms of air pollutants, air quality monitoring techniques, and air quality management strategies. The course also introduces various air pollution control technologies for particulate and gaseous emissions, enabling students to understand and apply air quality management principles for environmental protection.

Prerequisites: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Explain the sources, types, and characteristics of air pollutants and industrial processes causing air pollution (Cognitive Knowledge Level: Understand)
CO 2	Describe the effects of air pollutants on health, environment, and ecosystems including indoor air pollution issues (Cognitive Knowledge Level: Understand)
CO 3	Apply meteorological concepts and plume dispersion principles to understand the transport and dispersion of air pollutants (Cognitive Knowledge Level: Apply)
CO 4	Explain methods of air quality monitoring, air quality standards, emission inventory, and air quality management approaches (Cognitive Knowledge Level: Understand)
CO 5	Apply appropriate air pollution control technologies for particulate and gaseous emissions. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	1				2	3	1			
CO 2	2	1				3	3	2		1	
CO 3	3	2	1	2	2	2	3	1		1	1
CO 4	2	2		1	2	2	3	2	1	1	1
CO 5	3	2	2	1	2	2	3	1		1	2

Assessment Pattern

Air Quality Management			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	20	20	30
Understand	50	50	50
Apply	30	30	20
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course Project	: 10 marks
Self Study	: 5 marks

End Semester Examination Pattern

There will be two parts: Part A and Part B. Part A contain 10 questions, with 2 questions from each module, having 3 marks for each question. Students should answer all questions.

Part B contains 2 questions from each module, of which students should answer any one. Each question carries 14 marks and can have a maximum of 2 sub-divisions.

SYLLABUS

Module 1: Introduction to Air Quality Management (7 hours)

Introduction- Components of Environment - Definition - Air Pollution - History of air pollution episodes - Sources of Air pollution - Industrial Processes causing Air Pollution - Air Pollutants - Types of Air Pollutants - Criteria Pollutants.

Module 2: Air Pollution: Effects and Environmental Issues (7 hours)

Effect of air pollutants on health, vegetation, animals and materials and environment - Greenhouse effect - Smoke, smog and ozone layer disturbance - Indoor Air Pollution - Sources of indoor air pollutants - Effects of indoor air pollution.

Module 3: Meteorology and Dispersion of Air Pollutants (7 Hours)

Meteorological aspects of Air Pollutant Dispersion - Temperature and Pressure relationships - Atmospheric Stability - Temperature Lapse Rate- Inversions - Types, Plume behaviour. Dispersion of Air pollutants - Plume dispersion theory - Gaussian plume model (Derivation not required) - Assumptions - Advantages and Disadvantages.

Module 4: Air Quality Assessment and Management (7 Hours)

Air Quality monitoring - Ambient air sampling - Collection of gaseous air pollutants - Collection of particulate Pollutants - Ambient Air Quality standards- Emission Inventory - Air Quality Index (AQI) - Air Quality Management and Planning - Air Quality Case Studies and Global Perspectives.

Module 5: Air Pollution Control Technologies (8 Hours)

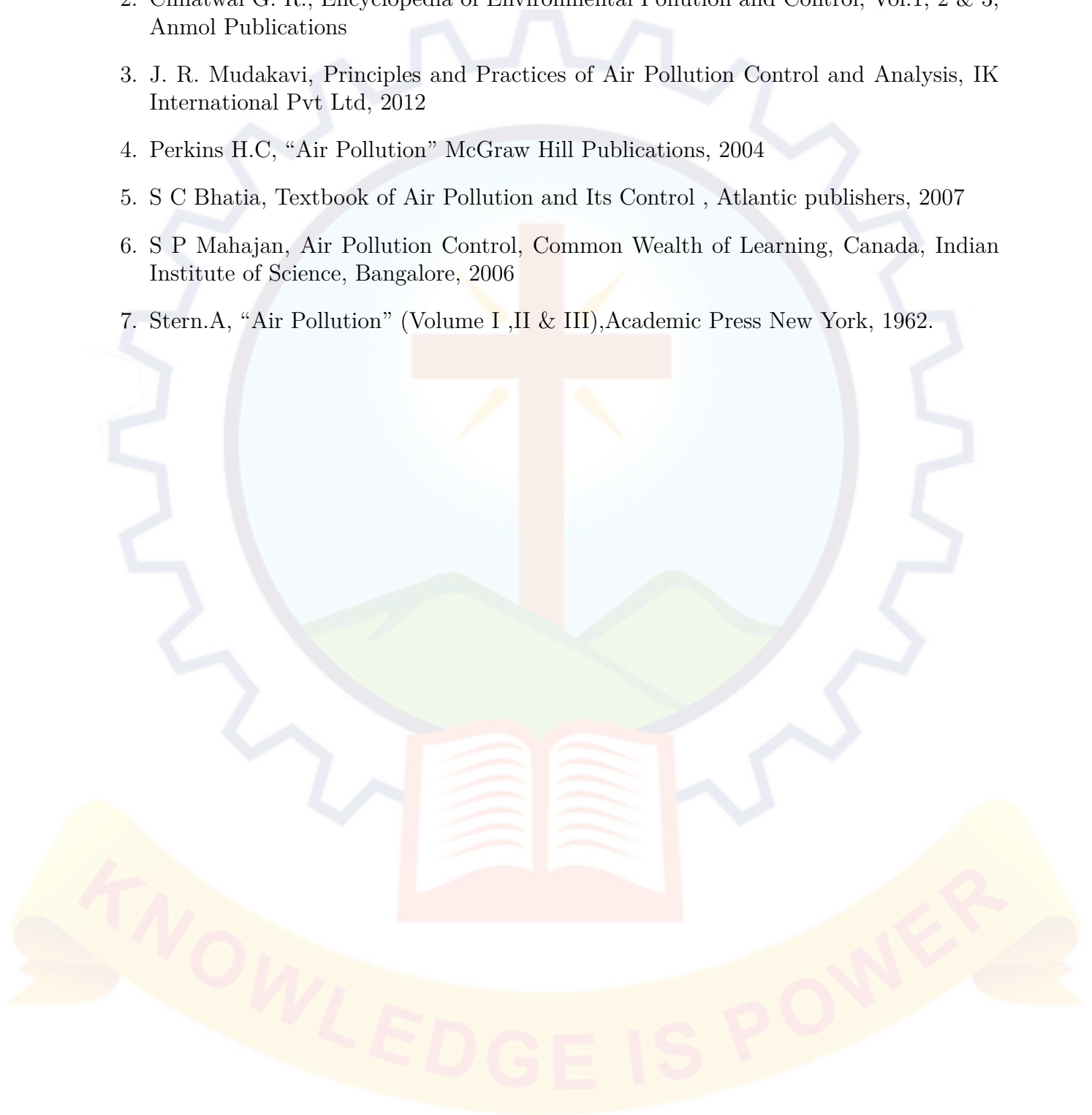
Control of Air Pollutants- Particulate emission control - methods, Scrubbing - Cyclones - Filtration - Electrostatic Precipitation - Gaseous emission control - adsorption, absorption, thermal methods - Control Technologies for Odour and Hazardous Air Pollutants (HAPs), Advanced Air Pollution Control Technologies.

Text Books:

1. C.S.Rao, "Environmental Pollution Control Engineering", New Age International Pub., 2006
2. M.N. Rao & H.V.N Rao ,Air Pollution, Tata McGraw Hill Co. Ltd, Delhi, 1990.
3. Peavy H S, Rowe, D.R. Tchobanaglou "Environmental Engineering" McGraw Hill Education, 1985

References:

1. Beat Meyer, Indoor Air Quality, Addison – Wesley Publishers
2. Chhatwal G. R., Encyclopedia of Environmental Pollution and Control, Vol.1, 2 & 3, Anmol Publications
3. J. R. Mudakavi, Principles and Practices of Air Pollution Control and Analysis, IK International Pvt Ltd, 2012
4. Perkins H.C, “Air Pollution” McGraw Hill Publications, 2004
5. S C Bhatia, Textbook of Air Pollution and Its Control , Atlantic publishers, 2007
6. S P Mahajan, Air Pollution Control, Common Wealth of Learning, Canada, Indian Institute of Science, Bangalore, 2006
7. Stern.A, “Air Pollution” (Volume I ,II & III),Academic Press New York, 1962.



COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	7 hours
1.1	Introduction - Components of Environment- Definition .	1
1.2	Air Pollution - History of air pollution episodes- Sources of Air pollution	2
1.3	Industrial Processes causing Air Pollution - Air Pollutants	2
1.4	Types of Air Pollutants - Criteria Pollutants.	2
2	Module 2	7 hours
2.1	Effect of air pollutants on health, vegetation, animals and materials and environment.	2
2.2	Greenhouse effect - Smoke, smog and ozone layer disturbance	2
2.3	Indoor Air Pollution - Sources of indoor air pollutants	2
2.4	Effects of indoor air pollution	1
3	Module 3	7 hours
3.1	Meteorological aspects of Air Pollutant Dispersion - Temperature and Pressure relationships	2
3.2	Atmospheric Stability - Temperature Lapse Rate - Inversions - Types, Plume behaviour	2
3.3	Dispersion of Air pollutants - Plume dispersion theory.	1
3.4	Gaussian plume model (Derivation not required) - Assumptions - Advantages and Disadvantages	2
4	Module 4	7 hours
4.1	Air Quality monitoring - Ambient air sampling .	1

4.2	Collection of gaseous air pollutants - Collection of particulate Pollutants	2
4.3	Ambient Air Quality standards - Emission Inventory	1
4.4	Air Quality Index (AQI) - Air Quality Management and Planning	2
4.5	Air Quality Case Studies and Global Perspectives	1
5	Module 5	8 hours
5.1	Control of Air Pollutants - Particulate emission control - methods, Scrubbing - Cyclones - Filtration	2
5.2	Electrostatic Precipitation - Gaseous emission control - adsorption, absorption, thermal methods	2
5.3	Control Technologies for Odour and Hazardous Air Pollutants (HAPs)	2
5.4	Advanced Air Pollution Control Technologies	2
Total		36 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Define air pollution and classify different types of air pollutants.
2. Explain the major sources of air pollution and industrial processes contributing to it.
3. Describe the criteria pollutants and their significance in air quality management.

Course Outcome 2 (CO 2):

1. Explain the effects of air pollution on human health and vegetation.
2. Describe the greenhouse effect and ozone layer depletion caused by air pollutants
3. Explain the sources and effects of indoor air pollution.

Course Outcome 3 (CO 3):

1. Explain atmospheric stability and its role in pollutant dispersion.
2. Describe temperature inversion and its influence on air pollution episodes.
3. Explain the assumptions and applications of the Gaussian plume model.

Course Outcome 4 (CO 4):

1. Explain the methods used for ambient air quality monitoring.
2. Describe the concept and significance of Air Quality Index (AQI).
3. Explain the importance of emission inventory in air quality management.

Course Outcome 5 (CO 5):

1. Explain the working principle of cyclone separators used for particulate control.
2. Describe the principle of electrostatic precipitators used for air pollution control.
3. Explain adsorption and absorption methods for gaseous pollutant control.

MODEL QUESTION PAPER

QP CODE:

Pages: 2

Reg.No.:

Name:

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

SEVENTH SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CE4P32

COURSE NAME : AIR QUALITY MANAGEMENT

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Define air pollution and list the components of the environment.
2. What are criteria pollutants?
3. Mention two effects of air pollution on vegetation.
4. What is indoor air pollution? List two sources.
5. Define atmospheric stability.
6. What is temperature inversion?
7. What is ambient air quality monitoring?
8. What is Air Quality Index (AQI)?
9. List any two particulate control devices.
10. What is adsorption in gaseous pollutant control?

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. a) Explain the sources and types of air pollutants . (8)
b) Discuss the history of major air pollution episodes. (6)

OR

12. a) Explain industrial processes that cause air pollution. (7)
b) Discuss the classification and characteristics of criteria pollutants (7)

MODULE 2

13. a) Explain the effects of air pollutants on human health and environment. (8)
b) Discuss the greenhouse effect and smog formation. (6)

OR

14. a) Explain the causes and effects of ozone layer depletion. (7)
b) Discuss the sources and impacts of indoor air pollution. (7)

MODULE 3

15. a) Explain the causes and effects of ozone layer depletion. (8)
b) Describe plume behavior with suitable diagrams. (6)

OR

16. a) Explain the Gaussian plume model and its assumptions. (7)
b) Discuss the effect of temperature inversion on pollutant dispersion. (7)

MODULE 4

17. a) Explain ambient air quality monitoring methods and sampling techniques. (8)
b) Discuss the significance of emission inventory in air quality management. (6)

OR

18. a) Explain Air Quality Index (AQI) and its importance. (7)
b) Discuss air quality management and planning strategies. (7)

MODULE 5

19. a) Explain cyclone separators and electrostatic precipitators for particulate control. (8)
b) Discuss filtration methods for air pollution control. (6)

OR

20. a) Explain adsorption and absorption methods for gaseous pollutant control. (7)
b) Discuss advanced air pollution control technologies for hazardous air pollutants. (7)

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE4P33	SOIL STRUCTURE INTERACTION	2	1	0	4	3	2024

Preamble

This course introduces the importance of behaviour and analysis of structures while interacting with soil. The actual behaviour of structures with respect to foundation and behaviour of foundation with respect to soil are studied considering different models. This knowledge will be helpful for economising the foundation size and to understand the complex behaviour of soil under particular situation.

Prerequisites: Soil Mechanics, Environmental Engineering, Structural Analysis

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Explain elastic soil behavior related to bearing capacity and settlement (Cognitive Knowledge Level: Understand)
CO 2	Identify the significance of SSI in foundation design (Cognitive Knowledge Level: Understand)
CO 3	Explain various soil idealizations for SSI (Cognitive Knowledge Level: Understand)
CO 4	Apply the mathematical models for 1- Dimensional soil structural analysis (Cognitive Knowledge Level: Apply)
CO 5	Apply SSI for general engineering design problems (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	2	2	-	-	-	-	-	-	-	-
CO 2	3	3	3	-	-	-	-	-	-	-	-
CO 3	2	3	3	-	-	-	-	-	-	-	-
CO 4	3	3	3	-	-	-	-	-	-	-	-
CO 5	3	2	2	-	-	-	-	-	-	-	-

Assessment Pattern

SOIL STRUCTURE INTERACTION			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	20	20	20
Understand	40	40	30
Apply	40	40	50
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course Project	: 10 marks
Self Study	: 5 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question carries 14 marks and can have maximum 2 sub-divisions.

SYLLABUS

Module 1: Soil bearing capacity: (7 Hours)

Bearing capacity analysis by Terzaghi's theory, Skempton, Meyerhof and IS code method. Types of settlement for soil - immediate or elastic settlement, primary consolidation settlement, secondary compression settlement. Settlement calculation for granular and clayey soils based on IS code method.

Module 2: Fundamentals of Soil-Structure Interaction: (7 Hours)

Introduction to soil-structure interaction - significance of SSI. Contact pressure distribution beneath rigid and flexible footings -cohesive and non-cohesive soils, concept of subgrade modulus-influencing factors, concentrically and eccentrically loaded cases - Static and Dynamic loading effects-static & dynamic SSI (concept only).

Module 3: Elastic models for soil response: (7 Hours)

Winkler model, Elastic continuum models - isotropic elastic continuum, layered & structured elastic media, Two parameter elastic models - Filonenko-Borodich, Hetenyi and Pasternak models. Elastic - Plastic behaviour - Time dependent behaviour.

Module 4: Beams on Elastic Foundations: (7 Hrs)

Infinite beams resting over Winkler medium - governing differential equation, solutions for the case of infinite beams subjected to concentrated forces and uniform force of finite length. Finite beams resting over Winkler medium- Hetenyi's principle of superposition. Classification of finite beams in relation to their stiffness.

Module 5: Applications of SSI in engineering design (7 Hrs)

Soil-structure interactions effects in design of isolated and mat foundations. Soil-structure interaction effects in vertical and lateral pile capacities. Dynamic soil structure interaction - Applications in Low rise residential buildings, multi-storey buildings, bridges, dams, nuclear power plants.

Text Books:

1. Selvadurai, A.P.S., Elastic Analysis of Soil Foundation Interaction, Elsevier, 1979.
2. Structure Soil Interaction- The real behaviour of Structures, Institution of structural

Engineers, London, 1989.

3. Hemsley, J.A., Elastic Analysis of Raft Foundations, Thomas Telford, 1998
4. Nainan P. Kurian, Design of Foundation Systems, Narosa, 2005
5. Murthy, V.N.S., Advanced Foundation Engineering, CBS Publishers, New Delhi, 2007.
6. Cakmak, A.K., Soil-Structure Interaction ,Developments in Geotechnical Engineering 43, Elsevier and Computational Mechanics Publications, 1987.
7. Kramer,S.L.,Geotechnical-Earthquake Engineering, Pearson Education, 1996.
8. Hall, W,S., Oliveto Kluwer,O., Boundary Element Method for Soil-Structure Interaction , Academic Publishers, 2003.
9. Wolf, J.P., Dynamic Soil-Structure Interaction , Prentice-Hall, 1985.

Reference Books:

1. Wolf, J.P.,Soil-Structure Interaction in the Time-Domain, Prentice-Hall, 1988.
2. Chen, Wai-Fah, Duan Lian, Bridge Engineering Seismic Design, CRC Press.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
	MODULE 1	7
1.1	Bearing capacity analysis by Terzaghi's theory, Skempton, Meyerhof and IS code method	2
1.2	Types of settlement for soil – immediate or elastic settlement, primary consolidation settlement, secondary compression settlement.	2
1.3	Settlement calculation for granular and clayey soils based on IS code method	2
1.4	Review Problems	1
	MODULE 2	7
2.1	Introduction to soil-structure interaction - significance of SSI.	1
2.2	Contact pressure distribution beneath rigid and flexible footings- cohesive and non-cohesive soils- Problems	2
2.3	Concept of subgrade modulus - influencing factors, concentrically and eccentrically loaded cases	2
2.4	Static and Dynamic loading effects-static & dynamic SSI (concept only)	2
	MODULE 3	7
3.1	Winkler model, Elastic continuum models - isotropic elastic continuum, layered & structured elastic media	2
3.2	Two parameter elastic models - Filonenko-Borodich, Hetenyi and Pasternak models.	3
3.3	Elastic -Plastic behaviour	1
3.4	Time dependant behaviour	1
	MODULE 4	8

4.1	Infinite beams resting over Winkler medium - governing differential equation	2
4.2	Solutions for the case of infinite beams subjected to concentrated forces and uniform force of finite length.	2
4.3	Finite beams resting over Winkler medium - Hetenyi's principle of superposition. Classification of finite beams in relation to their stiffness.	4
	MODULE 5	7
5.1	Soil-structure interactions effects in design of isolated and mat foundations	1
5.2	Soil-structure interaction effects in vertical and lateral pile capacities	1
5.3	Dynamic soil structure interaction - Applications in Low rise residential buildings	2
5.4	Dynamic soil structure interaction - Applications in multi storey buildings.	2
5.5	Dynamic soil structure interaction - Applications in bridges, dams, nuclear power plants.	1
	Total	36 Hours

MODEL QUESTION PAPER

QP CODE:

Pages: 3

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

SEVENTH SEMESTER B. TECH. DEGREE EXAMINATION, YEAR

Course Code: B24CE4P33

SOIL STRUCTURE INTERACTION

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Define net safe bearing capacity.
2. State any three assumptions of Terzaghi's theory.
3. What is immediate settlement?
4. Define modulus of subgrade reaction (k).
5. What is soil-structure interaction?
6. Differentiate elastic and consolidation settlement.
7. Define Winkler model.
8. What is meant by eccentric loading?
9. Define characteristic length of beam on elastic foundation.
10. List two applications of dynamic SSL.

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. (a) Derive Terzaghi's bearing capacity equation for strip footing. (7 marks)

- (b) A square footing of size $2\text{ m} \times 2\text{ m}$ is founded at a depth of 1.5 m in sand having: $\gamma = 18\text{ kN/m}^3$, $\phi = 30^\circ$, $c = 0$. Using Terzaghi's theory, calculate ultimate bearing capacity. (7 marks)

OR

12. (a) Explain types of settlement in soils. (6 marks)
(b) A clay layer of thickness 4 m undergoes consolidation. Given: Initial void ratio = 0.8 , Compression index $C_c = 0.25$, Initial stress = 100 kN/m^2 , Final stress = 200 kN/m^2 . Calculate primary consolidation settlement. (8 marks)

MODULE 2

13. (a) Explain SSI and its significance in foundation design. (6 marks)
(b) A rigid footing of width 2 m carries a load of 200 kN/m centrally. Determine contact pressure distribution for: (i) Cohesionless soil (ii) Cohesive soil (8 marks)

OR

14. (a) Explain modulus of subgrade reaction and influencing factors. (6 marks)
(b) A rectangular footing $2\text{ m} \times 3\text{ m}$ carries a load of 600 kN with eccentricity of 0.5 m . Determine maximum and minimum soil pressure. (8 marks)

MODULE 3

15. (a) Explain Winkler model with assumptions and limitations. (7 marks)
(b) Compare Winkler model and Pasternak model. (7 marks)

OR

16. (a) Explain elastic continuum models (isotropic and layered). (7 marks)
(b) Discuss elastic-plastic and time-dependent behaviour of soils. (7 marks)

MODULE 4

17. (a) Derive the governing differential equation for beam on elastic foundation. (6 marks)
(b) An infinite beam on elastic foundation is subjected to a point load P . Derive expressions for deflection and bending moment. (8 marks)

OR

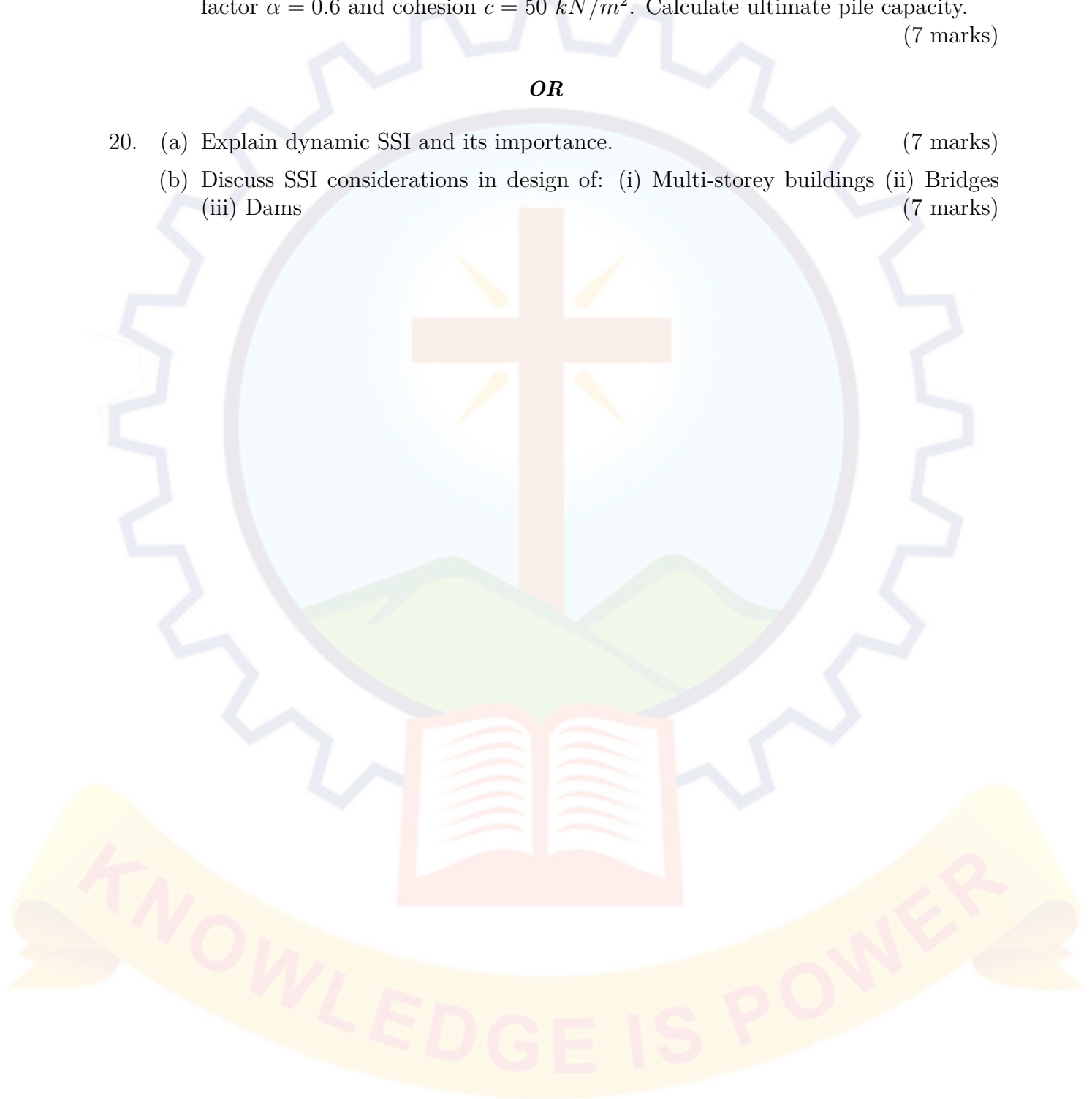
18. (a) Explain finite beam analysis using Hetenyi's method. (6 marks)
(b) A beam of length 6 m rests on elastic foundation with $k = 10,000\text{ kN/m}^3$. Given $EI = 2 \times 10^7\text{ kNm}^2$, calculate the characteristic length and classify the beam. (8 marks)

MODULE 5

19. (a) Explain SSI effects in mat and isolated foundations. (7 marks)
- (b) A pile of diameter 0.4 m and length 10 m is embedded in clay with adhesion factor $\alpha = 0.6$ and cohesion $c = 50 \text{ kN/m}^2$. Calculate ultimate pile capacity. (7 marks)

OR

20. (a) Explain dynamic SSI and its importance. (7 marks)
- (b) Discuss SSI considerations in design of: (i) Multi-storey buildings (ii) Bridges (iii) Dams (7 marks)



CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE4P34	ADVANCED DESIGN OF CONCRETE STRUCTURES	2	1	0	4	3	2024

Preamble

The course Advanced Design of Concrete Structures is intended to build upon the fundamental principles of reinforced concrete design and extend students' understanding to complex structural systems encountered in professional practice. It emphasizes analytical approaches, codal provisions, and practical design considerations for a variety of structural elements. It covers continuous beams, slender columns under axial and bending loads, water retaining structures, foundations including piles and pile caps, and retaining walls.

Prerequisites: Design of concrete structures

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Analyse and design continuous reinforced concrete beams considering critical loading conditions, moment redistribution, and IS code provisions. (Cognitive Knowledge Level: Analyse)
CO 2	Evaluate and design slender columns under axial load and uniaxial/biaxial bending using interaction diagrams and stability criteria. (Cognitive Knowledge Level: Apply)
CO 3	Design ground-supported circular and rectangular water tanks considering safety and serviceability requirements. (Cognitive Knowledge Level: Analyse)
CO 4	Design pile foundations and pile caps based on load transfer mechanisms and codal guidelines. (Cognitive Knowledge Level: Apply)
CO 5	Analyse earth pressure and design retaining walls ensuring overall stability. (Cognitive Knowledge Level: Analyse)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	3	2	1	2				2		1
CO 2	3	3	3	2	2				2		1
CO 3	3	3	1	2	2	3		1	2		2
CO 4	3	3	3	2	2	2	2	1	2		1
CO 5	3	3	3	2	2	2	2	1	2		1

Assessment Pattern

ADVANCED DESIGN OF CONCRETE STRUCTURES			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember			
Understand	20	20	20
Apply	40	40	40
Analyse	40	40	40
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course Project : 10 marks

Self Study : 5 marks

End Semester Examination Pattern

There will be two parts: Part A and Part B. Part A contain 10 questions, with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module, of which students should answer any one. Each question carries 14 marks and can have a maximum of 2 sub-divisions.

SYLLABUS

Module 1: Design of Continuous Beams (6 hours)

Continuous beams, definition and significance in structural engineering, analysis of loading conditions for maximum moment, overview of IS code provisions and design coefficients, design problems and practical applications, redistribution of moments and its implications in design.

Module 2: Design of Slender Columns (6 hours)

Slender columns, characteristics and significance in structural design, analysis of additional moments due to slenderness, behavior of columns under axial compression, uniaxial, and biaxial bending, generation and application of P-M interaction diagrams, design examples.

Module 3: Design of Water Tanks (8 Hours)

Water tank-classification- Design requirements- Design of Ground supported Circular and rectangular water tanks

Module 4: Design of Foundations (8 Hours)

Foundations-classifications. Pile-classifications, design of end-bearing piles and friction piles, Pile cap-classifications, design of pile cap.

Module 5: Design of Retaining Structures (8 Hours)

Retaining wall, Types, Earth pressure, Stability of retaining wall, Design of cantilever and counterfort RWs

Text Books:

1. B. C. Punmia, Ashok Kumar Jain and Arun Kumar Jain, "Reinforced Concrete Structures", Laxmi Publications, New Delhi.
2. S. Unnikrishna Pillai and Devdas Menon, "Reinforced Concrete Design", Tata McGraw Hill Education, New Delhi.
3. P. C. Varghese, "Advanced Reinforced Concrete Design", Prentice Hall of India, New Delhi.

4. P. Dayaratnam, “Design of Reinforced Concrete Structures”, Oxford and IBH Publishing, New Delhi.
5. R. N. Krishna Raju, “Design of Concrete Structures”, CBS Publishers and Distributors, New Delhi.
6. B. C. Punmia, Ashok Kumar Jain and Arun Kumar Jain, “Soil Mechanics and Foundations”, Laxmi Publications, New Delhi.
7. R. N. Krishna Raju, “Design of Liquid Retaining Concrete Structures”, CBS Publishers and Distributors, New Delhi.

References:

1. N.J. Delatte, ”Beyond Failure: Forensic Case Studies for Civil Engineers”, ASCE, 2009
2. Talreja, R. & Natarajan, C., Assessment of Existing Structures, Narosa Publishing House.
3. IS 456: 2000 – Plain and Reinforced Concrete – Code of Practice.
4. IS 13311 (Part 1 & 2): 1992 – Non-Destructive Testing of Concrete.
5. IS 15988: 2013 – Seismic Evaluation and Strengthening of Existing RC Buildings.
6. IS 16401: 2015 – Structural Health Monitoring of Civil Engineering Structures.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	6 hours
1.1	Continuous beams, definition and significance in structural engineering.	1
1.2	Analysis of loading conditions for maximum moment, overview of IS code provisions and design coefficients.	1
1.3	Design problems and practical applications	2
1.4	Redistribution of moments and its implications in design	2
2	Module 2	6 hours
2.1	Slender columns, characteristics and significance in structural design	1

2.2	Analysis of additional moments due to slenderness	1
2.3	Behaviour of columns under axial compression, uniaxial, and biaxial bending, generation and application of P-M interaction diagrams	1
2.4	Design examples	3
3	Module 3	8 hours
3.1	Water tank-classification- Design requirements	2
3.2	Design of Ground supported Circular water tanks	3
3.3	Design of Ground supported rectangular water tanks	3
4	Module 4	8 hours
4.1	Foundations-classifications. Piles-classifications	1
4.2	Design of end-bearing piles	2
4.3	Design of friction piles	2
4.4	Pile cap-classifications, design of pile cap	3
5	Module 5	8 hours
5.1	Retaining wall, Types, Earth pressure	1
5.2	Stability of retaining wall	2
5.3	Design of cantilever RWs	3
5.4	Design of counterfort RWs	2
Total		36 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Explain the concept of moment redistribution and its significance in the design of continuous beams.
2. Describe the loading conditions for maximum bending moments in a continuous beam.
3. Explain the design procedure of continuous beam as per IS codal provisions.

Course Outcome 2 (CO 2):

1. Explain the IS codal provisions for the design of slender columns.
2. What is a slender column?
3. Explain the concept of biaxial bending in columns and illustrate the use of P-M interaction diagrams in design

Course Outcome 3 (CO 3):

1. Explain the design principles of liquid retaining structures.
2. Why the crack width control is of prime importance for water tanks?
3. What are the design requirements of water tanks.

Course Outcome 4 (CO 4):

1. List types of footings.
2. Explain the load transfer in piles?
3. Discuss the design principles of pile cap.

Course Outcome 5 (CO 5):

1. What are the forces acting on a retaining wall?
2. Enlist the differences in structural action of cantilever and counterfort retaining walls.
3. Discuss on the stability checks in retaining wall.

MODEL QUESTION PAPER

QP CODE:

Pages: 3

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

SEVENTH SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CE4P34

ADVANCED DESIGN OF CONCRETE STRUCTURES

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. State the conditions under which maximum positive and negative bending moments occur in a continuous beam.
2. What are the limits of moment redistribution permitted as per IS 456? State any two conditions to be satisfied.
3. Define a slender column. What are the criteria used to classify a column as short or slender as per IS 456?
4. What are P-M interaction diagrams? Explain their significance in the design of columns under combined axial load and bending.
5. Classify water tanks based on their location and shape. Briefly explain any two types.
6. State the design requirements of liquid retaining structures as per IS 3370.
7. Classify foundations and explain the difference between shallow and deep foundations.
8. Differentiate between end-bearing piles and friction piles. State their applications.
9. Classify retaining walls and briefly explain any two types.
10. What are the different types of earth pressure? Explain active and passive earth pressure.

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. A two-span continuous beam ABC has equal spans of 6 m each and carries a uniformly distributed load of 20 kN/m over both spans. Analyze the beam using moment coefficients (IS 456). Determine the maximum positive and negative bending moments. Sketch the bending moment diagram.

OR

12. A continuous beam of two equal spans (5 m each) is subjected to a uniformly distributed load of 25 kN/m. Calculate the support moments using standard coefficients. Redistribute 20 percent of the negative moment at the interior support. Determine the final moments and comment on the effect of redistribution on beam design.

MODULE 2

13. A reinforced concrete column of size 300 mm $\times$ 500 mm has an effective length of 6 m and is subjected to an axial load of 1200 kN with a uniaxial moment of 60 kNm. Check whether the column is slender. Calculate the additional moment due to slenderness. Determine the design moment for the column.

OR

14. A rectangular column 400 mm $\times$ 600 mm is subjected to an axial load of 1500 kN along with biaxial moments of 80 kNm and 50 kNm about the major and minor axes respectively. Explain the procedure to check the adequacy of the column using P–M interaction curves. Verify the safety of the column using appropriate interaction relationships.

MODULE 3

15. Design a ground-supported circular water tank of capacity 500 m³ with a water depth of 4 m. Determine the tank dimensions. Calculate hoop tension at the base. Design the circumferential reinforcement.

OR

16. A rectangular water tank of internal dimensions 6 m $\times$ 4 m is required to store water up to a depth of 3.5 m. Analyze the tank walls for hydrostatic pressure. Determine the maximum bending moment in the long wall. Design the vertical reinforcement for the wall section.

MODULE 4

17. Design an end-bearing pile to carry a load of 1200 kN resting on a hard stratum at a depth of 12 m. Determine the required diameter of the pile. Check the load-carrying capacity using suitable assumptions.

OR

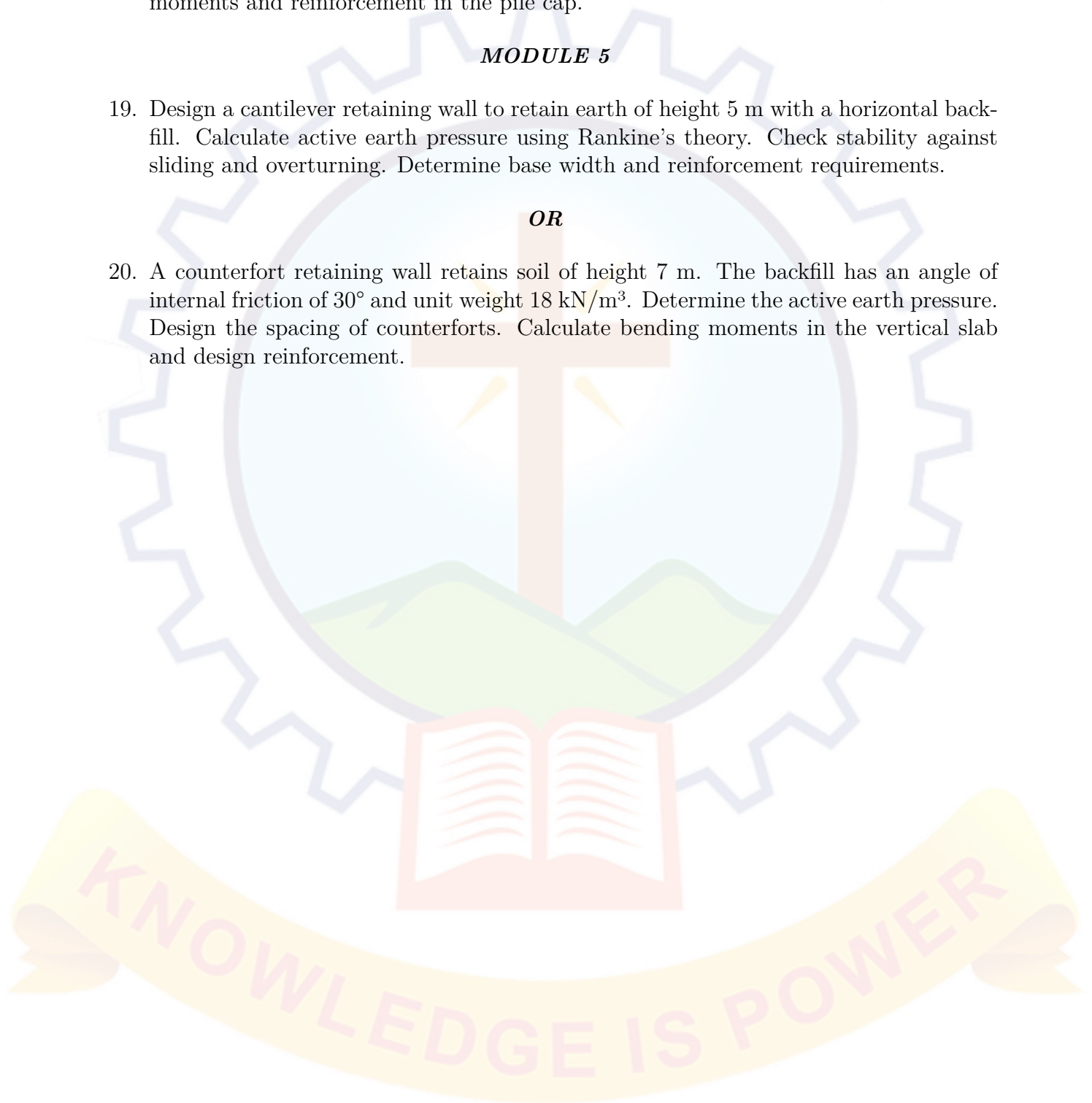
18. A group of 4 piles (2×2 arrangement) supports a column load of 1600 kN. The piles are spaced at 3 times the diameter. Design a suitable pile cap. Determine bending moments and reinforcement in the pile cap.

MODULE 5

19. Design a cantilever retaining wall to retain earth of height 5 m with a horizontal back-fill. Calculate active earth pressure using Rankine's theory. Check stability against sliding and overturning. Determine base width and reinforcement requirements.

OR

20. A counterfort retaining wall retains soil of height 7 m. The backfill has an angle of internal friction of 30° and unit weight 18 kN/m^3 . Determine the active earth pressure. Design the spacing of counterforts. Calculate bending moments in the vertical slab and design reinforcement.



CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE4P35	AI APPLICATIONS IN CIVIL ENGINEERING	2	1	0	4	3	2024

Preamble

This course introduces Artificial Intelligence in Civil Engineering, covering basic concepts, and smart applications, helping students develop skills to solve practical engineering problems efficiently.

Prerequisites: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Explain the fundamentals of Artificial Intelligence and its applications in civil engineering (Cognitive knowledge level -Understand)
CO 2	Apply Artificial Neural Networks to solve civil engineering problems. (Cognitive knowledge level -Apply)
CO 3	Use fuzzy logic and hybrid techniques for decision-making in civil engineering applications. (Cognitive knowledge Level: Apply)
CO 4	Analyze evolutionary algorithms for engineering applications. (Cognitive knowledge Level: Analyze)
CO 5	Apply IoT concepts in developing smart infrastructure and monitoring systems (Cognitive knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	2					1				2
CO 2	3	3	2	2	3	1				1	2
CO 3	2	3	2	2	2						1
CO 4	3	3	2	3	2						2
CO 5	3	3	3	2	3	2	2		2		1

Assessment Pattern

AI APPLICATIONS IN CIVIL ENGINEERING			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	20	20	30
Understand	50	50	50
Apply	30	20	10
Analyse		10	10
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course Project	: 10 marks
Self Study	: 5 marks

End Semester Examination Pattern

There will be two parts: Part A and Part B. Part A contains 10 questions, with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module, of which students should answer any one. Each question carries 14 marks and can have a maximum of 2 sub-divisions.

SYLLABUS

Module 1: Introduction to Artificial Intelligence for Civil Engineering (6 hours)

Artificial Intelligence (AI): definition, evolution, and development. Types of AI and AI techniques. Applications of AI in Civil Engineering. Uncertainty handling and learning systems. Optimisation concepts and overview of AI-based optimisation methods.

Module 2: Artificial Neural Networks and Applications (8 hours)

Basics of Artificial Neural Networks (ANN). ANN architecture and topology. Learning processes: supervised and unsupervised learning. Least Mean Square (LMS) algorithm. Feedforward networks and backpropagation algorithm. Advantages and limitations of ANN. Applications of ANN.

Module 3: Fuzzy Logic and Hybrid Soft Computing Techniques (7 Hours)

Introduction to fuzzy logic. Fuzzy sets, fuzzy relations, and fuzzy inference systems. Fuzzy rules and decision-making. Hybrid soft computing systems: neuro-fuzzy systems. Applications of fuzzy logic in Civil Engineering.

Module 4: Evolutionary Algorithms (7 Hours)

Genetic Algorithms (GA): biological background, basic terminology, working principles, advantages and limitations. Comparison of GA with traditional optimisation techniques. Applications of GA in Civil Engineering.

Module 5: Internet of Things (IoT) and Smart Infrastructure Applications (8 Hours)

Introduction to Internet of Things (IoT). IoT architecture and enabling technologies. Domain-specific IoT for civil engineering applications. Smart infrastructure systems: smart parking, smart lighting, smart roads, and structural health monitoring.

Text Books:

1. Gebrail Bekdaş, Sinan Melih Nigdeli and Melda Yücel, Artificial Intelligence and Machine Learning Applications in Civil, Mechanical, and Industrial Engineering, 2019 IGI, global. Australia.
2. Sivanandam S N and Deepa S N, Principles of Soft computing 2011, Second Edition, Wiley, USA.

References:

1. Arshdeep Bahga, Vijay Madisetti, Internet of Things: A hands on approach, 2015, University Press, UK.
2. Stuart J. Russell and Peter Norvig Artificial Intelligence A Modern approach, 2015, Pearson, India.
3. S M Yadav Application of soft computing techniques in Civil Engineering, 2018, MV learning, India

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	6 hours
1.1	Artificial Intelligence (AI): definition, evolution, and development.	1
1.2	Types of AI and AI techniques.	1
1.3	Applications of AI in Civil Engineering.	1
1.4	Uncertainty handling and learning systems.	1
1.5	Optimisation concepts and overview of AI-based optimisation methods.	2
2	Module 2	8 hours
2.1	Basics of Artificial Neural Networks (ANN).	1
2.2	ANN architecture and topology.	2
2.3	Learning processes: supervised and unsupervised learning.	1
2.4	Least Mean Square (LMS) algorithm.	1
2.5	Feedforward networks and backpropagation algorithm. .	1
2.6	Advantages and limitations of ANN.	1
2.7	Applications of ANN.	1

3	Module 3	7 hours
3.1	Introduction to fuzzy logic.	1
3.2	Fuzzy sets, fuzzy relations, and fuzzy inference systems.	1
3.3	Fuzzy rules and decision-making.	1
3.4	Hybrid soft computing systems: neuro-fuzzy systems.	2
3.5	Applications of fuzzy logic in Civil Engineering.	2
4	Module 4	7 hours
4.1	Genetic Algorithms (GA): biological background, basic terminology, working principles, advantages and limitations.	3
4.2	Comparison of GA with traditional optimisation techniques.	3
4.3	Applications of GA in Civil Engineering	1
5	Module 5	8 hours
5.1	Introduction to Internet of Things (IoT).	1
5.2	IoT architecture and enabling technologies.	2
5.3	Domain-specific IoT for civil engineering applications.	2
5.4	Smart infrastructure systems: smart parking, smart lighting, smart roads, and structural health monitoring.	3
Total		36 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Explain the concept of Artificial Intelligence and its applications in civil engineering.
2. Describe different AI techniques and their role in solving engineering problems.

Course Outcome 2 (CO 2):

1. Explain the architecture and working of Artificial Neural Networks
2. Apply backpropagation algorithm to solve a simple engineering problem.

Course Outcome 3 (CO 3):

1. Explain fuzzy sets and fuzzy inference systems with examples.
2. Apply fuzzy logic for decision-making in a civil engineering problem.

Course Outcome 4 (CO 4):

1. Explain the working principles of Genetic Algorithms.
2. Comparison of Genetic Algorithms with traditional optimisation techniques.

Course Outcome 5 (CO 5):

1. Explain the architecture and components of IoT systems.
2. Describe applications of IoT in smart infrastructure and structural health monitoring.

MODEL QUESTION PAPER

QP CODE:

Pages: 2

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

SEVENTH SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CE4P35

AI APPLICATIONS IN CIVIL ENGINEERING

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Define Artificial Intelligence and list its applications in civil engineering.
2. What are different types of AI techniques?
3. Define Artificial Neural Network (ANN).
4. What is backpropagation algorithm?
5. What is fuzzy logic?
6. Define fuzzy inference system.
7. What is a Genetic Algorithm?
8. List any four basic terminologies used in GA.
9. What is Internet of Things (IoT)?
10. List any two applications of IoT in civil engineering.

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. a) Explain the architecture and working of Artificial Neural Networks. (7)
b) Discuss applications of AI in civil engineering. (7)

OR

12. a) Explain different AI techniques used in engineering. (7)
b) Discuss uncertainty handling and optimization concepts in AI. (7)

MODULE 2

13. a) Explain the architecture and working of Artificial Neural Networks. (7)
b) Describe supervised and unsupervised learning. (7)

OR

14. a) Explain the backpropagation algorithm in detail. (7)
b) (b)Discuss advantages and limitations of ANN with applications. (7)

MODULE 3

15. a) Explain fuzzy sets and fuzzy relations (7)
b) Describe fuzzy inference systems with examples. (7)

OR

16. a) Explain fuzzy rules and decision-making process. (7)
b) Discuss hybrid soft computing techniques such as neuro-fuzzy systems. (7)

MODULE 4

17. a) Explain the working principles of Genetic Algorithms. (7)
b) Compare Genetic Algorithms with traditional optimization techniques. (7)

OR

18. a) State and explain the biological inspiration behind Genetic Algorithms. (7)
b) Apply the concept of fitness function in a civil engineering optimization problem. (7)

MODULE 5

19. a) Explain IoT architecture and enabling technologies. (7)
b) Discuss smart infrastructure systems in civil engineering (7)

OR

20. a) Explain domain-specific IoT applications in civil engineering. (7)
b) Discuss structural health monitoring using IoT. (7)

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE4P36	PAVEMENT ANALYSIS	2	1	0	4	3	2024

Preamble

Pavement Analysis deals with the structural behaviour and design of flexible and rigid pavements under traffic and environmental loading. The course focuses on stress analysis using theoretical approaches and the design of pavements as per IRC guidelines. It equips students with the ability to analyse pavement responses and design safe and durable pavement structures.

Prerequisites: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Explain the stress distribution in flexible pavements using theoretical approaches. (Cognitive Level: Understand)
CO 2	Apply IRC guidelines for the design of flexible pavements using traffic and subgrade parameters. (Cognitive Level: Apply)
CO 3	Apply mechanistic concepts in flexible pavement design as per IRC provisions. (Cognitive Level: Apply)
CO 4	Explain the stress behaviour in rigid pavements using Westergaard theory. (Cognitive Level: Understand)
CO 5	Apply IRC guidelines for the design of rigid pavements including joints and reinforcement. (Cognitive Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	2	1			1	2				
CO 2	2	3	2			2	3				
CO 3	2	3	2	1		2					1
CO 4	2	2	3	3	2						2
CO 5	1	1	2	2	3	3	2				

Assessment Pattern

PAVEMENT ANALYSIS			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	25	25	25
Understand	25	25	25
Apply	50	50	50
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course Project : 10 marks

Self Study : 5 marks

End Semester Examination Pattern

There will be two parts: Part A and Part B. Part A contain 10 questions, with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module, of which students should answer any one. Each question carries 14 marks and can have a maximum of 2 sub-divisions.

SYLLABUS

Module 1: Analysis of Stresses in Flexible Pavement (7 hours)

Flexible pavement system and load distribution; Boussinesq's theory; Burmister's layered theory; stress, strain and deflection analysis; critical stress locations; factors affecting stress distribution.

Module 2: Introduction to Design of Flexible Pavement (7 hours)

Design principles; traffic analysis (ESAL, VDF); subgrade strength (CBR method); IRC:37 guidelines; design inputs and parameters.

Module 2: Design of Flexible Pavement as per IRC Code (7 Hours)

IRC design procedure; fatigue and rutting criteria; layer thickness design; pavement composition; design examples.

Module 4: Stresses in Rigid Pavement (7 Hours)

Rigid pavement behaviour; Westergaard's theory; wheel load stresses (edge, corner, interior); temperature stresses; critical combination of stresses

Module 5: Design of Rigid Pavement as per IRC (8 Hours)

IRC:58 guidelines; slab thickness design; dowel bars and tie bars; design procedure.

Text Books:

1. Huang, Yang H. Pavement Analysis and Design, Pearson Education, 2008.
2. Das, Animesh. Analysis of Pavement Structures, CRC Press, 2014.
3. Papagiannakis, A.T. and Masad, E.A. Pavement Design and Materials, John Wiley & Sons, 2024.
4. Indian Roads Congress. IRC:37 – Guidelines for the Design of Flexible Pavements, IRC, New Delhi, 2018.
5. Indian Roads Congress. IRC:58 – Guidelines for the Design of Plain Jointed Rigid Pavements for Highways, IRC, New Delhi, 2015.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	7 hours
1.1	Flexible pavement system and load distribution	1
1.2	Boussinesq's and Burmister's theories	2
1.3	Stress, strain and deflection	2
1.4	Critical stresses and influencing factors	2
2	Module 2	7 hours
2.1	Design principles and factor affecting flexible pavement design	3
2.2	Subgrade strength (CBR)	1
2.3	IRC:37 guidelines and inputs	3
3	Module 3	7 hours
3.1	Design of flexible pavements by IRC 37	2
3.2	Fatigue and rutting criteria	2
3.3	Layer thickness and design examples	3
4	Module 4	7 hours
4.1	Mechanism of load transfer in Rigid Pavement, Westergaard's theory of stresses, critical loading positions	3
4.2	Modified Wheel load stresses in rigid pavements	2
4.3	Temperature stresses in pavements, Critical combination of stresses	2

5	Module 5	7 hours
5.1	IRC:58 design approach of rigid pavement	3
5.2	Design of slab thickness of Rigid Pavement	2
5.3	Dowel bars, tie bars and design of bars as per IRC	3

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Explain Boussinesq's theory in pavement analysis.
2. Describe stress distribution in flexible pavements.

Course Outcome 2 (CO 2):

1. Explain ESWL for a dual wheel assembly by graphical method
2. Explain IRC:37 guidelines for flexible pavement design.

Course Outcome 3 (CO 3):

1. How fatigue criteria is considered in pavement thickness design
2. Explain the Mechanistic Empirical design of flexible pavement of IRC by flow chart

Course Outcome 4 (CO 4):

1. Explain Westergaard's theory of stresses and state its assumptions
2. Describe temperature stresses in rigid pavements and mention the critical stress combinations

Course Outcome 5 (CO 5):

1. Differentiate between dowel bars and tie bars used in concrete pavements.
2. Explain the design of dowel bar and tie bar as per IRC

MODEL QUESTION PAPER

QP CODE:

Pages: 3

Reg.No.:

Name:

**MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM**

SEVENTH SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CE4P36

PAVEMENT ANALYSIS

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Define flexible pavement system and explain how load is distributed through its layers.
2. What are critical stresses in flexible pavements? Name the factors influencing them.
3. Define Equivalent Single Axle Load (ESAL) and state its purpose in pavement design.
4. State the two critical strain locations in flexible pavement design as per IRC:37-2018 and mention the associated distress types.
5. Define fatigue failure and rutting failure in flexible pavements.
6. What is meant by Performance evaluation in pavement design? Why is it important?
7. Define temperature stresses in concrete pavements.
8. What is meant by warping stress in rigid pavements? Outline the basic design approach followed in IRC:58 for rigid pavements.
9. What factors influence slab thickness design in cement concrete pavements?
10. Differentiate between dowel bars and tie bars in rigid pavements.

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. a) Explain the load distribution mechanism in a flexible pavement system with a neat sketch. (7)
b) Describe Boussinesq's theory and its application in pavement analysis. (7)

OR

12. a) Explain Burmister's layered theory and how it differs from Boussinesq's theory. (7)
b) Discuss stress, strain, and deflection in flexible pavements and explain the factors affecting them. (7)

MODULE 2

13. a) Explain the concept of Equivalent Single Wheel Load (ESWL) and discuss how wheel spacing and depth of pavement influence its value (7)
b) Discuss the effect of repeated application of loads on pavement and explain the concept of load equivalency using the fourth power law. (7)

OR

14. a) Explain the various climatic factors affecting pavement design and describe their influence on pavement performance. (7)
b) Explain Mechanistic-Empirical approach with flow chart. (7)

MODULE 3

15. a) Explain the fatigue and rutting criteria used in flexible pavement design as per IRC guidelines. (7)
b) Discuss the significance of layer thickness in flexible pavements and how it influences pavement performance. (7)

OR

16. a) Explain the procedure for determining pavement layer thickness using IRC design approach. (7)
b) Describe typical pavement design examples and explain how different parameters influence the final layer thickness. (7)

MODULE 4

17. a) Explain the mechanism of load transfer in rigid pavements and the role of dowel bars and tie bars. (7)
b) Describe Westergaard's theory of stress analysis in rigid pavements along with its basic assumptions. (7)

OR

18. a) Explain the modified wheel load stress equations and discuss their significance in pavement design. (7)
b) Discuss temperature stresses in rigid pavements and explain the critical combination of stresses. (7)

MODULE 5

19. a) Describe the design of slab thickness in cement concrete pavements and the factors affecting it
b) Explain the design procedure of dowel bars in rigid pavements and their role in load transfer.

OR

20. a) Explain the design procedure of dowel bars in rigid pavements, (7)
b) A cement concrete pavement slab has a thickness of 26 cm and is subjected to a design axle load of 12,000 kg. The radius of relative stiffness is 62 cm. design suitable dowel bars. (7)

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE4P41	INTRODUCTION TO BIM 2D DRAFTING AND ARCHITECTURAL MODELLING FUNDAMENTALS	2	1	0	4	3	2024

Preamble

Building Information Modeling (BIM) has transformed the Architecture, Engineering, and Construction (AEC) industry by enabling integrated, data-rich, and collaborative project delivery. This course introduces students to the fundamental concepts of BIM, starting from traditional 2D drafting principles and progressing towards basic architectural modelling and BIM - based documentation. Students will gain an understanding of BIM workflows, model creation, drawing extraction, and coordination concepts. The course prepares learners to transition from conventional drafting methods to modern BIM practices, emphasizing visualization, collaboration, and information management in construction projects.

Prerequisites: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Explain the concepts, evolution, and applications of BIM in the AEC industry. (Cognitive Knowledge Level: Understand)
CO 2	Apply principles of 2D drafting, drawing conventions, and documentation in engineering drawings. (Cognitive Knowledge Level: Apply)
CO 3	Develop basic architectural BIM models using parametric modelling concepts and software tools. (Cognitive Knowledge Level : Apply)
CO 4	Generate and interpret BIM-based drawings and visualizations for project documentation. (Cognitive Knowledge Level: Analyze)
CO 5	Explain BIM collaboration concepts, model coordination, and basic clash detection processes. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	2	1		1	2	3	2	1	1	1
CO 2	2	2	3	1	2	2	2	1	1	1	2
CO 3	2	3	2	2	1	2	3	2		1	2
CO 4	2	2	2	1	1	2	3	2	1	1	2
CO 5	2	2	3	2	2	2	3	2	1	1	2

Assessment Pattern

INTRODUCTION TO BIM 2D DRAFTING & ARCHITECTURAL MODELLING FUNDAMENTALS			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	20	20	30
Understand	30	30	30
Apply	30	30	20
Analyse	20	20	20
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course Project : 10 marks

Self Study : 5 marks

End Semester Examination Pattern

There will be two parts: Part A and Part B. Part A contain 10 questions, with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module, of which students should answer any one. Each question carries 14 marks and can have a maximum of 2 sub-divisions.

SYLLABUS

Module 1: Fundamentals of BIM (7 hours)

Concept and definition of Building Information Modeling (BIM), evolution from 2D CAD to BIM, comparison between CAD and BIM, BIM dimensions, BIM as a product and as a process, applications of BIM in the AEC industry, benefits and challenges of BIM adoption.

Module 2: 2D Drafting Concepts and Documentation (8 hours)

Drawing conventions, plans, sections and elevations, layers and annotation principles, scales and dimensioning, limitations of traditional 2D drafting, role of 2D drawings within BIM-based workflows.

Module 3: Architectural BIM Modelling Basics (6 Hours)

BIM software interface, project setup and templates, levels and grids, creation of walls, floors, roofs, doors and windows, parametric modeling concepts, basic architectural BIM modeling workflow.

Module 4: BIM-Based Drawing Generation and Visualization (7 Hours)

Generation of plans, sections and elevations from BIM models, view control and detailing, annotation in BIM environment, sheet setup and documentation, basic rendering and visualization techniques.

Module 5: BIM Collaboration and Introduction to Coordination (8 Hours)

Model organization and standards, families and libraries, model information and parameters, basic coordination concepts, introduction to clash detection, BIM deliverables and documentation.

Text Books:

1. Eastman C., Teicholz P., Sacks R., Liston K., BIM Handbook: A Guide to Building Information Modeling, Wiley
2. Smith P. – BIM Implementation: Global Strategies, Springer.

References:

1. Hardin B., & McCool D. – BIM and Construction Management: Proven Tools, Methods, and Workflows, Wiley.

2. Krygiel E., & Nies B. – Green BIM: Successful Sustainable Design with BIM, Wiley.
3. Autodesk – Revit Architecture Official Training Guide.
4. Succar B. – “Building Information Modelling Framework: A Research and Delivery Foundation for Industry Stakeholders.”

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	7 hours
1.1	Concept and definition of Building Information Modeling (BIM)	2
1.2	Evolution from 2D CAD to BIM, comparison between CAD and BIM	2
1.3	BIM dimensions, BIM as a product and as a process	2
1.4	Applications of BIM in the AEC industry, benefits and challenges of BIM adoption	1
2	Module 2	8 hours
2.1	Drawing conventions, plans, sections and elevations	2
2.2	Layers and annotation principles, scales and dimensioning	2
2.3	Limitations of traditional 2D drafting	2
2.4	Role of 2D drawings within BIM-based workflows	2
3	Module 3	6 hours
3.1	BIM software interface, project setup and templates	2
3.2	Levels and grids, creation of walls, floors, roofs	1
3.3	Doors and windows, parametric modeling concepts	1
3.4	Basic architectural BIM modeling workflow.	2

4	Module 4	7 hours
4.1	Generation of plans, sections and elevations from BIM models	2
4.2	View control and detailing, annotation in BIM environment	2
4.3	Sheet setup and documentation	1
4.4	Basic rendering and visualization techniques.	2
5	Module 5	8 hours
5.1	Model organization and standards, families and libraries	2
5.2	Model information and parameters, basic coordination concepts	2
5.3	Introduction to clash detection	2
5.4	BIM deliverables and documentation.	2
Total		36 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Explain the evolution of BIM from traditional 2D CAD systems and discuss its significance in the AEC industry.
2. Compare CAD and BIM methodologies and explain the advantages of BIM in project delivery.
3. Describe BIM dimensions and explain how BIM functions as both a product and a process.

Course Outcome 2 (CO 2):

1. Apply drawing conventions to prepare plans, sections, and elevations for a simple building.
2. Illustrate the use of layers, scales, and dimensioning in producing clear engineering drawings.
3. Explain the role of 2D drawings within BIM workflows and discuss their limitations in modern construction practice.

Course Outcome 3 (CO 3):

1. Develop a basic BIM model by creating walls, floors, and openings using appropriate tools.
2. Explain the process of project setup including levels and grids in BIM software.
3. Apply parametric modelling concepts to modify architectural elements efficiently.

Course Outcome 4 (CO 4):

1. Analyze the process of generating plans, sections, and elevations from a BIM model.
2. Explain the role of annotation, detailing, and sheet setup in BIM documentation.
3. Examine basic rendering and visualization techniques and their importance in project presentation.

Course Outcome 5 (CO 5):

1. Explain model organization, standards, and the use of families and libraries in BIM projects.
2. Describe the concept of clash detection and its importance in coordination.
3. Discuss BIM deliverables and explain their role in project documentation and collaboration.

MODEL QUESTION PAPER

QP CODE:

Pages: 3

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

SEVENTH SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CE4P41

**INTRODUCTION TO BIM 2D DRAFTING AND ARCHITECTURAL MODELLING
FUNDAMENTALS**

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Explain the concept of Building Information Modeling (BIM) and its significance in the AEC industry. .
2. Describe the differences between traditional CAD systems and BIM with respect to project workflow.
3. Explain drawing conventions used in preparing plans, sections, and elevations.
4. Describe the role of layers, scales, and dimensioning in producing engineering drawings.
5. Explain the process of setting up a BIM project using levels and grids.
6. Describe the creation of basic architectural elements such as walls, floors, and openings in BIM.
7. Explain the process of generating plans and sections from a BIM model.
8. Describe the role of annotation and sheet setup in BIM documentation.
9. Explain the concept of model organization and standards in BIM projects.
10. Describe the concept of clash detection and its importance in coordination.

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. a) Explain the evolution of BIM from traditional 2D CAD systems and discuss its importance in modern construction. (7)
b) Describe BIM dimensions and explain how BIM functions as both a product and a process. (7)

OR

12. a) Compare CAD and BIM methodologies with respect to design, documentation, and collaboration. (7)
b) Discuss the applications, benefits, and challenges of BIM adoption in the AEC industry. (7)

MODULE 2

13. a) Explain the preparation of plans, sections, and elevations using standard drawing conventions. (7)
b) Describe the importance of scales and dimensioning in engineering drawings. (7)

OR

14. a) Explain the use of layers and annotation principles in 2D drafting. (8)
b) Discuss the limitations of traditional 2D drafting and explain its role within BIM workflows. (6)

MODULE 3

15. a) Explain the BIM software interface and describe the process of project setup using templates. (7)
b) Describe the creation of architectural elements such as walls, roofs, doors, and windows. (7)

OR

16. a) Explain parametric modelling concepts and their application in BIM. (7)
b) Describe the basic workflow involved in architectural BIM modelling. (7)

MODULE 4

17. a) Explain the process of generating plans, sections, and elevations from BIM models. (7)
b) Describe view control and detailing in BIM-based documentation. (7)

OR

18. a) Explain annotation techniques and sheet setup in a BIM environment. (7)
b) Describe basic rendering and visualization techniques used in BIM. (7)

MODULE 5

19. a) Explain model organization, families, and libraries used in BIM projects. (7)
b) Describe model information and parameters and their role in BIM. (7)

OR

20. a) Explain the concept of coordination in BIM and describe the process of clash detection. (7)
b) Discuss BIM deliverables and their importance in project documentation and collaboration. (7)

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE4P42	TRANSPORTATION ECONOMICS	2	1	0	4	3	2024

Preamble

This course introduces the economic principles underlying transportation systems and infrastructure development. It focuses on demand and supply relationships, transportation costs, pricing strategies, and economic evaluation of transportation projects. The course also covers investment decisions, financing mechanisms, and policy frameworks to support efficient, sustainable, and economically viable transportation systems.

Prerequisites: B24CE2T06 -Highway and Pavement Engineering

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Explain fundamental economic principles related to transportation demand, supply, and system performance.(Cognitive Knowledge Level: Understand)
CO 2	Apply concepts of transportation cost analysis to identify direct, indirect, and social costs in transportation systems. (Cognitive Knowledge Level: Apply)
CO 3	Apply economic evaluation techniques such as NPV, IRR, and Benefit–Cost Analysis for assessing transportation projects. (Cognitive Knowledge Level: Apply)
CO 4	Understand principles of transportation investment analysis and project appraisal in infrastructure planning. (Cognitive Knowledge Level: Understand)
CO 5	Explain transportation policy, financing, and regulatory frameworks influencing transportation systems. (Cognitive Knowledge Level: Understand)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	2	-	-	-	-	-	-	-	-	-
CO2	3	3	1	-	-	-	2	-	-	-	-
CO3	3	3	2	-	-	-	1	-	-	-	2
CO4	3	3	2	-	-	-	1	-	-	-	3
CO5	2	2	-	-	-	2	3	2	-	-	2

Assessment Pattern

TRANSPORTATION ECONOMICS			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	30	30	30
Understand	50	50	50
Apply	20	20	20
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course Project	: 10 marks
Self Study	: 5 marks

End Semester Examination Pattern

There will be two parts: Part A and Part B. Part A contain 10 questions, with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module, of which students should answer any one. Each question carries 14 marks and can have a maximum of 2 sub-divisions.

SYLLABUS

Module 1: Fundamentals of Transportation Economics (7 hours)

Role of transportation in economic development; transportation demand and supply concepts; transportation and land-use interaction; basic microeconomic principles relevant to transportation; value of travel time; elasticity of demand; transportation system performance indicators.

Module 2: Transportation Costs and Externalities (7 hours)

Concept of transportation costs; fixed and variable costs; vehicle operating costs and road user costs; value of travel time savings; accident costs; congestion costs; environmental and social costs; economies of scale and cost functions.

Module 3: Pricing and Economic Evaluation Methods (8 Hours)

Principles of transport pricing; marginal and average cost pricing; congestion and road pricing; public transport fare structures; discounted cash flow analysis; Net Present Value (NPV), Internal Rate of Return (IRR), and Benefit–Cost Analysis (BCA); opportunity cost and shadow pricing.

Module 4: Transportation Investment and Project Appraisal(7 Hours)

Transportation investment decisions; project feasibility analysis; life cycle cost analysis; evaluation of alternatives; risk and uncertainty in project appraisal; public–private partnership models; project financing concepts.

Module 5: Transportation Policy, Financing, and Regulation(7 Hours)

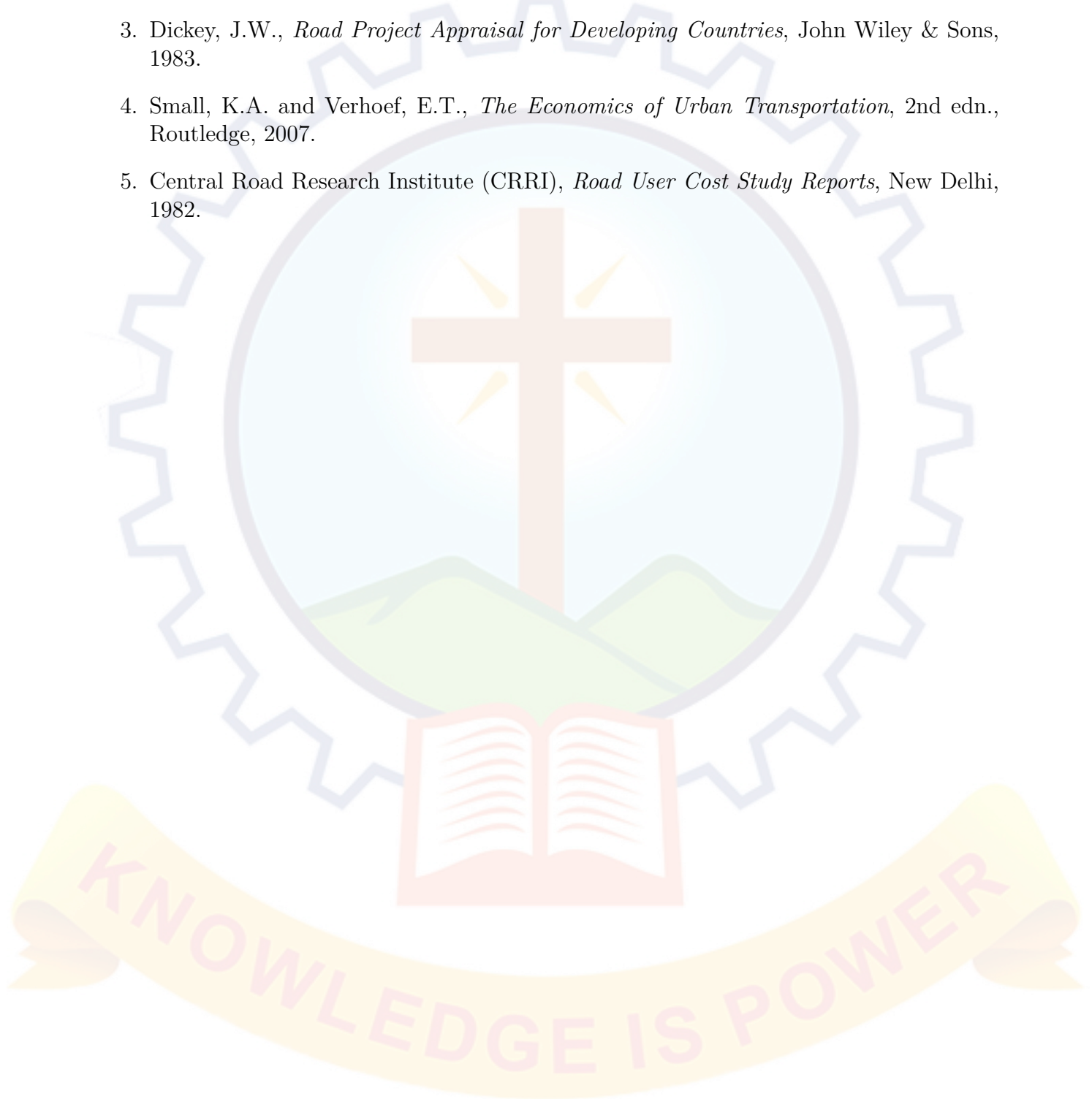
Transport policy frameworks; taxation and financing mechanisms; privatization and regulation; institutional and legal aspects; sustainability and equity considerations; case studies in transportation economics and policy.

Text Books:

1. Khanna, S.K., Justo, C.E.G. and Veeraragavan, A., *Highway Engineering*, 10th edn., Nem Chand & Bros., New Delhi, 2015.
2. Chakroborty, P. and Das, A., *Principles of Transportation Engineering*, PHI Learning Pvt. Ltd., New Delhi, 2003.
3. McCarthy, P.S., *Transportation Economics: Theory and Practice*, Blackwell Publishers, 2001.

References:

1. Button, K.J., *Transport Economics*, 3rd edn., Edward Elgar Publishing, 2010.
2. Winfrey, R., *Economic Analysis for Highways*, International Textbook Company, 1969.
3. Dickey, J.W., *Road Project Appraisal for Developing Countries*, John Wiley & Sons, 1983.
4. Small, K.A. and Verhoef, E.T., *The Economics of Urban Transportation*, 2nd edn., Routledge, 2007.
5. Central Road Research Institute (CRRI), *Road User Cost Study Reports*, New Delhi, 1982.



COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture Hours
1	Module 1: Fundamentals of Transportation Economics	7 hours
1.1	Role of transportation in economic development; transportation and land-use interaction; transportation system characteristics	2
1.2	Transportation demand and supply concepts; elasticity of demand; factors influencing travel demand	3
1.3	Value of travel time; transportation performance indicators; overview of transportation markets	2
2	Module 2: Transportation Costs and Externalities	7 hours
2.1	Fixed and variable costs; vehicle operating costs; road user costs; cost components in transportation systems	2
2.2	Value of travel time savings; accident costs; congestion costs	3
2.3	Environmental and social costs; economies of scale, density, and scope; cost estimation concepts	2
3	Module 3: Pricing and Economic Evaluation Methods	8 hours
3.1	Principles of transport pricing; marginal and average cost pricing; congestion and road pricing concepts	3
3.2	Public transport fare structures; pricing strategies; introduction to shadow pricing and opportunity cost	2
3.3	Discounted cash flow analysis; Net Present Value (NPV); Internal Rate of Return (IRR); Benefit–Cost Analysis (BCA)	3
4	Module 4: Transportation Investment and Project Appraisal	7 hours
4.1	Transportation investment decisions; financial and economic feasibility analysis; evaluation of alternatives	3

4.2	Life cycle cost analysis; risk and uncertainty in project appraisal	2
4.3	Public-private partnership models; project financing concepts	2
5	Module 5: Transportation Policy, Financing, and Regulation	7 hours
5.1	Transport policy frameworks; taxation and financing mechanisms; sources of revenue	3
5.2	Privatization, regulation, and institutional aspects in transportation systems	2
5.3	Sustainability, equity considerations, and case studies in transportation economics and policy	2
Total		36 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Explain the role of transportation in economic development with suitable examples illustrating its influence on land-use and regional growth.
2. Describe transportation demand and supply concepts and explain the factors affecting travel demand in urban areas.
3. Apply the concept of elasticity of demand to explain how changes in travel cost or travel time affect transportation demand.

Course Outcome 2 (CO 2):

1. Identify the components of transportation costs and explain the difference between fixed and variable costs with suitable examples.
2. Apply the concept of vehicle operating cost and road user cost to estimate the major cost components for a highway project.
3. Explain congestion, accident, and environmental costs as transportation externalities and discuss their impact on society.

Course Outcome 3 (CO 3):

1. Explain marginal cost and average cost pricing principles and discuss their application in transportation systems.
2. Apply discounted cash flow concepts to determine the economic feasibility of a transportation project using NPV or IRR methods.
3. Explain the concept of Benefit–Cost Analysis (BCA) and describe its application in transportation project evaluation.

Course Outcome 4 (CO 4):

1. Explain the steps involved in transportation project feasibility analysis and evaluation of alternative projects.
2. Apply life cycle cost analysis concepts to compare alternative transportation infrastructure options.
3. Explain the role of Public–Private Partnership (PPP) models such as BOT and BOOT in transportation infrastructure development.

Course Outcome 5 (CO 5):

1. Explain the role of government policies and regulations in transportation planning and infrastructure development.
2. Identify various sources of transportation financing and explain their significance in infrastructure development.
3. Discuss sustainability and equity considerations in transportation policy with suitable examples.

MODEL QUESTION PAPER

QP CODE:

Pages: 2

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

SEVENTH SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CE4P42

TRANSPORTATION ECONOMICS

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Define transportation demand and list the major factors affecting travel demand.
2. Explain the concept of value of travel time and its importance in transportation planning.
3. Differentiate between fixed costs and variable costs in transportation systems.
4. Define congestion cost and list its major components.
5. Define marginal cost pricing and average cost pricing in transportation systems.
6. List the basic steps involved in Benefit–Cost Analysis (BCA).
7. Define life cycle cost analysis and state its importance in transportation projects.
8. List the different types of Public–Private Partnership (PPP) models used in transportation infrastructure.
9. List the major sources of transportation financing.
10. Define privatization and regulation in transportation systems.

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. Explain the relationship between transportation and economic development, highlighting the role of transportation in regional growth and land-use patterns.

OR

12. Describe transportation demand and supply characteristics and explain the concept of elasticity of demand with suitable transportation examples.

MODULE 2

13. Explain the components of vehicle operating costs and road user costs, and discuss the factors influencing these costs.

OR

14. Describe various transportation externalities such as accident, congestion, and environmental costs, and discuss their impact on transportation planning.

MODULE 3

15. Explain the principles of transport pricing and discuss the application of congestion pricing in urban transportation systems.

OR

16. Describe the methods of economic evaluation used in transportation projects, including Net Present Value (NPV), Internal Rate of Return (IRR), and Benefit–Cost Ratio.

MODULE 4

17. Explain the process of transportation project feasibility analysis and evaluation of alternative project options.

OR

18. Describe the concept of Public–Private Partnerships (PPP) and discuss the features of BOT and BOOT models in transportation infrastructure development.

MODULE 5

19. Explain the role of government policies and regulatory frameworks in transportation system development.

OR

20. Discuss sustainability and equity considerations in transportation policy, highlighting their importance in modern transportation planning.

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE4P43	ENVIRONMENTAL IMPACT ASSESSMENT	2	1	0	4	3	2024

Preamble

This course introduces the fundamental principles and procedures of Environmental Impact Assessment (EIA). It covers the evolution of EIA, environmental clearance processes, impact assessment methodologies, and preparation of Environmental Management Plans (EMP). The course also addresses environmental legislation, public participation, and relevant case studies, enabling students to understand and apply EIA practices for sustainable development and regulatory compliance.

Prerequisites: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Explain the concepts, evolution, and policy framework of Environmental Impact Assessment. (Cognitive Knowledge Level: Understand)
CO 2	Describe the environmental clearance process and structure of EIA documentation. (Cognitive Knowledge Level: Understand)
CO 3	Apply appropriate EIA methodologies for predicting environmental impacts. (Cognitive Knowledge Level: Apply)
CO 4	Apply principles of Environmental Management Plan (EMP) and environmental monitoring in projects. (Cognitive Knowledge Level: Apply)
CO 5	Explain environmental legislation, public participation, and case studies related to EIA practice. (Cognitive Knowledge Level: Understand)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	1				2	3	1			
CO 2	2	1				3	3	2		1	1
CO 3	3	2	1	2	2	2	3	1		1	1
CO 4	2	2	2	1	2	2	3	2	1	1	2
CO 5	2	1				3	3	2	1	2	1

Assessment Pattern

ENVIRONMENTAL IMPACT ASSESSMENT			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	20	20	30
Understand	50	50	50
Apply	30	30	20
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course Project : 10 marks

Self Study : 5 marks

End Semester Examination Pattern

There will be two parts: Part A and Part B. Part A contain 10 questions, with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module, of which students should answer any one. Each question carries 14 marks and can have a maximum of 2 sub-divisions.

SYLLABUS

Module 1: EIA Concepts and Policy Framework (8 hours)

Definition and need for Environmental Impact Assessment (EIA). Evolution of EIA – global and Indian perspectives. Environmental quality standards for water, air, and noise. Overview of EIA Notification, 2006. National Environmental Policy Act (NEPA): key features, implementation, and Council on Environmental Quality (CEQ) guidelines. Role of the United States Environmental Protection Agency (USEPA). Overview of global environmental issues.

Module 2: Environmental Clearance and EIA Documentation (7 hours)

Environmental clearance process in India: screening, scoping, public consultation, and appraisal. Form 1 and project categorization. Generic structure of an EIA report. Terms of Reference (ToR), Types of EIA, Initial Environmental Examination (IEE), Environmental Impact Statement (EIS), and environmental appraisal.

Module 3: EIA Methods and Impact Assessment (7 Hours)

EIA methodologies: Ad hoc, checklist, matrix, network, and overlay methods. Impact prediction, evaluation, and mitigation measures. Assessment of impacts on water (surface and groundwater), air, and noise environments. Ecological and socio-economic impact assessment.

Module 4: Environmental Management and Auditing (7 Hours)

Environmental Management Plan (EMP): objectives, importance, and contents. Environmental monitoring programmes. Environmental audit: need, types, benefits, and procedure. ISO 14001 Environmental Management Systems: importance, salient features, stages of implementation, and benefits.

Module 5: Legal Framework, Participation, and Case Studies (7 Hours)

Environmental legislation and clearance procedures in India and selected other countries. Project siting criteria. Coastal Regulation Zone (CRZ) regulations. Public participation in EIA. Resettlement and rehabilitation. EIA case studies.

Text Books:

1. Larry W Canter, “Environmental Impact Assessment”, McGraw Hill Inc., New York, 1995

2. Betty Bowers Marriott, Environmental Impact Assessment: A Practical Guide, McGraw-Hill Professional, 1997
3. Environmental Impact Assessment, 2003, Y.Anjaneyulu, B.S Publications

References:

1. Lawrence, David P., Environmental Impact Assessment (Practical Solutions to Recurrent Problems), Wiley International, New Jersey.
2. Ministry of Environment & Forests, Govt. of India 2006 EIA Notification
3. Jain, R.K., Urban, L.V. and Stacey, G.S., Environment Impact Analysis, Von Nostrand Reinhold Company.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	8 hours
1.1	Definition and need for Environmental Impact Assessment (EIA). Evolution of EIA – global and Indian perspectives	2
1.2	Environmental quality standards for water, air, and noise.	2
1.3	Overview of EIA Notification, 2006. National Environmental Policy Act (NEPA): key features, implementation, and Council on Environmental Quality (CEQ) guidelines.	2
1.4	Role of the United States Environmental Protection Agency (USEPA). Overview of global environmental issues	2
2	Module 2	7 hours
2.1	Environmental clearance process in India: screening, scoping, public consultation, and appraisal.	2
2.2	Form 1 and project categorization. Generic structure of an EIA report.	1
2.3	Terms of Reference (ToR), Types of EIA	2
2.4	Initial Environmental Examination (IEE), Environmental Impact Statement (EIS), and environmental appraisal	2

3	Module 3	7 hours
3.1	EIA methodologies: Ad hoc, checklist, matrix, network, and overlay methods	2
3.2	Impact prediction, evaluation, and mitigation measures.	2
3.3	Assessment of impacts on water (surface and groundwater), air, and noise environments.	2
3.4	Ecological and socio-economic impact assessment	1
4	Module 4	7 hours
4.1	Environmental Management Plan (EMP): objectives, importance, and contents.	2
4.2	Environmental monitoring programmes	1
4.3	Environmental audit: need, types, benefits, and procedure	2
4.4	ISO 14001 Environmental Management Systems: importance, salient features, stages of implementation, and benefits.	2
5	Module 5	7 hours
5.1	Environmental legislation and clearance procedures in India and selected other countries.	2
5.2	Project siting criteria. Coastal Regulation Zone (CRZ) regulations.	2
5.3	Public participation in EIA. Resettlement and rehabilitation.	2
5.4	EIA case studies	1
Total		45 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Define Environmental Impact Assessment (EIA) and explain its need in environmental management.
2. Describe the evolution of EIA from global perspectives to its implementation in India.
3. Explain the key features of the EIA Notification 2006 and its significance in environmental regulation

Course Outcome 2 (CO 2):

1. Explain the steps involved in the environmental clearance process in India
2. Describe the generic structure of an EIA report and the importance of Terms of Reference
3. Explain the role of screening, scoping, and public consultation in the EIA process.

Course Outcome 3 (CO 3):

1. Compare different EIA methodologies such as checklist, matrix, and overlay methods used in impact assessment
2. Apply suitable impact prediction techniques to assess air, water, or noise pollution impacts for a proposed project.
3. Explain how ecological and socio-economic impacts are considered in environmental impact assessment.

Course Outcome 4 (CO 4):

1. Explain the objectives and key components of an Environmental Management Plan (EMP).
2. Describe the need and types of environmental auditing in industrial projects.
3. Explain the importance and key elements of ISO 14001 Environmental Management Systems

Course Outcome 5 (CO 5):

1. Explain the importance of public participation in Environmental Impact Assessment.
2. Describe the Coastal Regulation Zone (CRZ) regulations and their significance in project planning.
3. Explain the role of resettlement and rehabilitation (R&R) in environmental project development

MODEL QUESTION PAPER

QP CODE:

Pages: 3

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

SEVENTH SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CE4P43

Course Name: ENVIRONMENTAL IMPACT ASSESSMENT

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Define Environmental Impact Assessment (EIA). State its importance in environmental management.
2. Briefly explain the key features of the EIA Notification 2006.
3. What are the main stages involved in the environmental clearance process in India?
4. What is the role of Terms of Reference (ToR) in preparing an EIA report?
5. List and briefly explain any three methods used in Environmental Impact Assessment.
6. What is meant by impact prediction in EIA? Mention any two environmental components commonly assessed.
7. What is an Environmental Management Plan (EMP)? Mention its main objectives.
8. Define environmental audit and state any two benefits.
9. What is the significance of public participation in the EIA process?
10. What are Coastal Regulation Zone (CRZ) regulations? State their purpose.

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. a) Explain the concept, objectives, and importance of Environmental Impact Assessment (EIA). (8)
b) Discuss the evolution of EIA at the global level and in India. (6)

OR

12. a) Explain the key features and provisions of the EIA Notification 2006. (8)
b) Describe the role of NEPA, CEQ guidelines, and USEPA in environmental impact assessment. (6)

MODULE 2

13. a) Explain the environmental clearance process in India including screening, scoping, public consultation, and appraisal. (8)
b) Discuss Form 1 and project categorization in the EIA process. (6)

OR

14. a) Describe the generic structure of an Environmental Impact Assessment (EIA) report. (7)
b) Explain the significance of Terms of Reference (ToR), Initial Environmental Examination (IEE), and Environmental Impact Statement (EIS). (7)

MODULE 3

15. a) Explain different EIA methodologies such as Ad hoc, checklist, matrix, network, and overlay methods. (8)
b) Discuss the advantages and limitations of EIA methods in environmental assessment. (6)

OR

16. a) Explain the procedure for impact prediction and evaluation in EIA studies. (7)
b) Discuss the assessment of impacts on water, air, and noise environments. (7)

MODULE 4

17. a) Explain the objectives and components of an Environmental Management Plan (EMP). (8)

- b) Describe the role of environmental monitoring programmes in environmental management. (6)

OR

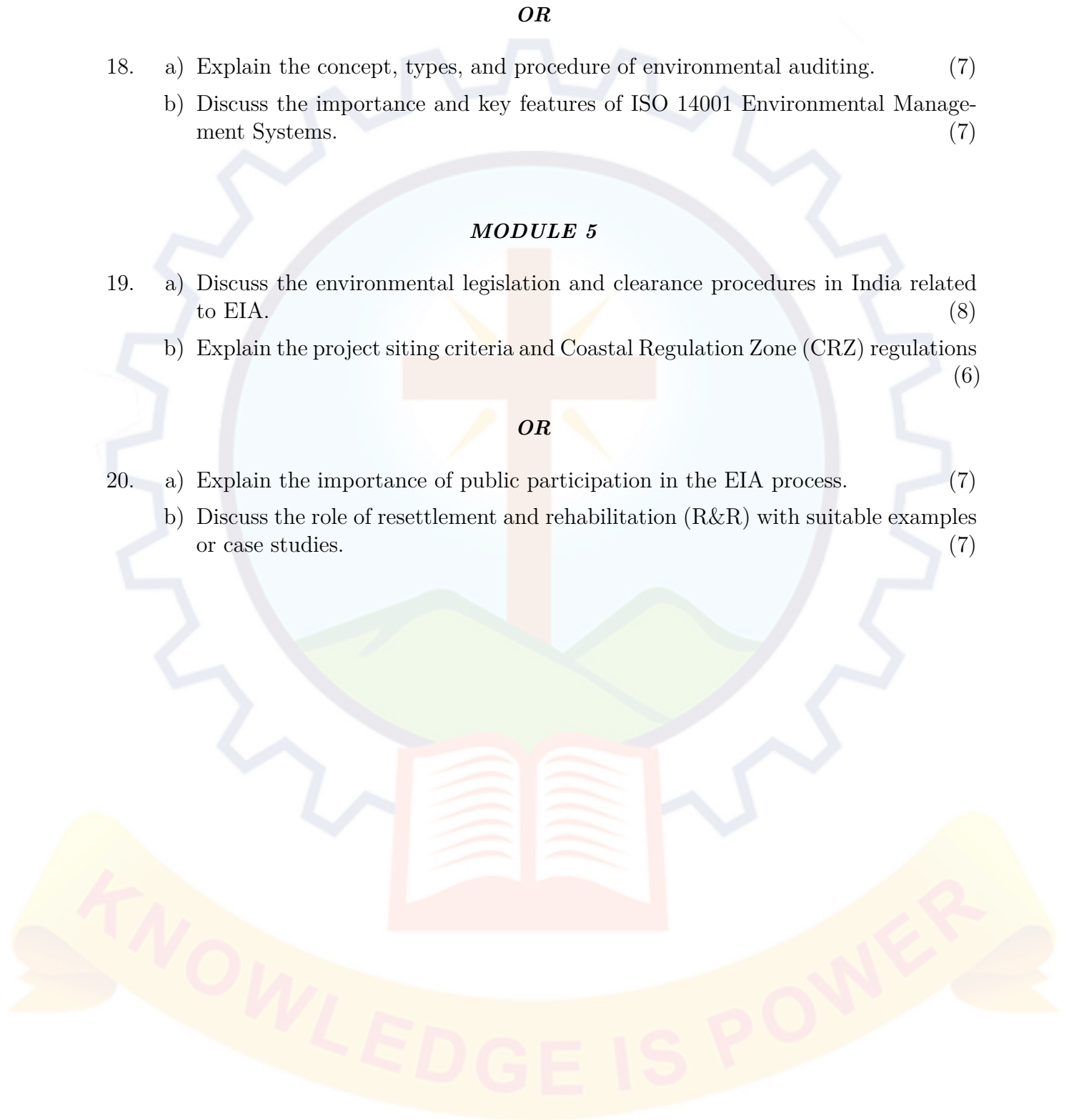
18. a) Explain the concept, types, and procedure of environmental auditing. (7)
b) Discuss the importance and key features of ISO 14001 Environmental Management Systems. (7)

MODULE 5

19. a) Discuss the environmental legislation and clearance procedures in India related to EIA. (8)
b) Explain the project siting criteria and Coastal Regulation Zone (CRZ) regulations (6)

OR

20. a) Explain the importance of public participation in the EIA process. (7)
b) Discuss the role of resettlement and rehabilitation (R&R) with suitable examples or case studies. (7)



CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE4P44	ADVANCED FOUNDATION DESIGN	2	1	0	4	3	2024

Preamble

Goal of this course is to impart to the students, in-depth knowledge about the basic concepts and theories of foundation design. After this course the students will be able to understand and apply the design considerations to satisfy the major and other requirements of the geotechnical design of foundation.

Prerequisites: Soil Mechanics, Foundation Engineering

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Understand the different types of foundations, basic design principles, and the importance of SSI in foundation design. (Cognitive Knowledge Level: Understand)
CO 2	Proficiency in designing shallow foundations based on bearing capacity and settlement analysis, considering soil and load conditions. (Cognitive Knowledge Level: Understand)
CO 3	Perform geotechnical design of deep foundations, including pile foundations, for various loading and soil conditions.(Cognitive Knowledge Level: Apply)
CO 4	Understand the design of foundations subjected to special loads, including seismic and dynamic loads, calculate the uplift and lateral load capacity of vertical piles (Cognitive Knowledge Level: Understand)
CO 5	Understand advanced foundation systems such as mat foundations, pile-raft foundations, design strategies for problematic soils, and evaluate the safe bearing capacity of single bulb and double bulb under reamed piles in sand and clay. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	-	-	-	-	-	-	-	-	-	-
CO 2	3	3	-	-	-	-	-	-	-	-	-
CO 3	3	3	-	2	-	-	-	-	-	-	-
CO 4	3	3	2	-	-	-	-	-	-	-	-
CO 5	3	3	3	-	-	-	-	-	-	2	2

Assessment Pattern

ADVANCED FOUNDATION DESIGN			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	20	20	20
Understand	40	40	30
Apply	40	40	50
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course Project : 10 marks

Self Study : 5 marks

End Semester Examination Pattern There will be two parts; Part A and Part B.

Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question carries 14 marks and can have maximum 2 sub-divisions.

SYLLABUS

Module 1: Introduction to Advanced Foundation Design (6 hours)

Overview of Foundation Design: Basic concepts in foundation design, Types of foundations (shallow and deep foundations), Selection criteria for foundations based on site and loading conditions

Soil-Structure Interaction (SSI) for Foundations: Introduction to SSI principles and their influence on foundation design, Impact of soil behaviour on foundation performance

Foundation Load Types: Static and dynamic loads (earthquake, wind, machine loads), Load transfer mechanisms from superstructure to foundation

Module 2: Design of Shallow Foundations (8 hours)

Bearing Capacity of Shallow Foundations: Theories of bearing capacity (Terzaghi, Meyerhof, Hansen), Bearing capacity for different soil conditions (cohesive, cohesionless, layered), Effect of groundwater table on bearing capacity, Allowable bearing pressure from SPT N-values - Numerical problems

Settlement Analysis: Immediate, consolidation, and differential settlement, Settlement calculation using empirical and theoretical methods, Allowable settlement and structural tolerances

Module 3: Design of Deep Foundations (7 hours)

Introduction to Deep Foundations: Types of deep foundations (piles, piers, caissons), Situations requiring deep foundations, Load transfer mechanisms for deep foundations (skin friction and end bearing)

Pile Foundation Design: Types of piles (driven, bored, cast-in-situ, precast), Load-carrying capacity of single piles and pile groups, Group effect, pile spacing, and negative skin friction, Geotechnical Design of Piles from SPT and CPT -values - Numerical problems. Settlement of pile groups in clay and sand - equivalent raft approach - Numerical problems - Settlement of pile groups in sand-Skempton's method - Meyerhof's method - Numerical problems.

Module 4: Foundations Subjected to Special Loads (7 hours)

Seismic Design of Foundations: Seismic forces and their effects on foundation design, Consideration of SSI in seismic design, Design of foundations for seismic performance (isolation, damping) (concepts only)

Foundations for Machine Loads: Types of machine foundations (block, framed, and raft foundations), Dynamic analysis of machine foundations under cyclic and vibratory loads,

Isolation techniques for vibration control

Foundation Design for Uplift and Lateral Loads: Uplift capacity of piles in clay - Numerical problems. Uplift resistance in foundations for transmission towers, wind turbines (concepts only), Behaviour of vertical piles under lateral loading, Pile resistance and deflection under lateral loads, IS and Brom's method, IS lateral load test on vertical piles - numerical problems. Lateral load design for offshore foundations and bridge piers (concepts only).

Module 5: Advanced Topics in Foundation Design (7 hours)

Sheet pile walls-Types of sheet pile structures-Design of cantilever Sheet pile wall in clay and sand -Numerical problems

Mat Foundations and Raft Design: Introduction to mat and raft foundations for heavy structures.

Pile Raft Foundations: Principles of pile-raft foundation systems, Load sharing between piles and raft in pile-raft systems

Design of Foundations on Expansive and Collapsible Soils: Characteristics of expansive and collapsible soils, Foundation design techniques to mitigate soil movement (under-reamed piles, belled piers), Under reamed piles - Load capacity in sand and clay-design considerations as per IS - numerical problems.

Text Books:

1. Das B. M., Principles of Geotechnical Engineering, Cengage India Pvt. Ltd., 2010.
2. Ranjan G. and A. S. R. Rao, Basic and Applied Soil Mechanics, New Age International, 2002.
3. Donald P. Coduto, Foundation Design: Principles and Practices, Prentice Hall, 2001
4. Bowles. J.E., Foundation Analysis and Design, Tata McGraw-Hill International Edition, 5th Edn, 1997.

Reference Books:

1. Tomlinson M.J., Pile design and construction Practice, Chapman and Hall Publication, 1994.
2. Peck, R.B., Hanson, W.E. and Thornburn, T.H., Foundation Engineering, Wiley Eastern Ltd., 2nd Edn., 1980.
3. Kurian, N.P. Design of Foundation Systems - Principles and Practices, Narosa Publishing House, 2nd Edn., 1994.
4. Prakash, S. and Sharma, H.D., Pile Foundations in Engineering Practice, John Wiley & Sons Inc., 1990.
5. Teng W.C., Foundation Design, Prentice-Hall of India (Pvt) Ltd., 1965.
6. Tomlinson, M.J., Foundation Design and Construction, English Language Book Society, Longman Group Ltd., 5th Edn., 1986.
7. Winterkorn, H.F. and Fang, H., Foundation Engineering Handbook, Van Nostrand Reinhold Company, 1975.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
	MODULE 1	6
1.1	Overview of Foundation Design: Basic concepts in foundation design, Types of foundations (shallow and deep foundations),	1
1.2	Selection criteria for foundations based on site and loading conditions	1
1.3	Soil-Structure Interaction (SSI) for Foundations: Introduction to SSI principles and their influence on foundation design, Impact of soil behaviour on foundation performance	2
1.4	Foundation Load Types: Static and dynamic loads (earthquake, wind, machine loads), Load transfer mechanisms from superstructure to foundation	2
	MODULE 2	7
2.1	Bearing Capacity of Shallow Foundations: Theories of bearing capacity (Terzaghi, Meyerhof, Hansen)	1
2.2	Bearing capacity for different soil conditions (cohesive, cohesionless, layered)	1
2.3	Effect of groundwater table on bearing capacity	1
2.4	Allowable bearing pressure from SPT N-values -Numerical problems	2
2.5	Settlement Analysis: Immediate, consolidation, and differential settlement, Settlement calculation using empirical and theoretical methods	1
2.6	Allowable settlement and structural tolerances	1

	MODULE 3	8
3.1	Introduction to Deep Foundations: Types of deep foundations (piles, piers, caissons), Situations requiring deep foundations, Load transfer mechanisms for deep foundations (skin friction and end bearing)	1
3.2	Pile Foundation Design: Types of piles (driven, bored, cast-in-situ, precast)	1
3.3	Load-carrying capacity of single piles and pile groups, Group effect, pile spacing, and negative skin friction	2
3.4	Geotechnical Design of Piles from SPT and CPT - values - Numerical problems	2
3.5	Settlement of pile groups in clay and sand - equivalent raft approach-Numerical problems	1
3.6	Settlement of pile groups in sand-Skempton's method-Meyerhof's method - Numerical problems .	1
	MODULE 4	8
4.1	Seismic Design of Foundations: Seismic forces and their effects on foundation design, Consideration of SSI in seismic design, Design of foundations for seismic performance (isolation, damping) (concepts only)	1
4.2	Foundations for Machine Loads: Types of machine foundations (block, framed, and raft foundations), Dynamic analysis of machine foundations under cyclic and vibratory loads, Isolation techniques for vibration control	2
4.3	Foundation Design for Uplift and Lateral Loads: Uplift capacity of piles in clay- Numerical problems.	1
4.4	Uplift resistance in foundations for transmission towers, wind turbines (concepts only)	1
4.5	Behaviour of vertical piles under lateral loading, Pile resistance and deflection under lateral loads, IS and Brom's method, IS lateral load test on vertical piles- numerical problems	2
4.6	Lateral load design for offshore foundations and bridge piers (concepts only).	1

	MODULE 5	7
5.1	Sheet pile walls - Types of sheet pile structures -Design of cantilever Sheet pile wall in clay and sand - Numerical problems	2
5.2	Mat Foundations and Raft Design: Introduction to mat and raft foundations for heavy structures	1
5.3	Pile Raft Foundations: Principles of pile-raft foundation systems, Load sharing between piles and raft in pile -raft systems	1
5.4	Design of Foundations on Expansive and Collapsible Soils: Characteristics of expansive and collapsible soils, Foundation design techniques to mitigate soil movement (under-reamed piles, belled piers) - concepts only	1
5.5	Under reamed piles - Load capacity in sand and clay -design considerations as per IS - numerical problems	2
Total		36 Hours

MODEL QUESTION PAPER

QP CODE:

Pages: 3

Reg.No.:

Name:

**MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM**

SEVENTH SEMESTER B. TECH DEGREE EXAMINATION, YEAR

Course Code: B24CE4P44

ADVANCED FOUNDATION DESIGN

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. What are the criteria for selecting shallow and deep foundations?
2. Define soil-structure interaction (SSI) in foundation design.
3. What are dynamic loads acting on foundations? Give examples.
4. Define allowable bearing pressure.
5. What is negative skin friction in piles?
6. List different types of piles.
7. What is meant by group efficiency of piles?
8. Define uplift capacity of piles.
9. What is a sheet pile wall?
10. What are expansive soils?

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. (a) Explain types of foundations and selection criteria based on soil and loading conditions. (7 marks)
(b) Discuss soil-structure interaction (SSI) and its influence on foundation performance. (7 marks)

OR

12. (a) Explain load transfer mechanisms from superstructure to foundation. (7 marks)
(b) Discuss different types of static and dynamic loads and their effect on foundation design. (7 marks)

MODULE 2

13. (a) Explain bearing capacity theories (Terzaghi, Meyerhof, Hansen). (6 marks)
(b) A footing rests on sand with: SPT $N = 20$, Water table at footing level. Determine the allowable bearing pressure using empirical relations. (8 marks)

OR

14. (a) Explain types of settlement and allowable limits. (6 marks)
(b) A clay layer of thickness 5 m has: $C_c = 0.3$, $e_0 = 0.9$, Initial stress = 120 kN/m^2 , Final stress = 240 kN/m^2 . Calculate consolidation settlement. (8 marks)

MODULE 3

15. (a) Explain load transfer in piles (skin friction and end bearing). (6 marks)
(b) A pile of diameter 0.5 m and length 12 m is embedded in clay with: $c = 60 \text{ kN/m}^2$, $\alpha = 0.5$. Calculate ultimate load capacity of the pile. (8 marks)

OR

16. (a) Explain pile group settlement using equivalent raft concept. (6 marks)
(b) A pile group in sand has: Width = 3 m, Length = 3 m, Applied load = 1800 kN. Estimate settlement using Meyerhof's method. (8 marks)

MODULE 4

17. (a) Explain machine foundations and vibration isolation techniques. (6 marks)
(b) A pile of diameter 0.4 m and length 10 m is embedded in clay with: $c = 50 \text{ kN/m}^2$. Determine uplift capacity. (8 marks)

OR

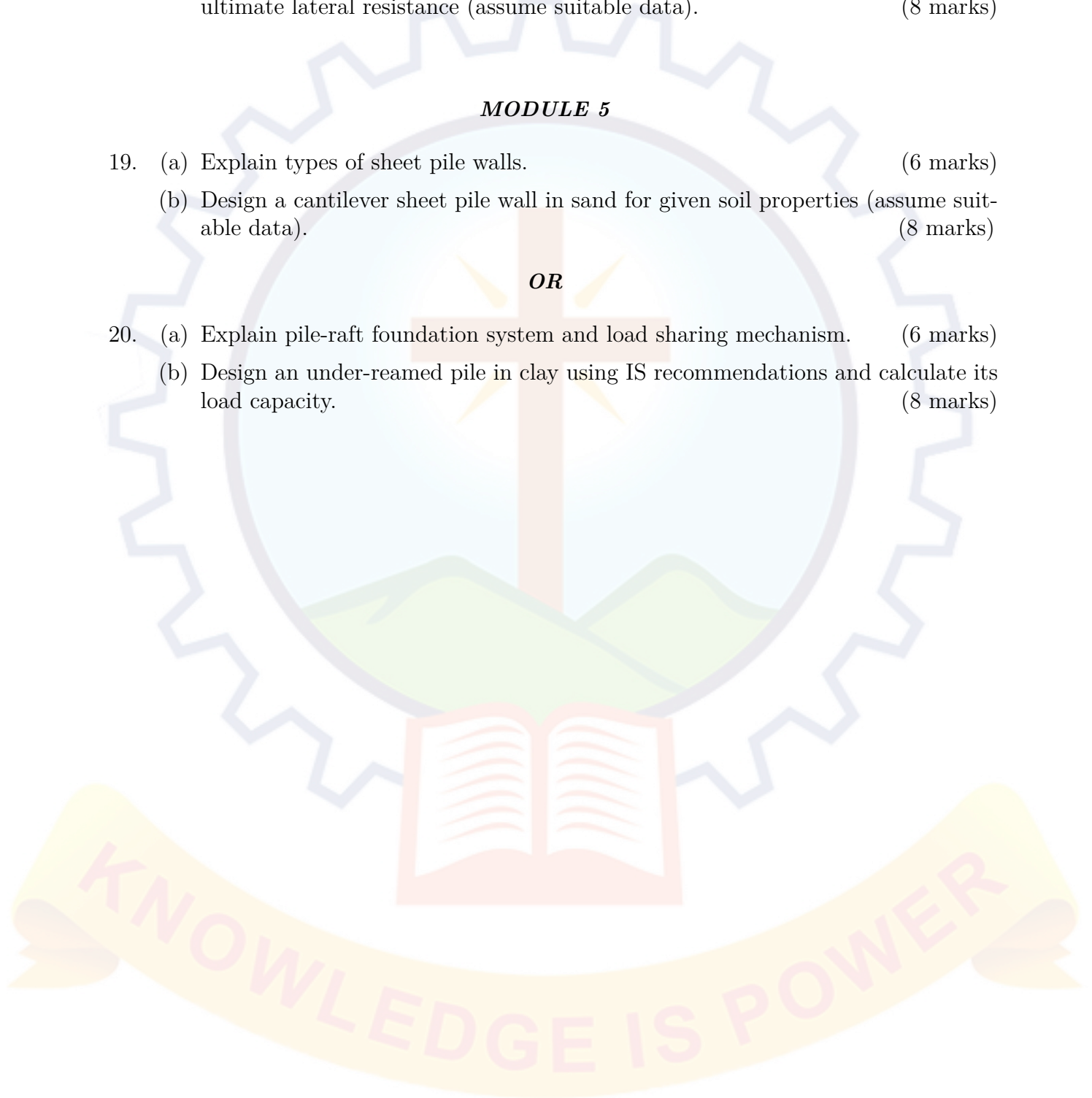
18. (a) Explain behaviour of piles under lateral loading. (6 marks)
(b) A vertical pile is subjected to lateral load. Using Brom's method, determine ultimate lateral resistance (assume suitable data). (8 marks)

MODULE 5

19. (a) Explain types of sheet pile walls. (6 marks)
(b) Design a cantilever sheet pile wall in sand for given soil properties (assume suitable data). (8 marks)

OR

20. (a) Explain pile-raft foundation system and load sharing mechanism. (6 marks)
(b) Design an under-reamed pile in clay using IS recommendations and calculate its load capacity. (8 marks)



CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE4P45	STRUCTURAL DYNAMICS	2	1	0	4	3	2024

Preamble

The course provides the basic concepts of structural dynamics and the theoretical background to perform dynamic analysis of structures. The course focuses on analysis of single and multi-degree freedom systems. Also, an introduction to mass distributed systems and earthquake analysis of structures is included.

Prerequisites: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Model single degree freedom systems for dynamic analysis and develop equations of motion. (Cognitive Knowledge Level: Apply)
CO 2	Perform dynamic analysis of single degree freedom systems. (Cognitive Knowledge Level: Analyse)
CO 3	Model multi degree freedom systems for dynamic analysis and develop equations of motion. (Cognitive Knowledge Level: Apply)
CO 4	Perform dynamic analysis of multi degree freedom systems. (Cognitive Knowledge Level: Analyse)
CO 5	Perform dynamic analysis of mass distributed parameter systems. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	3	2	2	2						1
CO 2	3	3	2	2	2						1
CO 3	3	3	2	2	2						1
CO 4	3	3	2	2	2						1
CO 5	3	3	2	2	2						1

Assessment Pattern

STRUCTURAL DYNAMICS			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember			
Understand	40	40	40
Apply	50	50	50
Analyse	10	10	10
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course Project	: 10 marks
Self Study	: 5 marks

End Semester Examination Pattern

There will be two parts: Part A and Part B. Part A contain 10 questions, with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module, of which students should answer any one. Each question carries 14 marks and can have a maximum of 2 sub-divisions.

SYLLABUS

Module 1: Vibration studies and its importance to structural engineering applications (8 hours)

Introduction – dynamic loads and dynamic response, stiffness & damping, degree of freedom, schematic representation of structural systems. SDOF systems – equation of motion, D’ Alembert’s principle, free vibrations, overdamped, critically damped and underdamped systems, logarithmic decrement, negative damping.

Module 2: Response of single degree of freedom systems (8 hours)

SDOF systems - forced vibrations under different types of dynamic loading, support motion, vibration isolation, transmissibility of force and transmissibility of displacement, Duhamel integral, response spectrum.

Module 3: Free vibration of multi degree of freedom systems (7 Hours)

MDOF systems – free vibrations, natural modes, orthogonality, Shear frame, matrix iteration of eigen values and eigen vectors

Module 4: Forced vibrations of multi degree of freedom systems (8 Hours)

MDOF systems – Forced vibrations of multi degree of freedom systems – equations of motion – response of MDOF systems – mode superposition method – damping in MDOF systems.

Module 5: Continuous systems (5 Hours)

Vibration of continuous systems with distributed mass – governing differential equation of beams – free vibration of beams – beams with different end conditions. Introduction to vibration control in structures: passive, active, semi-active and hybrid control devices used in civil engineering structures.

Text Books:

1. Anil K. Chopra, “Dynamics of Structures”. Theory and Applications to Earthquake Engineering, Pearson Education, India, 2023.
2. Mukhopadhyay M, “Structural Dynamics - Vibrations and Systems”, Ane Books India, Delhi, 2021.
3. Mario Paz, “Structural Dynamics – Theory and Computation”, CBS Publishers and Distributors, Delhi, 2019.

References:

1. Clough R W and Penzien J, “Dynamics of Structures”, McGraw Hill, New Delhi, 2003.
2. Weaver W, Timoshenko S P, and Young D H, “Vibration Problems in Engineering”, John Wiley and Sons, USA, 1990.
3. Roy R. Craig and Andrew J. Kurdila, Fundamentals of Structural Dynamics, 2011.
4. Paul A. Kurowski, Structural Dynamics: Concepts and Applications, 2006.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	8 hours
1.1	Introduction – dynamic loads and dynamic response	1
1.1	Stiffness & damping, degree of freedom, schematic representation of structural systems.	2
1.3	SDOF systems – equation of motion, D’ Alembert’s principle, free vibrations	2
1.4	Overdamped, critically damped and underdamped systems, logarithmic decrement, negative damping.	3
2	Module 2	8 hours
2.1	SDOF systems - forced vibrations under different types of dynamic loading	3
2.2	Support motion, vibration isolation, transmissibility of force and transmissibility of displacement, Duhamel integral	3
2.3	Response spectrums	2
3	Module 3	7 hours
3.1	MDOF systems – free vibrations, natural modes	2
3.2	Orthogonality, Shear frame	2

3.3	Matrix iteration of eigen values and eigen vectors	3
4	Module 4	8 hours
4.1	MDOF systems – Forced vibrations of multi degree of freedom systems – equations of motion.	1
4.2	Response of MDOF systems	2
4.3	Mode superposition method	3
4.4	Damping in MDOF systems	2
5	Module 5	5 hours
5.1	Vibration of continuous systems with distributed mass – governing differential equation of beams	1
5.2	Free vibration of beams – beams with different end conditions	2
5.3	Introduction to vibration control in structures: passive, active, semi-active and hybrid control devices used in civil engineering structures.	2
Total		36 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

4. Illustrate the concept of degree of freedom and discuss its significance in modelling structural systems for vibration analysis.
5. Differentiate between underdamped, critically damped and overdamped systems with suitable response characteristics.

Course Outcome 2 (CO 2):

1. Discuss the response of a single degree freedom system subjected to harmonic loading.
2. Summarize the concept of response spectrum and its importance in structural dynamics

Course Outcome 3 (CO 3):

1. Develop the equations of motion for a two-degree freedom system.
2. Examine the concepts of natural modes and orthogonality in multi degree freedom

Course Outcome 4 (CO 4):

1. Illustrate the mode superposition method used in analysing forced vibration of multi degree freedom systems.
2. Discuss the significance of damping in multi degree freedom systems.

Course Outcome 5 (CO 5):

1. Outline the governing differential equation of transverse vibration of beams.
2. Classify the different types of vibration control devices used in structures. .

MODEL QUESTION PAPER

QP CODE:

Pages: 3

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

SEVENTH SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CE4P45

STRUCTURAL DYNAMICS

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Define degree of freedom of a structural system and illustrate with one example of an SDOF system.
2. Distinguish between underdamped, critically damped and overdamped vibrations with suitable response characteristics.
3. Explain vibration isolation and state its importance in structural engineering applications.
4. Define force transmissibility and displacement transmissibility in forced vibration of SDOF systems.
5. Define natural mode of an MDOF system and mention the significance of mode shapes in vibration analysis.
6. State the orthogonality condition of mode shapes in multi-degree freedom systems.
7. Explain the mode superposition method used for dynamic analysis of MDOF systems.
8. What is damping in MDOF systems? Mention any two types commonly considered in analysis.
9. Write the governing differential equation of transverse vibration of beams.
10. Classify vibration control devices used in structures.

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. a) Derive the equation of motion of a damped single degree freedom system using D'Alembert's principle. (7)
b) Explain the response characteristics of underdamped, critically damped and overdamped systems with neat sketches (7)

OR

12. a) Write note on Logarithmic decrement. (4)
b) A mass of 5kg is attached to a spring of stiffness 120 N/m and a damper with damping coefficient 5Ns/m. Find the damping factor, natural frequency, logarithmic decrement, natural frequency of damped system, ratio between two consecutive amplitudes and number of cycles after which original amplitude is reduced to 25 %. (10)

MODULE 2

13. A machine of mass 250 kg is mounted on springs of total stiffness 100 kN/m and subjected to harmonic force: $F(t)=800 \sin(15t)$ N. i) Determine the steady state amplitude neglecting damping ii) Find the magnification factor.

OR

14. A spring-supported machine has mass 100 kg, stiffness 40 kN/m and damping coefficient 500 Ns/m. It is subjected to harmonic force of amplitude 300 N at frequency 10 rad/s. i) Determine amplitude of vibration ii) Calculate force transmissibility.

MODULE 3

15. a) Derive the equations of motion for a two-degree freedom spring-mass system. (7)
b) Explain orthogonality of mode shapes. (7)

OR

16. For a two-degree freedom system with equal masses $m = 2$ kg and equal stiffness $k = 2000$ N/m: i) Formulate mass and stiffness matrices. ii) Determine the natural frequencies.

MODULE 4

17. a) Explain the mode superposition method for forced vibration analysis of MDOF systems. (7)
b) Discuss damping in MDOF systems. (7)

OR

18. a) Discuss the concept of forced vibration in multi degree freedom systems and explain the role of modal coordinates. (7)
b) Explain damping in MDOF systems and distinguish between classical and non-classical damping. (7)

MODULE 5

19. a) Derive the governing differential equation for transverse vibration of beams with distributed mass. (7)
b) Explain the free vibration characteristics of a simply supported beam. (7)

OR

20. a) Compare the free vibration behaviour of beams with different end conditions. (7)
b) Discuss the working principle and applications of passive, active, semi-active and hybrid vibration control devices used in civil engineering structures. (7)

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE4P46	SUSTAINABLE CONSTRUCTION MATERIALS AND PRACTICES	2	1	0	4	3	2024

Preamble

This course introduces the principles, materials, technologies, and practices associated with sustainable construction in the built environment. It enables students to understand sustainable construction materials, life cycle assessment, green building systems, and circular economy approaches for reducing environmental impacts. The course also familiarizes students with economic, policy, digital, and future trends such as BIM, net-zero buildings, smart technologies, and carbon-neutral construction.

Prerequisites: Energy Conservation and Environmental Sustainability

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Explain the principles of sustainability and their relevance to the construction industry. (Cognitive Knowledge Level: Understand)
CO 2	Describe the properties, classification, and applications of sustainable construction materials and modern technologies. (Cognitive Knowledge Level: Understand)
CO 3	Apply life cycle assessment concepts and embodied carbon evaluation methods for sustainable material selection. (Cognitive Knowledge Level: Apply)
CO 4	Apply sustainable construction practices, green building systems, and resource-efficient strategies in construction projects. (Cognitive Knowledge Level: Apply)
CO 5	Analyze the economic, policy, and technological factors influencing the future of sustainable construction. (Cognitive Knowledge Level: Analyze)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	2	1	3	1	1	2	3	2	1	1	2
CO 2	2	1	3	2	2	2	3	1	1	1	2
CO 3	3	1	3	3	2	2	3	1	1	1	2
CO 4	2	1	3	2	3	2	3	1	2	1	2
CO 5	2	2	3	2	2	3	3	2	1	2	3

Assessment Pattern

SUSTAINABLE CONSTRUCTION MATERIALS AND PRACTICES			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	50		20
Understand	50	50	40
Apply		30	20
Analyse		20	20
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course Project	: 10 marks
Self Study	: 5 marks

End Semester Examination Pattern

There will be two parts: Part A and Part B. Part A contain 10 questions, with 2 questions

from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module, of which students should answer any one. Each question carries 14 marks and can have a maximum of 2 sub-divisions.

SYLLABUS

Module 1: Fundamentals of Sustainability in Construction (7 hours)

Definition and principles of sustainability; Environmental, social, and economic pillars; Sustainability in the built environment; Sustainable Development Goals relevant to construction; Benefits and challenges of sustainable construction; Introduction to sustainable construction materials; Classification of sustainable materials; Emerging trends in sustainable construction.

Module 2: Sustainable Construction Materials and Technologies (8 hours)

Characteristics of sustainable materials: renewable, recyclable, low-carbon, and resource-efficient; Eco-efficient and smart materials; Materials such as bamboo, recycled aggregates, fly ash and slag concrete, geopolymer concrete, engineered timber; Low-embodied-energy materials; Advanced construction methods: prefabrication, modular construction, MIVAN, tunnel form construction; Emerging technologies: 3D printing and robotic construction (overview); Low-carbon concrete and innovative material systems.

Module 3: Life Cycle Assessment and Material Sustainability (7 Hours)

Life Cycle Assessment (LCA): principles and framework; Cradle-to-grave and cradle-to-cradle approaches; Embodied energy and embodied carbon; Material transparency and Environmental Product Declarations (EPDs); LCA tools and software (overview): ISO standards, Open LCA; Circular economy in construction; Strategies to reduce lifecycle carbon emissions; Case studies of LCA in concrete, steel, and timber.

Module 4: Sustainable Construction Practices and Green Building Systems (7 Hours)

Sustainable site planning and design; Resource efficiency and construction waste management; Design for disassembly, reuse, and recycling; Lean construction principles; Water conservation: rainwater harvesting and greywater reuse; Energy-efficient construction practices: passive design and active systems; Green building rating systems: LEED, BREEAM, IGBC, and GRIHA; Digital tools for green building assessment.

Module 5: Economics, Policies, and Future Trends in Sustainable Construction (7 Hours)

Economic analysis of sustainable construction; Cost-benefit analysis and return on investment; Government policies, regulations, and incentives; BIM for sustainability; Analytical approaches: material flow analysis and value stream mapping (overview); Net-zero and positive-energy buildings; Smart technologies: IoT, AI, and sensor-based building management; Future trends: carbon-neutral construction, ESG in real estate, smart cities.

Text Books:

1. Kibert, C. J. (2016). Sustainable Construction: Green Building Design and Delivery (4th ed.). Hoboken, New Jersey: John Wiley and Sons.
2. Kubba, S. (2017). Handbook of Green Building Design and Construction: LEED, BREEAM, and Green Globes (2nd ed.). Oxford: Butterworth-Heinemann / Elsevier.
3. Dodds, F., de Begg, L., Hardcastle, K., Campbell, M., Fairclough, R., Callanan, T. (2014). Eco-efficient Construction and Building Materials. New Delhi: Woodhead Publishing India.
4. Spiegel, R., Meadows, D. (2010). Green Building Materials: A Guide to Product Selection and Specification (3rd ed.). Hoboken, New Jersey: John Wiley and Sons.

References:

1. McDonough, W., Braungart, M. (2002). Cradle to Cradle: Remaking the Way We Make Things. New York: North Point Press.
2. Lu, Y., Wu, Z., Chang, R., Li, Y. (2017). Building information modeling for green buildings: A critical review and future directions. Automation in Construction, 83, 134–148.
3. Liew, K. M., Sojobi, A. O., Zhang, L. W. (2017). Green concrete: Prospects and challenges. Construction and Building Materials, 156, 1063–1095.
4. BIS. (2019). IS 10262:2019 – Concrete Mix Proportioning: Guidelines. New Delhi: Bureau of Indian Standards.
5. IGBC. (Latest Edition). Indian Green Building Council Rating Systems. Hyderabad: Confederation of Indian Industry.
6. GRIHA Council. (Latest Edition). GRIHA Manual for Green Buildings. New Delhi: GRIHA Council.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	7 hours
1.1	Definition and principles of sustainability; Environmental, social, and economic pillars; Sustainability in the built environment	3
1.2	Sustainable Development Goals relevant to construction; Benefits and challenges of sustainable construction	2
1.3	Introduction to sustainable construction materials; Classification of sustainable materials; Emerging trends in sustainable construction.	2
2	Module 2	8 hours
2.1	Characteristics of sustainable materials: renewable, recyclable, low-carbon, and resource-efficient; Eco-efficient and smart materials	2
2.2	Materials such as bamboo, recycled aggregates, fly ash and slag concrete, geopolymers concrete, engineered timber; Low-embodied-energy materials	2
2.3	Advanced construction methods: prefabrication, modular construction, MIVAN, tunnel form construction	2
2.4	Emerging technologies: 3D printing and robotic construction (overview); Low-carbon concrete and innovative material systems	2
3	Module 3	7 hours
3.1	Life Cycle Assessment (LCA): principles and framework; Cradle-to-grave and cradle-to-cradle approaches	1
3.2	Embodied energy and embodied carbon; Material transparency and Environmental Product Declarations (EPDs)	2
3.3	LCA tools and software (overview): ISO standards, Open LCA; Circular economy in construction	2

3.4	Strategies to reduce lifecycle carbon emissions; Case studies of LCA in concrete, steel, and timber.	2
4	Module 4	7 hours
4.1	Sustainable site planning and design; Resource efficiency and construction waste management; Design for disassembly, reuse, and recycling	2
4.2	Lean construction principles; Water conservation: rainwater harvesting and greywater reuse	2
4.3	Energy-efficient construction practices: passive design and active systems	1
4.4	Green building rating systems: LEED, BREEAM, IGBC, and GRIHA; Digital tools for green building assessment.	2
5	Module 5	7 hours
5.1	Economic analysis of sustainable construction; Cost-benefit analysis and return on investment; Government policies, regulations, and incentives	2
5.2	BIM for sustainability; Analytical approaches: material flow analysis and value stream mapping (overview); Net-zero and positive-energy buildings	2
5.3	Smart technologies: IoT, AI, and sensor-based building management; Future trends: carbon-neutral construction, ESG in real estate, smart cities.	3
Total		36 Hours

MODEL QUESTION PAPER

QP CODE:

Pages: 3

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

SEVENTH SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CE4P46

**SUSTAINABLE CONSTRUCTION MATERIALS
AND PRACTICES**

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions.
Each question carries 3 marks.

1. Explain the three pillars of sustainability in construction.
2. State the relevance of Sustainable Development Goals to the construction industry.
3. Describe any three characteristics of sustainable construction materials.
4. Explain the applications of prefabrication and modular construction in sustainable projects.
5. Explain the concept of Life Cycle Assessment in construction materials.
6. Distinguish between embodied energy and embodied carbon.
7. Explain the principles of construction waste management.
8. Describe any three green building rating systems used in construction.
9. Explain the concept of cost-benefit analysis in sustainable construction.
10. State the role of BIM in achieving sustainability in construction projects.

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. a) Explain the principles of sustainability and discuss their significance in the built environment. (8)
b) Discuss the benefits and challenges of sustainable construction practices. (6)

OR

12. a) Explain the environmental, social, and economic dimensions of sustainability with suitable examples from construction. (8)
b) Describe emerging trends in sustainable construction. (6)

MODULE 2

13. a) Explain the properties and applications of bamboo, recycled aggregates, fly ash concrete, and engineered timber as sustainable materials. (8)
b) Discuss the importance of low-embodied-energy materials in modern construction. (6)

OR

14. a) Explain advanced construction methods such as prefabrication, modular construction, MIVAN, and tunnel form systems. (8)
b) Discuss the scope of 3D printing and robotic construction in sustainable development. (6)

MODULE 3

15. a) Explain the framework of Life Cycle Assessment and its application in construction materials. (8)
b) Discuss cradle-to-grave and cradle-to-cradle approaches. (6)

OR

16. a) Analyze the significance of embodied energy, embodied carbon, and Environmental Product Declarations in sustainable construction. (8)
b) Discuss strategies to reduce lifecycle carbon emissions in buildings. (6)

MODULE 4

17. a) Explain sustainable site planning and resource-efficient construction practices. (8)
b) Discuss rainwater harvesting and greywater reuse in buildings. (6)

OR

18. a) Explain the principles of green building rating systems such as LEED, BREEAM, IGBC, and GRIHA. (8)
b) Discuss lean construction principles and design for disassembly. (6)

MODULE 5

19. a) Explain economic analysis methods used in sustainable construction projects. (8)
b) Discuss government policies and incentives promoting sustainable construction. (6)

OR

20. a) Analyze the role of smart technologies such as IoT, AI, and sensor-based systems in future buildings. (8)
b) Discuss net-zero buildings, ESG in real estate, and smart cities as future trends. (6)

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE4G21	ENERGY MANAGEMENT AND INTEGRATION	2	1	0	4	3	2024

Preamble

This course provides an understanding of energy resources, energy policies, and principles of energy management for sustainable development. It covers energy audit techniques, energy efficiency measures in industrial and utility systems, and methods for process integration and energy optimization. The course also introduces renewable energy systems, energy storage technologies, and financial evaluation of energy projects to support sustainable energy planning and efficient resource utilization.

Prerequisites: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Explain the global and Indian energy scenario, energy policies, and the importance of energy conservation. (Understand)
CO 2	Describe the principles of energy management and procedures involved in energy auditing. (Understand)
CO 3	Apply energy efficiency measures in industrial and utility systems for improved energy performance. (Apply)
CO 4	Apply process integration concepts for heat recovery and energy optimization in industrial processes. (Apply)
CO 5	Explain renewable energy technologies and financial evaluation methods for sustainable energy projects. (Understand)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	1				2	3	1			
CO 2	3	2		1	2	2	3	1		1	1
CO 3	3	2	2	1	2	2	3	1		1	2
CO 4	3	2	2	2	2	2	3	1		1	2
CO 5	2	1			1	2	3	2	1	1	1

Assessment Pattern

ENERGY MANAGEMENT AND INTEGRATION			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	40	40	40
Understand	40	40	40
Apply	20	20	20
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course Project : 10 marks

Self Study : 5 marks

End Semester Examination Pattern

There will be two parts: Part A and Part B. Part A contain 10 questions, with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module, of which students should answer any one. Each question carries 14 marks and can have a maximum of 2 sub-divisions.

SYLLABUS

Module 1: Energy Scenario and Policy (7 hours)

Indian and global energy scenario - Energy sources, generation mix, and consumption patterns - Energy pricing, energy security, and conservation - Energy policy and sustainability - Energy Conservation Act, 2001 - National and State energy policies - Role of Bureau of Energy Efficiency (BEE)

Module 2: Energy Management & Energy Audit (7 hours)

Principles of energy management - Need and types of energy audits - Energy audit methodology and procedures - Energy costing and benchmarking techniques - Demand-Side Management (DSM) - Energy monitoring and targeting - Energy audit instruments and reporting

Module 3: Energy Efficiency in Industrial & Utility Systems (7 Hours)

Boilers, furnaces, steam, and compressed air systems - Pumps, motors, fans, and blowers - HVAC and refrigeration systems - Electrical energy management - Power factor improvement and energy-efficient lighting - Waste heat recovery and cogeneration

Module 4: Energy Integration & Process Optimization (7 Hours)

Process integration principles - Pinch analysis for heat integration - Composite curves and grand composite curves - Heat Exchanger Network (HEN) design - Heat recovery optimization - Vapor recompression and heat pumping - Optimization of industrial energy networks

Module 5: Renewable Energy, Sustainability & Project Evaluation (8 Hours)

Renewable energy systems and grid integration - Energy storage technologies - Energy system modeling and optimization - Financial appraisal of energy projects - Life-cycle cost analysis - Carbon trading and environmental impacts - Sustainable energy planning

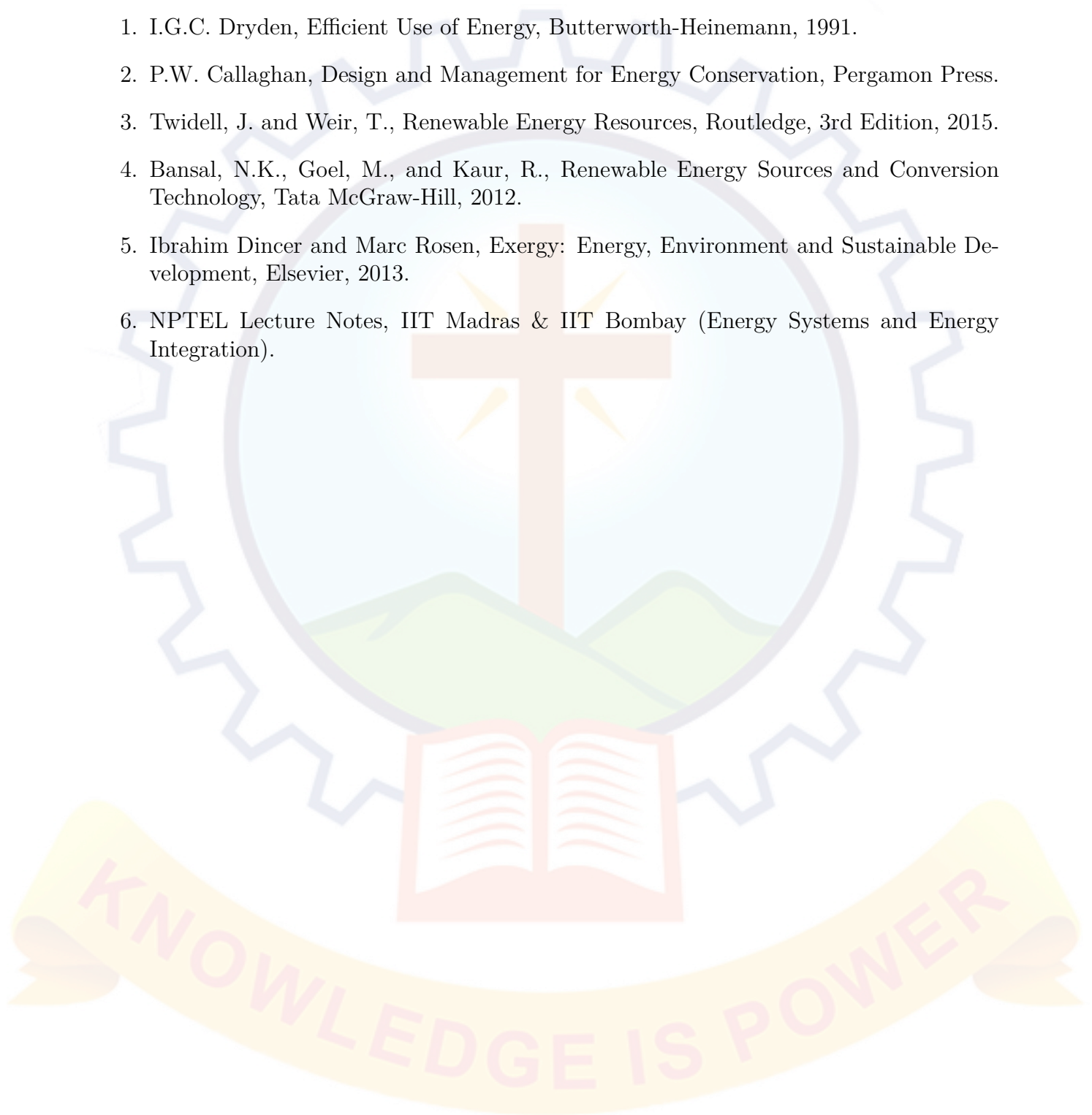
Text Books:

1. Wayne C. Turner, Energy Management Handbook, Wiley, 8th Edition, 2019.
2. Bureau of Energy Efficiency (BEE), Energy Manager and Energy Auditor Training Manuals (Volumes 1–4), Government of India.
3. L.C. Witte, P.S. Schmidt, and D.R. Brown, Industrial Energy Management and Utilization, CRC Press, 2008.

4. Yunus A. Cengel and Mehmet Kanoglu, Energy Efficiency and Management for Engineers, McGraw-Hill Education, 2015.

Reference Books:

1. I.G.C. Dryden, Efficient Use of Energy, Butterworth-Heinemann, 1991.
2. P.W. Callaghan, Design and Management for Energy Conservation, Pergamon Press.
3. Twidell, J. and Weir, T., Renewable Energy Resources, Routledge, 3rd Edition, 2015.
4. Bansal, N.K., Goel, M., and Kaur, R., Renewable Energy Sources and Conversion Technology, Tata McGraw-Hill, 2012.
5. Ibrahim Dincer and Marc Rosen, Exergy: Energy, Environment and Sustainable Development, Elsevier, 2013.
6. NPTEL Lecture Notes, IIT Madras & IIT Bombay (Energy Systems and Energy Integration).



COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	7 hours
1.1	Indian and global energy scenario - Energy sources, generation mix, and consumption patterns	2
1.2	Energy pricing, energy security, and conservation	1
1.3	Energy policy and sustainability -Energy Conservation Act, 2001	1
1.4	National and State energy policies	2
1.5	Role of Bureau of Energy Efficiency (BEE)	1
2	Module 2	7 hours
2.1	Principles of energy management	1
2.2	Need and types of energy audits - Energy audit methodology and procedures	2
2.3	Energy costing and benchmarking techniques	1
2.4	Demand-Side Management (DSM)	1
2.5	Energy monitoring and targeting - Energy audit instruments and reporting	2
3	Module 3	7 hours
3.1	Boilers, furnaces, steam, and compressed air systems	1
3.2	Pumps, motors, fans, and blowers	1
3.3	HVAC and refrigeration systems	1
3.4	Electrical energy management - Power factor improvement and energy	2
3.5	efficient lighting - Waste heat recovery and cogeneration	2

4	Module 4	7 hours
4.1	Process integration principles - Pinch analysis for heat integration	2
4.2	Composite curves and grand composite curves	1
4.3	- Heat Exchanger Network (HEN) design - Heat recovery optimization	2
4.4	Vapor recompression and heat pumping - Optimization of industrial energy networks	2
5	Module 5	8 hours
5.1	Renewable energy systems and grid integration	1
5.2	Energy storage technologies - Energy system modeling and optimization	2
5.3	Financial appraisal of energy projects - Life-cycle cost analysis	2
5.4	Carbon trading and environmental impacts	2
5.5	Sustainable energy planning	1
Total		36 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Explain the global and Indian energy scenario with reference to energy demand and consumption patterns.
2. Describe the objectives and key provisions of the Energy Conservation Act, 2001.
3. Explain the role of the Bureau of Energy Efficiency (BEE) in promoting energy conservation in India.

Course Outcome 2 (CO 2):

1. Explain the principles and objectives of energy management.
2. Describe the different types of energy audits and their importance in industries.
3. Explain the steps involved in energy audit methodology and reporting.

Course Outcome 3 (CO 3):

1. Explain energy efficiency improvement measures in boilers and steam systems.
2. Describe energy conservation techniques in motors, pumps, and compressors.
3. Explain the concept of waste heat recovery and cogeneration in industrial systems.

Course Outcome 4 (CO 4):

1. Explain the concept and importance of process integration in energy management.
2. Describe the principle of pinch analysis for heat integration.
3. Explain the design concept of heat exchanger networks (HEN).

Course Outcome 5 (CO 5):

1. Explain different renewable energy systems and their role in sustainable development.
2. Describe the concept of life-cycle cost analysis in energy projects.
3. Explain the role of carbon trading and sustainable energy planning.

MODEL QUESTION PAPER

QP CODE:

Pages: 2

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

SEVENTH SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CE4G21

ENERGY MANAGEMENT AND INTEGRATION

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Define energy conservation.
2. What is the role of the Bureau of Energy Efficiency (BEE)?
3. What is an energy audit?
4. Define Demand-Side Management (DSM).
5. What is power factor improvement?
6. What is waste heat recovery?
7. What is pinch analysis?
8. Define heat exchanger network (HEN).
9. What are renewable energy sources?
10. What is life-cycle cost analysis?

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. a) Explain the global and Indian energy scenario and energy consumption patterns.
b) Discuss the importance of energy policy and energy conservation in sustainable development. (6)

OR

12. a) Explain the Energy Conservation Act, 2001 and its significance. (7)
b) Discuss the role and functions of the Bureau of Energy Efficiency (BEE). (7)

MODULE 2

13. a) Explain the principles and objectives of energy management. (8)
b) Discuss the need and types of energy audits in industries. (6)

OR

14. a) Explain the methodology and procedures involved in energy auditing. (7)
b) Discuss energy monitoring, targeting, and benchmarking techniques. (7)

MODULE 3

15. a) Explain energy efficiency measures in boilers, furnaces, and steam systems. (8)
b) Discuss energy conservation techniques in motors and pumps. (6)

OR

16. a) Explain HVAC and refrigeration systems in energy management. (7)
b) Discuss waste heat recovery and cogeneration techniques. (7)

MODULE 4

17. a) Explain the principles of process integration for energy optimization. (8)
b) Discuss vapor recompression and heat pumping techniques. (6)

OR

18. a) Explain pinch analysis and composite curves used for heat integration. (7)
b) Discuss heat exchanger network (HEN) design for industrial energy systems. (7)

MODULE 5

19. a) Explain renewable energy systems and their integration with the power grid. (8)
b) Discuss energy storage technologies and their applications. (6)

OR

20. a) Explain life-cycle cost analysis for energy projects. (7)
b) Discuss carbon trading and sustainable energy planning. (7)

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE4G22	CLIMATE CHANGE AND SUSTAINABILITY	2	1	0	4	3	2024

Preamble

This course provides an understanding of the Earth's climate system, the causes and impacts of climate change, and the strategies for mitigation and adaptation. It also introduces the concept of sustainability along with global frameworks and policies, enabling students to address environmental challenges and contribute to sustainable development..

Prerequisites: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Explain the components of the Earth's climate system and the fundamental concepts of climate change, including energy balance and greenhouse effect. (Cognitive Knowledge Level: Understand)
CO 2	Understand the impacts of climate change on natural resources, ecosystems, and human society. (Cognitive Knowledge Level: Understand)
CO 3	Apply mitigation strategies such as renewable energy, energy efficiency, and carbon management to reduce climate change impacts. (Cognitive Knowledge Level: Apply)
CO 4	Understand adaptation and resilience measures for climate-sensitive sectors like agriculture, water resources, and urban systems. (Cognitive Knowledge Level: Understand)
CO 5	Interpret the principles of sustainability and assess global frameworks and policies related to climate change and sustainable development. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	2	1			2	3	2	1	1	1
CO 2	2	2	3	1	2	2	2	1	1	1	1
CO 3	2	3	2	2	1	2	3	2	1	1	2
CO 4	2	2	2	1	1	2	3	2	1	1	2
CO 5	2	2	3	2	2	2	3	2	1	1	2

Assessment Pattern

CLIMATE CHANGE AND SUSTAINABILITY			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	20	20	20
Understand	50	50	50
Apply	30	30	30
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course Project	: 10 marks
Self Study	: 5 marks

End Semester Examination Pattern

There will be two parts: Part A and Part B. Part A contain 10 questions, with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module, of which students should answer any one. Each question carries 14 marks and can have a maximum of 2 sub-divisions.

SYLLABUS

Module 1: Climate System and Climate Change (7 hours)

Climate and weather, Earth's climate system – Components, Energy balance of the Earth, Factors influencing climate, Greenhouse effect and greenhouse gases, Global warming, Natural climate variability, Anthropogenic drivers of climate change.

Module 2: Impacts of Climate Change (7 hours)

Climate change and hydrological cycle, Impacts on water resources and freshwater availability, Climate change and agriculture, Impacts on forests, ecosystems, biodiversity, Ocean warming and acidification, Climate change and human health, Socio-economic impacts and climate-induced migration.

Module 3: Climate Change Mitigation (7 Hours)

Carbon footprint & Ecological footprint, Renewable energy – sources, energy efficiency, Carbon sequestration and nature-based solutions, Waste Management & Circular economy.

Module 4: Climate Change Adaptation & Resilience (7 Hours)

Climate adaptation and resilience, Difference between mitigation and adaptation, Climate-resilient agriculture and water management, Urban climate adaptation and resilient infrastructure, Disaster risk reduction and early warning systems, Ecosystem-based adaptation, Community-based adaptation strategies.

Module 5: Sustainability & Global Frameworks (8 Hours)

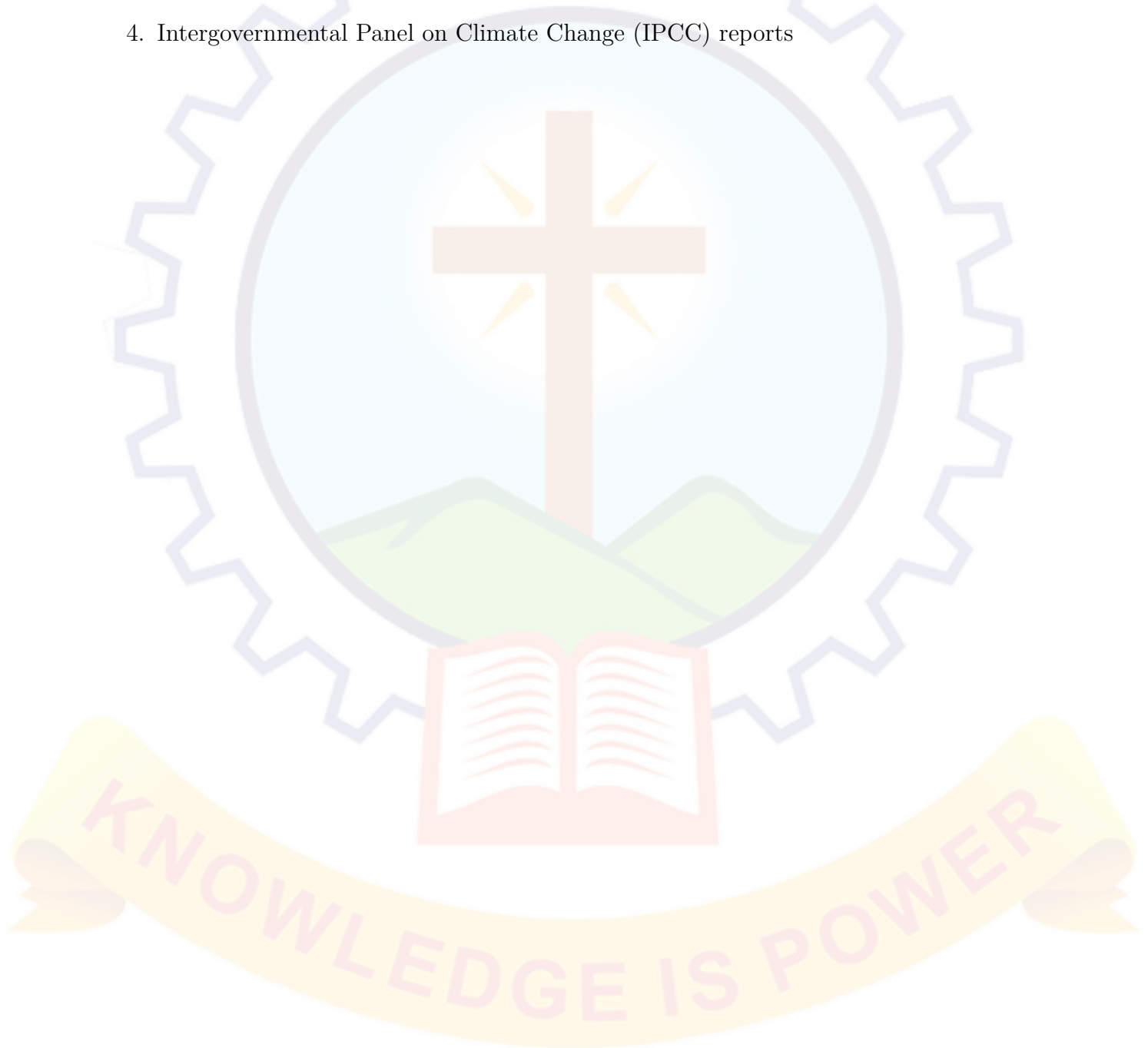
Sustainability - concept and evolution, Pillars of sustainability - environmental, social, economic, Sustainable consumption and production, Sustainable Development Goals (SDGs) – overview and linkages, Climate governance (UNFCCC, IPCC, Paris Agreement), National and international climate policies, National and State Climate Action Plan for India.

Text Books:

1. John T.Hardy, Jean Ponce, "Climate Change-Causes, Effects, and Solutions", Wiley Publications, 2003
2. G. S. Campbell, and J. M. Norman, An Introduction to Environmental Biophysics, Springer, 2013.
3. M. L. Shelton, Hydroclimatology: Perspectives and Applications, Cambridge University Press, 2009.

References:

1. Keith D. Alverson, Zinta Zommers, "Resilience: The science of adaptation to climate change", Elsevier, 201
2. KS. Raju, DN Kumar. Impact of Climate change on water resources –with modeling techniques and case studies. Springer, 2008
3. Leal Filho, W., Azul, A.M., Brandli, L., Özuyar, P.G., Wall, T. (Eds.), "Sustainable Cities and Communities" Springer
4. Intergovernmental Panel on Climate Change (IPCC) reports



COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	7 hours
1.1	Climate and weather	1
1.2	Earth's climate system – Components.	2
1.3	Energy balance of the Earth.	2
1.4	Factors influencing climate - Greenhouse effect and greenhouse gases, Global warming,.	1
1.5	Natural climate variability, Anthropogenic drivers of climate change.	1
2	Module 2	7 hours
2.1	Climate change and hydrological cycle, Impacts on water resources and freshwater availability.	2
2.2	Climate change and agriculture, Impacts on forests, ecosystems, biodiversity.	2
2.3	Ocean warming and acidification.	1
2.4	Climate change and human health.	1
2.5	Socio-economic impacts and climate-induced migration.	1
3	Module 3	7 hours
3.1	Carbon footprint & Ecological footprint.	1
3.2	Renewable energy – sources, energy efficiency.	1
3.3	Carbon sequestration and nature-based solutions.	1
3.4	Waste Management & Circular economy.	2
3.5	Waste minimization and resource efficiency at design stage.	2

4	Module 4	7 hours
4.1	Climate adaptation and resilience.	1
4.2	Difference between mitigation and adaptation.	1
4.3	Climate-resilient agriculture and water management, Urban climate adaptation and resilient infrastructure.	1
4.4	Disaster risk reduction and early warning systems.	2
4.5	Ecosystem-based adaptation, Community-based adaptation strategies.	2
5	Module 5	8 hours
5.1	Sustainability - concept and evolution, Pillars of sustainability - environmental, social, economic.	2
5.2	Sustainable consumption and production, Green buildings and sustainable cities.	2
5.3	Sustainable Development Goals (SDGs) – overview and link-ages.	1
5.4	Climate governance (UNFCCC, IPCC, Paris Agreement).	1
5.5	National and international climate policies, National and State Climate Action Plan for India.	2
Total		36 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Explain the components of the Earth's climate system.
2. Discuss the relationship between greenhouse effect, global warming, and climate change.

Course Outcome 2 (CO 2):

1. Discuss the impacts of climate change on water resources and freshwater availability.
2. Discuss the socio-economic impacts of climate change.

Course Outcome 3 (CO 3):

1. Discuss various renewable energy sources such as solar, wind, hydro, biomass, and geothermal energy.
2. Discuss the role of nature-based solutions in climate change mitigation.

Course Outcome 4 (CO 4):

1. Discuss various strategies for sustainable water management under changing climate conditions.
2. Explain the concept of resilient infrastructure and its role in reducing climate risks in cities.

Course Outcome 5 (CO 5):

1. Explain the three pillars of sustainability and their interdependence with examples.
2. Explain the functions and contributions of IPCC in understanding climate change

MODEL QUESTION PAPER

QP CODE:

Pages: 2

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

FIRST SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CE4G22

CLIMATE CHANGE AND SUSTAINABILITY

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. What is the role of the atmosphere in the climate system?
2. How does carbon dioxide contribute to the greenhouse effect?
3. How does climate change affect crop productivity?
4. List any three impacts of climate change on ecosystems.
5. What are the advantages of renewable energy sources?
6. Define circular economy.
7. List any three major green building rating systems used in India and abroad.
8. Differentiate between climate mitigation and adaptation.
9. Explain the three pillars of sustainability.
10. How do green buildings improve energy efficiency?

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. Describe the Earth's energy balance in detail. Explain incoming solar radiation, reflection, absorption, and outgoing terrestrial radiation with a neat diagram. .

OR

12. Explain the greenhouse effect with a neat diagram. Discuss various greenhouse gases and their contribution to climate change.

MODULE 2

13. Explain the impact of climate change on the hydrological cycle. Discuss changes in precipitation, evaporation, runoff, and groundwater recharge.

OR

14. Explain the effects of climate change on agriculture. Discuss impacts on crop yield, soil moisture, irrigation demand, and food security.

MODULE 3

15. Explain the concept of energy efficiency. Discuss various techniques and measures to improve energy efficiency in industries, buildings, and transportation.

OR

16. What is carbon sequestration? Explain different methods including biological and geological sequestration. Discuss the role of nature-based solutions in climate change mitigation.

MODULE 4

17. Differentiate between climate mitigation and adaptation. Discuss their roles, strategies, and significance in climate change management.

OR

18. Explain how disaster risk reduction, ecosystem-based adaptation, and community participation together enhance climate resilience. (6)

MODULE 5

19. Define sustainability and explain its evolution over time. Discuss the concept of sustainable development with suitable examples.

OR

20. Explain the Sustainable Development Goals (SDGs). Discuss their key features and interlinkages in achieving global sustainability.

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE4G23	INTELLIGENT TRANSPORT SYSTEMS	2	1	0	4	3	2024

Preamble

This course introduces the fundamental concepts and applications of Intelligent Transportation Systems (ITS) for improving the safety, efficiency, and sustainability of transportation networks. It covers system architecture, sensing technologies, traffic management strategies, and emerging mobility solutions such as connected and automated vehicles. The course prepares students to understand and apply technology-driven approaches in modern transportation planning and operations.

Prerequisites: NIL

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Explain the need for Intelligent Transportation Systems (ITS) and describe their applications in smart cities, public transport, and traveler information services to improve mobility and sustainability. (Cognitive Knowledge Level: Understand)
CO 2	Understand basic sensing, communication, and mobility data concepts used in ITS for collecting and managing transportation information. (Cognitive Knowledge Level: Understand)
CO 3	Apply basic mobility analytics and visualization techniques to interpret transportation data and support decision-making. (Cognitive Knowledge Level: Apply)
CO 4	Explain the working principles of connected and intelligent vehicle systems and apply related concepts to understand modern vehicle–infrastructure interactions. (Cognitive Knowledge Level: Understand)
CO 5	Explain policy, sustainability, and emerging technology considerations in ITS and apply these concepts to understand future mobility solutions. (Cognitive Knowledge Level: Understand)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	2	-	-	-	-	-	-	-	-	-
CO2	2	3	1	2	-	-	-	-	-	-	-
CO3	1	2	3	2	2	-	-	-	-	1	-
CO4	1	3	2	3	1	-	-	-	-	1	-
CO5	-	2	3	2	1	3	2	2	-	2	1

Assessment Pattern

INTELLIGENT TRANSPORT SYSTEMS			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	30	30	30
Understand	50	50	50
Apply	20	20	20
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course Project : 10 marks

Self Study : 5 marks

End Semester Examination Pattern

There will be two parts: Part A and Part B. Part A contain 10 questions, with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module, of which students should answer any one. Each question carries 14 marks and can have a maximum of 2 sub-divisions.

SYLLABUS

Module 1: Introduction to Intelligent Transportation Systems (7 hours)

Need for ITS in modern mobility; ITS user services overview; smart city integration; public transport ITS; electronic tolling and parking management; traveler information systems; sustainability and mobility efficiency perspectives.

Module 2: Sensors, Communication and Mobility Data (7 hours)

Traffic sensing technologies; GPS and probe data; mobile and IoT-based data sources; communication basics for ITS; data platforms and databases; privacy and ethical considerations.

Module 3: Mobility Analytics and Decision Support (8 Hours)

Travel time estimation concepts; congestion assessment; introductory forecasting methods; data visualization; performance indicators; decision-support systems in transportation.

Module 4: Connected and Intelligent Vehicles (7 Hours)

Overview of connected vehicle systems; V2V and V2I concepts; telematics and fleet management; automated driving overview; integration with infrastructure.

Module 5: Policy, Sustainability and Future Directions (7 Hours)

Safety, security and equity considerations; environmental impacts; electric mobility integration; Mobility-as-a-Service; artificial intelligence in ITS; future trends and deployment challenges.

Text Books:

1. Chowdhury, M.A. and Sadek, A.W., *Fundamentals of Intelligent Transportation Systems Planning*, 2nd edn., Artech House, 2003.
2. Tyagi, A.K. and Sreenath, N., *Intelligent Transportation Systems: Theory and Practice*, 1st edn., CBS Publishers & Distributors, New Delhi, 2017.

References:

1. Sussman, J.M., *Perspectives on Intelligent Transportation Systems*, Springer, New York, 2005.
2. World Road Association (PIARC), *ITS Handbook*, PIARC, 2015.

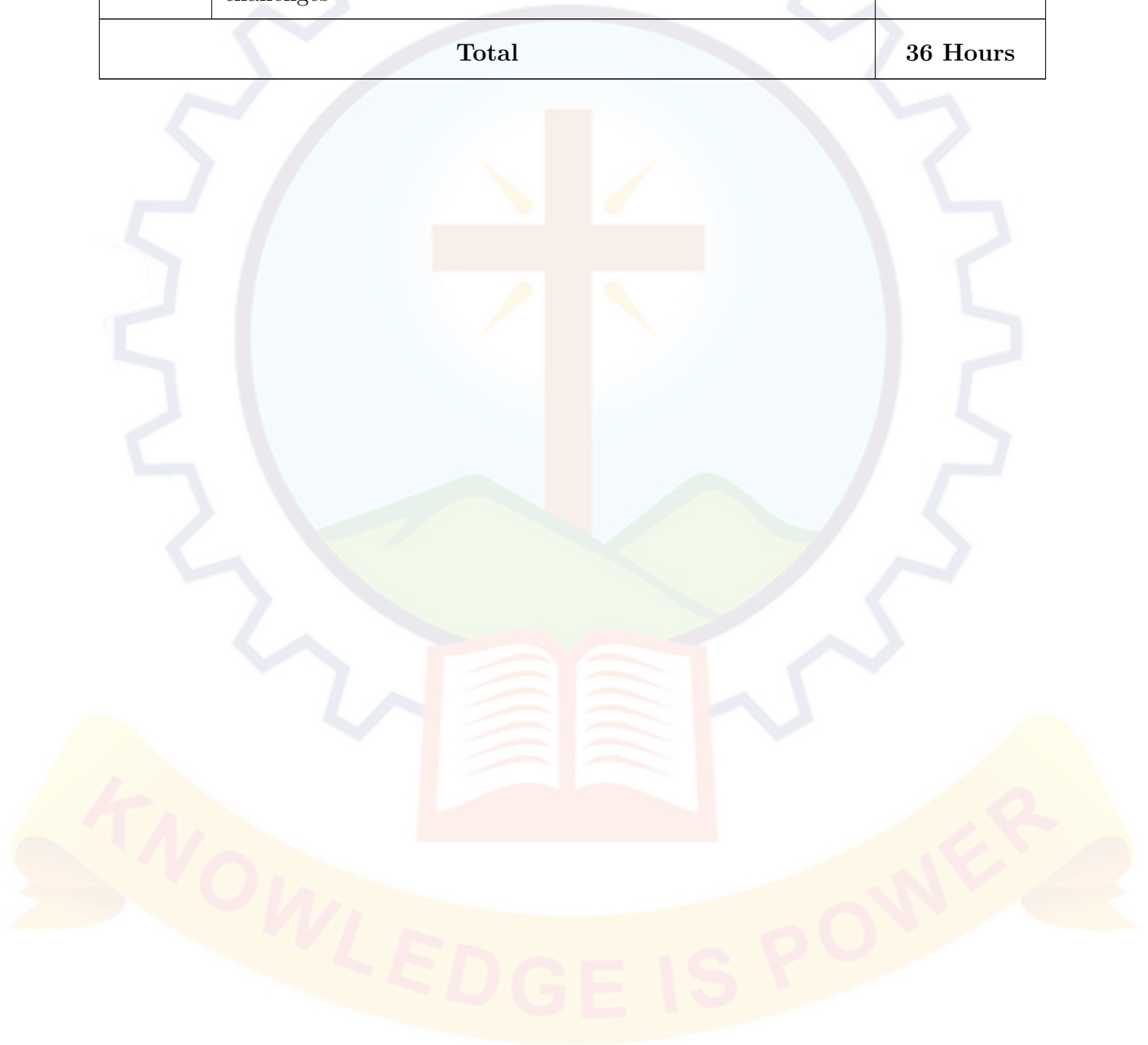
3. Recent survey papers on AI in transportation, *various journals*, 2018–2023.



COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	7 hours
1.1	Need for ITS in modern mobility; ITS user services overview; smart city integration	2
1.2	Public transport ITS; electronic tolling and parking management; traveler information systems	3
1.3	Sustainability and mobility efficiency perspectives.	2
2	Module 2	7 hours
2.1	Traffic sensing technologies; GPS and probe data; mobile and IoT-based data sources	3
2.2	Communication basics for ITS; data platforms and databases	2
2.3	Privacy and ethical considerations	2
3	Module 3	8 hours
3.1	Travel time estimation concepts ; Congestion assessment	2
3.2	Introductory forecasting methods; data visualization	4
3.3	Performance indicators; decision-support systems in transportation.	2
4	Module 4	7 hours
4.1	Overview of connected vehicle systems; V2V and V2I concepts; automated driving overview; integration with infrastructure	4
4.2	Telematics and fleet management	3
5	Module 5	7 hours

5.1	Safety, security and equity considerations; environmental impacts;electric mobility integration	4
5.2	Mobility-as-a-Service	1
5.3	Artificial intelligence in ITS; future trends and deployment challenges	2
Total		36 Hours



CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

4. State the need for Intelligent Transportation Systems (ITS) in modern mobility.
5. What are ITS user services? List any four examples related to urban transportation.
6. Explain the need for Intelligent Transportation Systems (ITS) in modern transportation systems.

Course Outcome 2 (CO 2):

1. List the major traffic sensing technologies used in Intelligent Transportation Systems.
2. What are IoT-based data sources in ITS? Give two examples.
3. Discuss the structure and functions of data platforms and databases used in ITS.

Course Outcome 3 (CO 3):

1. Define decision-support systems (DSS) in transportation. State their primary purpose.
2. Explain the importance of data visualization in interpreting traffic and mobility data.
3. Discuss commonly used performance indicators for evaluating traffic conditions.

Course Outcome 4 (CO 4):

1. What are connected vehicle systems? State their main objective.
2. List any two applications of telematics in fleet management.
3. Define Vehicle-to-Vehicle (V2V) and Vehicle-to-Infrastructure (V2I) communication.

Course Outcome 5 (CO 5):

1. List the key safety and security considerations associated with Intelligent Transportation Systems (ITS)
2. What is electric mobility integration?
3. Explain the concept of Mobility-as-a-Service (MaaS) and electric mobility integration. Discuss their role in achieving sustainable and efficient urban mobility.

MODEL QUESTION PAPER

QP CODE:

Pages: 3

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

SEVENTH SEMESTER B TECH DEGREE EXAMINATION, 2024

Course Code: B24CE4G23

INTELLIGENT TRANSPORT SYSTEMS

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. What is electronic tolling? State its advantages over manual toll collection.
2. List any four ITS applications used in public transport systems.
3. What is GPS-based probe data? State two advantages of using probe data in traffic monitoring.
4. State any three privacy and ethical considerations associated with traffic data collection.
5. What is congestion assessment? State any two indicators used to measure congestion.
6. List two commonly used methods for estimating travel time.
7. What are connected vehicle systems? State their main objective.
8. List any four components of infrastructure required for supporting automated driving systems.
9. What is Mobility-as-a-Service (MaaS)? State its main features.
10. Mention two benefits of integrating electric vehicles into transportation systems.

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. Describe traveler information systems and their role in enhancing sustainability and mobility efficiency in urban transport systems.

OR

12. Explain ITS applications in public transport, electronic tolling, and parking management systems.

MODULE 2

13. Discuss the role of GPS and probe vehicle data in traffic data collection and monitoring.

OR

14. a) Discuss the structure and functions of data platforms and databases used in ITS. (8)
b) Explain various traffic sensing technologies used in ITS. (6)

MODULE 3

15. What is data visualization? Mention two tools or techniques used for visualizing transportation data.

OR

16. Discuss the role of decision-support systems (DSS) in transportation management. Explain how performance indicators and forecasting techniques assist in effective decision-making.

MODULE 4

17. Explain how automated vehicles are integrated with roadway infrastructure to improve transportation efficiency and safety.

OR

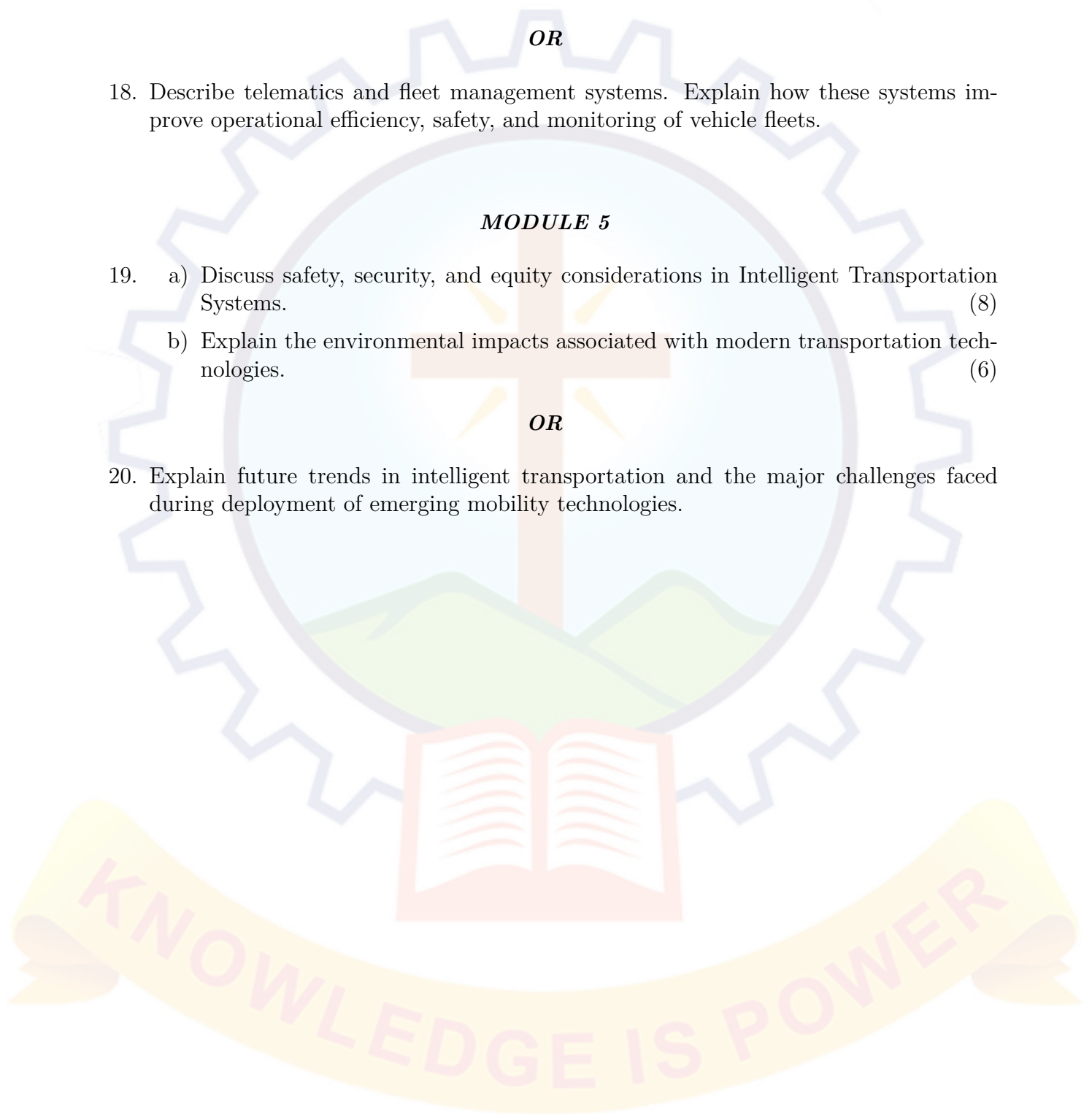
18. Describe telematics and fleet management systems. Explain how these systems improve operational efficiency, safety, and monitoring of vehicle fleets.

MODULE 5

19. a) Discuss safety, security, and equity considerations in Intelligent Transportation Systems. (8)
b) Explain the environmental impacts associated with modern transportation technologies. (6)

OR

20. Explain future trends in intelligent transportation and the major challenges faced during deployment of emerging mobility technologies.



CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24HU4T04	DISASTER MANAGEMENT AND INDUSTRIAL SAFETY	2	1	0	4	3	2024

Preamble

This course explains how disasters happen and how to reduce risk through planning, preparedness, response, and recovery. It also covers industrial safety—identifying hazards, using basic assessment tools, and applying safety rules to prevent accidents.

Prerequisites: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Understand the fundamental concepts, classifications, and phases of the disaster management cycle and their impacts on society. (Cognitive Knowledge Level: Understand)
CO 2	Apply remote sensing resolutions and risk analysis concepts to identify and predict hazards at various administrative levels. (Cognitive Knowledge Level: Apply)
CO 3	Utilize hazard identification techniques like HAZOP and FMEA to assess industrial risks and causation theories. (Cognitive Knowledge Level: Apply)
CO 4	Analyze industrial safety standards, fire safety protocols, and statutory provisions like the Factories Act and OSHA.(Cognitive Knowledge Level: Analyse)
CO 5	Evaluate ethical responsibilities and lessons from historical case studies to develop sustainable disaster prevention strategies. (Cognitive Knowledge Level: Evaluate)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	2	2	1			3					1
CO 2	3	3	2	2	3	1					1
CO 3	3	3	3	2	2	2	1	2			1
CO 4			1			3	2	2	3	2	1
CO 5	1	2	2	1		3	3		2		2

Assessment Pattern

DISASTER MANAGEMENT AND INDUSTRIAL SAFETY			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	20	10	10
Understand	30	20	20
Apply	30	25	25
Analyse	20	25	20
Evaluate		20	15
Create			10

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course Project : 10 marks

Self-Learning : 5 marks

End Semester Examination Pattern

There will be two parts: Part A and Part B. Part A contain 10 questions, with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module, of which students should answer any one. Each question carries 14 marks and can have a maximum of 2 sub-divisions.

SYLLABUS

Module 1: Introduction to Disaster Management (8 hours)

Disaster: definition, scope, and importance. Classification of disasters: natural and man-made. Natural disasters: earthquake, flood, cyclone, drought, landslide, tsunami – causes and effects. Man-made disasters: industrial accidents, chemical disasters, nuclear disasters, fire hazards – Impacts of disasters on human life, infrastructure, economy, and environment. Disaster management cycle: prevention, mitigation, preparedness, response, recovery.

Module 2: Disaster Preparedness, Mitigation, and Response (8 hours)

Disaster risk reduction concepts. Hazard, vulnerability, and risk analysis. Disaster preparedness planning at community, district, state, and national levels. Early warning systems and forecasting methods. Emergency response planning, evacuation procedures, and shelter management. Role of government agencies (NDMA, SDMA, DDMA).

Module 3: Industrial Safety and Hazard Identification (7 Hours)

Introduction to industrial safety and accident prevention. Types of industrial hazards: mechanical, electrical, chemical, biological, radiation, ergonomic. Causes of industrial accidents and accident causation theories. Hazard identification techniques: HAZOP, FMEA. Safety management systems and safety culture. Risk assessment and control measures.

Module 4: Industrial Safety Practices and Legislation (7 Hours)

Safety legislation and statutory provisions – Hearing Conservation Programme: Principles, implementation and monitoring. Fire safety: causes of fire, fire prevention, detection, and fire-fighting systems – Electrical safety and machine guarding – Personal Protective Equipment (PPE): types, selection, and usage.

Module 5: Environmental Safety, Case Studies (6 Hours)

Environmental pollution due to industrial activities – Solid, liquid, and hazardous waste management – Sustainable industrial safety practices – Case studies: Bhopal Gas Tragedy, Chernobyl Nuclear Disaster, Fukushima Disaster – Lessons learned and preventive strategies.

Text Books:

1. Disaster Management — Harsh K. Gupta. Universities Press (Orient Black swan), 2003. ISBN: 9788173714566.
2. Remote Sensing of the Environment: An Earth Resource Perspective — John R. Jensen. 2nd Edition, Pearson Prentice Hall, Upper Saddle River, NJ, 2007. ISBN: 9780131889507.
3. Fundamentals of Industrial Safety and Health (Vol. 1 & 2) — K. U. Mistry. 4th Edition, Siddharth, 2022.

References:

1. Harsh K. Gupta, “Disaster Management”, Universities Press.
2. Thomas M. Lillesand, Ralph W. Kiefer, Jonathan W. Chipman, “Remote Sensing and Image Interpretation”, Wiley.
3. R. K. Jain, Sunil S. Rao, “Industrial Safety, Health and Environment Management Systems”, Khanna Publishers.
4. Roger L. Brauer, “Safety and Health for Engineers”, Wiley.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	8 hours
1.1	Disaster: definition, scope, and importance. Classification of disasters: natural and man-made. Natural disasters: earthquake, flood, cyclone, drought, landslide, tsunami – causes and effects.	2
1.2	Man-made disasters: industrial accidents, chemical disasters, nuclear disasters, fire hazards.	2
1.3	Impacts of disasters on human life, infrastructure, economy, and environment.	2
1.4	Disaster management cycle: prevention, mitigation, preparedness, response, recovery.	2
2	Module 2	8 hours
2.1	Disaster risk reduction concepts. Hazard, vulnerability, and risk analysis.	2
2.2	Disaster preparedness planning at community, district, state, and national levels.	2
2.3	Early warning systems and forecasting methods.	2
2.4	Emergency response planning, evacuation procedures, and shelter management.	1
2.5	Role of government agencies (NDMA, SDMA, DDMA).	1
3	Module 3	7 hours
3.1	Introduction to industrial safety and accident prevention. Types of industrial hazards: mechanical, electrical, chemical, biological, radiation, ergonomic.	2
3.2	Causes of industrial accidents and accident causation theories.	1

3.3	Hazard identification techniques: HAZOP, FMEA, Fault Tree Analysis.	2
3.4	Safety management systems and safety culture. Risk assessment and control measures.	2
4	Module 4	7 hours
4.1	Safety Legislation & Statutory Provisions Hearing Conservation Programme	2
4.2	Fire Safety Fundamentals.	1
4.3	Fire-Fighting Systems and Electrical Safety	2
4.4	Machine Guarding & Personal Protective Equipment (PPE)	2
5	Module 5	6 hours
5.1	Environmental pollution due to industrial activities – Solid, liquid, and hazardous waste management.	1
5.2	Sustainable industrial safety practices – Ethical responsibilities of engineers in disaster prevention and industrial safety.	2
5.3	Case studies: Bhopal Gas Tragedy, Chernobyl Nuclear Disaster, Fukushima Disaster.	2
5.4	Lessons learned and preventive strategies.	1
Total		36 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Define “disaster” and classify disasters into natural and man-made categories. Explain with suitable examples relevant to civil infrastructure.
2. Explain the Disaster Management Cycle (DMC) and discuss how each phase (prevention, mitigation, preparedness, response, recovery) reduces impacts on human life, infrastructure, economy, and environment.

Course Outcome 2 (CO 2):

1. A district experiences repeated flooding. Using the concept $\text{Risk} = \text{Hazard} \times \text{Vulnerability}$, explain how you would identify high-risk zones and prioritize mitigation measures at community and district levels.
2. Explain spatial, spectral, temporal, and radiometric resolutions in remote sensing. For each, mention one disaster-management application (flood/cyclone/landslide monitoring).

Course Outcome 3 (CO 3):

1. In a chemical storage facility, outline the steps to perform a HAZOP study and demonstrate how deviations (e.g., “more pressure”, “less flow”) can lead to accident scenarios.
2. Perform an FMEA framework for an industrial system (any one: boiler, conveyor belt, electrical panel, solvent storage tank): identify failure modes, effects, severity/occurrence/detection, and suggest controls.

Course Outcome 4 (CO 4):

1. Discuss key provisions of the Factories Act related to safety, health, and welfare. Explain how statutory compliance improves industrial safety performance.
2. For an industrial workshop/lab building, prepare a fire safety and electrical safety plan covering fire triangle, detection & suppression systems, safe evacuation, LOTO concept, and machine guarding.

Course Outcome 5 (CO 5):

1. Compare the engineering and governance lessons learned from any two case studies: Bhopal Gas Tragedy, Chernobyl, Fukushima. Focus on root causes, systemic failures, and preventable gaps.
2. As a consulting engineer, propose a sustainable disaster prevention strategy for an industrial township (or campus): include ethical responsibilities, waste/pollution control, emergency preparedness, and “build back better” principles.

MODEL QUESTION PAPER

QP CODE:

Pages: 3

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

SEVENTH SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24HU4T04

DISASTER MANAGEMENT AND INDUSTRIAL SAFETY

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Define disaster and explain the scope and importance of disaster management.
2. Classify disasters into natural and man-made and list any three examples of each.
3. Define hazard, vulnerability, and risk and write the relation between them.
4. List the roles of NDMA, SDMA, and DDMA in disaster preparedness and response.
5. List any six industrial hazards and give one example for each (mechanical/electrical/chemical etc.).
6. Differentiate HAZOP and FMEA (any three points).
7. State any three key safety provisions of the Factories Act related to health and welfare.
8. Explain the fire triangle and list any three fire prevention measures in industries.
9. List types of industrial wastes (solid/liquid/hazardous) and mention one safe disposal method for each.
10. Write any three ethical responsibilities of engineers in disaster prevention and industrial safety.

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. a) Explain the causes and effects of any two natural disasters.
b) Explain the Disaster Management Cycle and describe how each phase reduces impacts.

OR

12. a) Explain man-made disasters with reference to industrial accidents/chemical/nuclear/fire hazards—causes and impacts.
b) Explain spatial, spectral, temporal, and radiometric resolutions and mention one application of each in disaster studies..

MODULE 2

13. a) Explain Disaster Risk Reduction (DRR) and describe risk analysis using hazard–vulnerability concepts.
b) Prepare a community-level disaster preparedness plan (key components and steps).

OR

14. a) Explain early warning systems and forecasting methods for any one hazard.
b) Describe evacuation procedures and shelter management for a district-level emergency.

MODULE 3

15. a) Explain accident causation theories and discuss common causes of industrial accidents.
b) Explain safety management system and elements of safety culture with suitable measures.

OR

16. a) Conduct a HAZOP outline for a chemical storage/processing unit: nodes, deviations, causes, consequences, safeguards.
b) Prepare an FMEA for an industrial system (any one: electrical panel/boiler/conveyor/solvent tank): failure modes, effects, and controls.

MODULE 4

17. a) Discuss major Factories Act provisions for safety, health, and welfare with examples.
b) Explain OSHA principles and how they improve workplace safety performance.

OR

18. a) Explain fire detection and fire-fighting systems (alarms, extinguishers, hydrants/sprinklers) and a basic emergency plan.
b) Explain electrical safety and machine guarding, and discuss PPE types, selection, and correct usage.

MODULE 5

19. a) Explain industrial pollution pathways and describe solid, liquid and hazardous waste management practices.
b) Explain sustainable industrial safety practices and the ethical role of engineers in prevention.

OR

20. a) Write a case study on Bhopal / Chernobyl / Fukushima (any one): causes, failures, impacts.
b) List lessons learned and preventive strategies (engineering + management) to avoid recurrence and support “build back better”.

KNOWLEDGE IS POWER

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE4L11	ENVIRONMENTAL ENGINEERING LABORATORY	0	0	3	2	3	2024

Preamble

This laboratory course is designed to provide students with practical exposure to the analysis of water and wastewater quality parameters commonly used in environmental engineering practice. The experiments focus on the determination of important physical, chemical, and biological characteristics of water such as pH, alkalinity, hardness, turbidity, dissolved oxygen, biochemical oxygen demand (BOD), and chemical oxygen demand (COD). Students will gain hands-on experience in sampling, analytical procedures, interpretation of results, and comparison with water quality standards. The course enhances the understanding of water quality assessment and supports the theoretical concepts learned in water supply and wastewater engineering.

Prerequisites: B24CE3T05 Environmental Engineering

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Perform laboratory tests to determine basic physical and chemical parameters of water and wastewater.
CO 2	Analyse water quality parameters such as alkalinity, hardness, chlorides, turbidity, and conductivity using standard methods.
CO 3	Evaluate pollution indicators such as dissolved oxygen, BOD, COD, and solids in water samples.
CO 4	Conduct treatment-related tests such as coagulant dosage determination and residual chlorine analysis.
CO 5	Interpret laboratory results and assess water quality with reference to standard guidelines.

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	2	-	3	2	-	-	-	1	-	-
CO 2	3	3	-	3	2	-	-	-	1	-	-
CO 3	3	3	-	3	2	2	2	-	-	-	-
CO 4	3	2	2	3	2	-	-	-	-	-	-
CO 5	3	3	-	3	-	2	2	-	-	1	1

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance 10 marks

Continuous Assessment 10 marks

Viva-Voce (Self Study) 10 marks

Test 15 marks

Lab Record 5 marks

Note:

Marks shall not be awarded for the Lab Record in the End Semester Examination. However, students having a certified Lab Record are only eligible to appear for the End Semester Examination. A weightage of 30% of the total marks shall be given for the Viva-Voce in the End Semester Examination.

End Semester Examination (ESE) Pattern

The following guidelines should be followed regarding the award of marks:

Preliminary work : 20 marks

Implementation / Conducting the experiment : 20 marks

Performance, result and inference : 30 marks

Viva voce : 30 marks

SYLLABUS

Course Content and Practical Schedule List of Experiments

No	Topic
1	Determination of pH
2	Determination of electrical conductivity
3	Determination of alkalinity
4	Determination of Hardness
5	Determination of acidity
6	Determination of Turbidity
7	Determination of Chlorides
8	Determination of Dissolved Oxygen
9	Determination of BOD
10	Determination of COD
11	Determination of Optimum Coagulant Dosage
12	Determination of Total Iron
13	Determination of Residual chlorine
14	Determination of Solids
15	Determination of Total coliform

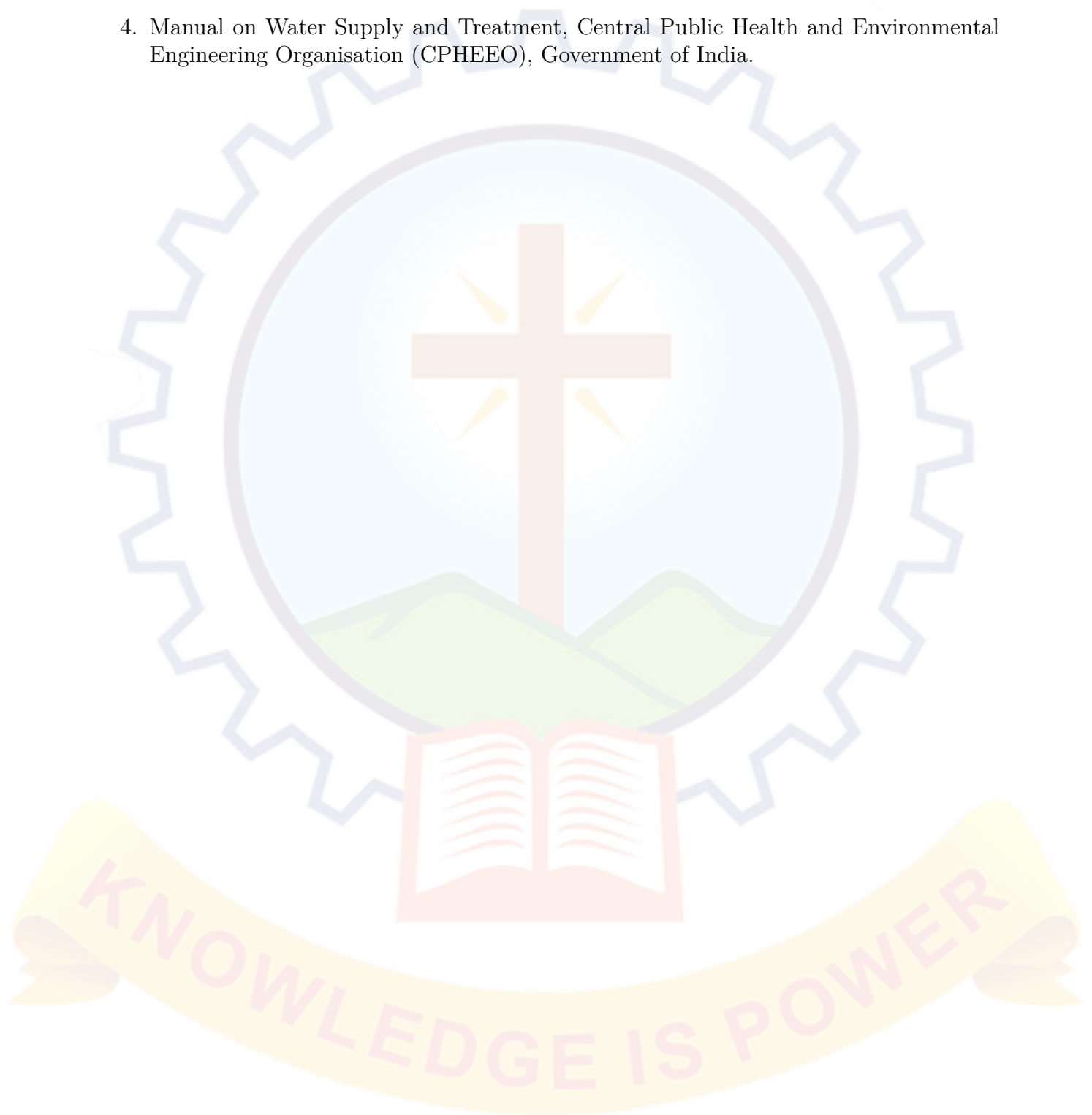
Textbooks

1. Standard Methods for the Examination of Water and Wastewater, APHA, AWWA, WEF, 23rd Edition.
2. S.K. Garg, Environmental Engineering (Vol. I – Water Supply Engineering), Khanna Publishers.

References

1. Metcalf & Eddy, Wastewater Engineering: Treatment and Resource Recovery, McGraw Hill Education.

2. Peavy, Row and Tchobanoglous, Environmental Engineering, McGraw Hill.
3. Sawyer, McCarty and Parkin, Chemistry for Environmental Engineering and Science, McGraw Hill.
4. Manual on Water Supply and Treatment, Central Public Health and Environmental Engineering Organisation (CPHEEO), Government of India.



CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE4L12	PROJECT PHASE I	0	0	6	2	3	2024

Preamble

The course 'Project Work' is mainly intended to evoke innovation and invention skills in students. It provides an opportunity to synthesize and apply knowledge and analytical skills to develop a prototype or simulation. Projects should be finalized in thrust areas of the engineering stream or as interdisciplinary efforts, with importance given to addressing societal problems, developing indigenous technologies, and aligning with sustainable development.

Course Objectives

- To apply engineering knowledge in practical problem-solving.
- To foster innovation in design of products, processes, or systems with consideration for sustainability.
- To develop creative thinking in finding viable, ethical, and socially relevant solutions to engineering problems.

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Apply engineering knowledge across domains to model, analyze, and solve real-world problems through practical design, simulation, or prototyping. (Apply)
CO 2	Develop innovative, sustainable, and socially relevant products, processes, or systems, addressing technology/research gaps while considering ethical, environmental, and SDG-aligned aspects. (Apply / Create)
CO 3	Function effectively as an individual and as a leader/member in diverse teams, demonstrating responsibility, collaboration, and task execution in multidisciplinary settings. (Apply)
CO 4	Plan, schedule, and execute project tasks efficiently using available resources, within timelines, while adhering to ethical, professional, and budgetary norms. (Apply)
CO 5	Identify gaps through literature review and propose creative solutions; organize and communicate technical findings effectively in written reports and oral presentations. (Analyze / Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	3	2	2	2	1		1			1
CO 2	2	2	3	1	1	2	3	2	1	1	2
CO 3						3	2	3	2	2	1
CO 4	1	1	1		2	1	1	2	3	3	3
CO 5	2	3	2	2	2	1	1	1	2	3	2

SDG Relevance — Projects should align with UN SDGs (e.g., SDG 9 for innovation/infrastructure, SDG 7/13 for clean energy/climate, SDG 11 for sustainable communities, SDG 3/6 for health/water, etc.), especially in CO2 and problem definition.

Phase 1 Targets (unchanged core, minor emphasis on sustainability/ethics):

- Literature study/survey.
- Formulation of objectives.
- Formulation of hypothesis/design/methodology.
- Work plan and task allocation.
- Block-level design documentation.
- Seeking project funds.
- Preliminary analysis/modeling/simulation/experiment/design/feasibility study/prototype.
- Preparation of Phase 1 report.

Evaluation Guidelines & Rubrics Total: **100 marks** (Minimum to pass: 50).

- Project progress evaluation by guide: 30 Marks.
- Interim evaluation by Evaluation Committee: 30 Marks.
- Final Evaluation by Evaluation Committee: 30 Marks.
- Project Phase-I Report (by Evaluation Committee): 10 Marks.

(The Evaluation Committee comprises HoD/Senior faculty, Project Coordinator, and Supervisor.)

Evaluation by the Guide (30 Marks)

Sl. No.	Parameters	Marks	Poor (0–3)	Fair (4–6)	Very Good (7–9)	Outstanding (10)
1-a	Topic identification, selection, formulation of objectives and/or literature survey (Group) [CO1/CO5]	15	Failed to identify relevant topic timely; no literature; no objectives clarity.	Identified topic but lacks originality/substance; limited references.	Good brainstorming; relevant topic; good literature; objectives mostly clear.	Highly relevant/innovative topic; excellent survey; clear, feasible objectives; strong societal/SDG relevance.
1-b	Project Planning, Scheduling, Resource/Tasks Identification & Allocation (Group) [CO4]	15	No evidence of planning/scheduling/budget; poor task allocation.	Some primary plan; incomplete schedules/journal.	Good planning; schedules prepared; better allocation.	Excellent planning; Gantt charts/modern tools; detailed budget; well-kept journal; clear individual tasks.

Interim Evaluation (30 Marks - Group mostly)

Sl. No.	Parameters	Marks	Poor (0–3)	Fair (4–6)	Very Good (7–9)	Outstanding (10)
1-a	Topic identification, selection, formulation of objectives and/or literature survey (Group) [CO1/CO5]	15	Failed to identify relevant topic timely; no literature; no objectives clarity.	Identified topic but lacks originality/substance; limited references.	Good brainstorming; relevant topic; good literature; objectives mostly clear.	Highly relevant/innovative topic; excellent survey; clear, feasible objectives; strong societal/SDG relevance.
1-b	Project Planning, Scheduling, Resource/Tasks Identification & Allocation (Group) [CO4]	15	No evidence of planning/scheduling/budget; poor task allocation.	Some primary plan; incomplete schedules/journal.	Good planning; schedules prepared; better allocation.	Excellent planning; Gantt charts/modern tools; detailed budget; well-kept journal; clear individual tasks.

Final Evaluation (30 Marks - Mix of Group & Individual)

Sl. No.	Parameters	Marks	Poor (0–3)	Fair (4–6)	Very Good (7–9)	Outstanding (10)
1-c	Formulation of Design/ Methodology and Progress (Group) [CO1]	5	No evidence/ knowledge of design/ methodology; no progress.	Some knowledge; limited progress.	Comfortable with methods; good progress.	Clear/ well-defined methodology; excellent adherence/ progress.
1-d	Individual & Teamwork Leadership (Individual) [CO3]	10	Passive/ no interest.	Some interest (superficial).	Good interest/ responsibility/ team support.	Leadership; clear evidence of leading/ supporting team.
1-e	Preliminary Analysis/ Modeling/ Simulation/ Experiment/ Design/ Feasibility (Group) [CO1/ CO2]	10	No preliminary work.	Started but not thorough.	Good evidence; can improve.	Strong/ excellent work; poised for strong completion; shows innovation/ sustainability aspects.
1-f	Documentation & Presentation (Group/ Individual) [CO5]	5	Poor/ no documentation/ presentation.	Some but incomplete.	Good; needs improvement.	Professional (e.g., LaTeX); excellent structure/ presentation; clear communication of findings.

Project Phase-I Report (10 marks)

Sl. No.	Parameters	Marks	Poor (0–3)	Fair (4–6)	Very Good (7–9)	Outstanding (10)
1-g	Report [CO5]	10	Shallow; no standard format; poor organization & references.	Follows format partially; some organization issues; few references cited.	Good organization; standard format; most references cited properly.	Exceptionally organized; professional format; all references/diagrams properly cited & presented; effective communication of technical content.

General guidelines

- Team size: Preferably 4 members (Maximum 5 members) (Preferably from same batch unless for interdisciplinary projects).
- For the project, identify one base paper publication. It should be from IEEE, Elsevier, ACM journal, Science Citation Index (SCI) journal or a good Scopus Indexed journal. Conference papers are not permitted. Only recently published papers are allowed.
- For the literature survey at least 10 publications are to be reviewed.
- Try to get funding from agencies like KSCSTE, CERD, etc. Projects that can benefit society have more probability of attracting funding and prizes.
- Every student must keep their own project diary. It should be a in the prescribed format. Record all details related to the project with dates. Every week, you must show the project diary to your project guide and get a signature (Or email approval if classes are handled in online mode). You will be asked to submit the project diaries periodically.
- At the end of the Seventh semester, a project report has to be prepared in the prescribed format.
- Proceed with project work, keeping in mind that preferably you need to publish one paper during the eighth semester.

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE4L13	SEMINAR	0	0	4	1	2	2024

Preamble

The course 'Seminar' enables B.Tech graduates to search, read, comprehend, present, and report on academic/technical documents (e.g., peer-reviewed journals, conferences, books, theses, project reports). Students select a topic/paper in consultation with their guide, preferably linked to their final-year project area or emerging technologies with relevance to sustainable development. This fosters literature survey skills, presentation abilities, technical reporting, and awareness of broader societal/environmental impacts (aligned with SDGs like SDG 4: Quality Education, SDG 9: Industry/Innovation/Infrastructure, and SDG 13: Climate Action where applicable).

Course Objectives

- Conduct literature survey in a selected engineering area of interest.
- Understand and analyze academic/technical documents from peer-reviewed sources.
- Prepare and deliver an effective presentation on the selected document/topic.
- Prepare a comprehensive technical report with accurate references and consideration for sustainability/ethics where relevant.

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Identify and select relevant academic documents from literature in their area of interest (Cognitive level: Apply).
CO 2	Read, comprehend, and analyze an academic document/technical paper related to their area of interest (Cognitive level: Analyze).
CO 3	Prepare a structured presentation on the selected academic document (Cognitive level: Create).
CO 4	Deliver an effective presentation and engage in discussions/Q& A on the academic document (Cognitive level: Apply).
CO 5	Prepare a well-structured technical report with proper references, formatting, and consideration for societal/sustainable aspects where applicable (Cognitive level: Create).

Mapping of Course OutcomesProgram Outcomes (NBA 11 POs, GAPC V4.0):

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	2	2	1	1	-	2	1	-	-	-	3
CO 2	3	3	2	3	-	2	1	-	-	-	3
CO 3	3	2	2	-	3	-	-	1	-	2	3
CO 4	3	-	-	-	2	-	-	1	-	3	3
CO 5	3	3	2	2	2	2	2	2	-	3	3

General Guidelines

- Department forms Internal Evaluation Committee (IEC): Academic coordinator (Chair-person), Seminar coordinator, and guide(s) as members. All IEC members present during presentations.
- IEC formation and guide allotment within one week after previous semester exams/end.
- Guide assists in topic/paper selection (current, broad-based; preferably linked to final-year project; consider SDG relevance where possible).
- Student selects topic/paper during semester break; finalize/submit to IEC in Week 1; IEC approves by Week 2.
- Accurate references from genuine peer-reviewed sources required (verified in report).
- Maintain seminar diary for weekly progress monitoring by guide.

Evaluation Pattern

Total marks: 100 (CIE only, minimum required to pass: 50)

1. Seminar Guide: 20 marks

- Background Knowledge (10 marks): Assessed by the guide based on the student's depth of understanding demonstrated during weekly interactions, discussions, and diary entries.
- Relevance of Topic/Paper Selected (10 marks): Alignment with discipline, currency, breadth, linkage to final-year project/SDGs (if applicable), and justification.

Rubric for Background Knowledge (10 marks) – Guide awards holistically or averages sub-criteria.

Level	Score	Descriptor
Excellent	9–10	Demonstrates exceptional grasp; explains concepts deeply, handles advanced questions confidently, shows critical insight beyond the paper.
Good	7–8	Solid understanding; explains key ideas clearly, answers most questions accurately, shows good analysis.
Satisfactory	5–6	Basic understanding; explains main points but with gaps, answers simple questions, limited depth.
Unsatisfactory	0–4	Poor/limited knowledge; struggles to explain basics, major misconceptions evident.

Rubric for Relevance of Topic/Paper (10 marks)

Level	Score	Descriptor
Excellent	9–10	Highly relevant, current/emerging topic; strong linkage to discipline/project/SDG; broad yet focused; peer-reviewed sources premium.
Good	7–8	Relevant and current; good project/SDG linkage; appropriate breadth.
Satisfactory	5–6	Moderately relevant; some linkage but narrow/specific or outdated.
Unsatisfactory	0–4	Low relevance; no clear linkage, outdated, or non-peer-reviewed dominant.

2. Seminar Coordinator: 20 marks

- Seminar Diary (10 marks): Weekly progress entries, guide approvals, regularity.
- Attendance (10 marks)

Rubric for Seminar Diary (10 marks)

Level	Score	Descriptor
Excellent	9–10	Complete, detailed weekly entries; clear progress milestones; insightful reflections; all approvals timely.
Good	7–8	Regular entries with good detail; most milestones tracked; approvals mostly on time.
Satisfactory	5–6	Basic entries; some gaps in detail/progress; approvals irregular.
Unsatisfactory	0–4	Incomplete/sparse entries; major gaps; few approvals.

3. Presentation: 40 marks (Awarded by IEC – all members)

Analytic rubric applied during the presentation session.

Criterion	Weight	Excellent (4)- Full marks scaled	Good (3)	Satisfactory (2)	Unsatisfactory (1)
Clarity of Presentation (Structure, flow, delivery, time management)	10	Exceptionally clear, logical flow, excellent delivery, perfect timing (within limits $\pm 10\%$).	Clear and well-structured, good delivery, minor timing issues.	Moderately clear, some disorganization, delivery fair, timing off.	Unclear, poor flow, mumbled delivery, major timing overrun/underrun.
Interactions / Q&A (Ability to answer questions, defend concepts, depth)	10	Confident, accurate, insightful answers; handles complex questions effectively.	Good answers to most questions; some depth shown.	Basic answers; struggles with follow-ups.	Poor/ inaccurate answers; unable to defend key points.
Overall Participation (Involvement in peers' sessions – questions asked, feedback given)	10	Highly active; insightful questions/ feedback in most sessions.	Active; contributes meaningfully in several sessions.	Minimal participation; occasional questions.	Little/no involvement in others' sessions.
Quality of Slides (Visual appeal, content organization, technical accuracy, references, minimal text)	10	Outstanding design; error-free, well-organized, excellent visuals/ references.	Good design; minor errors, clear organization.	Adequate but cluttered/ average visuals.	Poor design; many errors, overcrowded, missing references.

4. Report: 20 marks (Awarded by IEC)

Analytic rubric for the final technical report.

Criterion	Weight	Excellent (4)- Full marks scaled	Good (3)	Satisfactory (2)	Unsatisfactory (1)
Technical Content & Depth (Analysis quality, relevance, originality, understanding of paper)	8	In-depth critical analysis; original insights; excellent synthesis.	Good analysis; clear understanding; some insights.	Basic summary; limited analysis.	Superficial; major errors/gaps.
Overall Quality & Structure (Formatting, language, grammar, templates followed, logical flow)	5	Professional; flawless language/ structure; adheres to template perfectly.	Good quality; minor errors; logical.	Average; noticeable errors; fair structure.	Poor formatting; many errors; disorganized.
Adequacy of References & Citations (Genuine peer-reviewed sources, proper style e.g. IEEE, in-text & list)	4	Extensive, high-quality sources; perfect citation style.	Adequate relevant sources; minor citation issues.	Basic sources; some citation errors.	Few/poor sources; major citation flaws/ plagiarism risk.
Consideration for Sustainability/ Ethics/ Societal Impact (SDG linkage, ethical aspects, where applicable)	3	Strong, relevant discussion of impacts/ SDGs/ ethics.	Some discussion of broader impacts.	Minimal mention.	No consideration.

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE4T02	Viva-Voce	0	0	0	0	1	2024

Evaluation: 100% Continuous Internal Evaluation (CIE) – No End Semester Examination (ESE). Minimum pass: 50 marks out of 100.

Objective: To evaluate the student's comprehensive understanding of core subjects studied up to 6th semester, ensuring retention, integration, and application of knowledge.

Scope: Questions cover all core/program-specific courses from Semesters 1 to 6 (excluding open/minor electives unless specified). Includes basic to advanced concepts, problem-solving, derivations, applications, and interconnections between subjects.

Conduct: Viva conducted by a panel (Internal examiner from the department, with HoD/senior faculty). Duration: 15–30 minutes per student (individual). May include follow-up questions, blackboard explanations, or simple derivations.

Evaluation Scheme & Rubrics (Total: 100 Marks)

The evaluation is holistic and panel-based. Marks are awarded individually based on performance during the viva.

Parameters	Marks	Poor (0–10)	Fair (11–20)	Good (21–30)	Very Good (31–40)	Outstanding (41–50)
Depth of Subject Knowledge (Core concepts, definitions, laws, theorems, derivations from all major core subjects up to S6)	50	Very limited recall; major gaps in fundamentals; unable to answer basic questions from >50% of core subjects.	Basic recall in some subjects; frequent prompting needed; gaps in key topics from multiple semesters.	Reasonable recall; answers most basic/medium questions correctly; minor gaps but can explain core ideas.	Strong grasp; handles medium- to advanced questions well across most subjects; explains derivations/applications confidently.	Exceptional depth; accurate, quick recall; integrates concepts across subjects; handles advanced questions fluently.
Understanding & Application (Ability to apply concepts, solve problems, explain real - world relevance)	20	No meaningful application; rote answers only; cannot relate concepts or solve basic problems.	Limited application; struggles with simple problems or real - world links.	Fair application; solves basic problems; some understanding of relevance.	Good application; solves medium-level problems; explains practical relevance.	Outstanding application; solves unseen problems creatively; links concepts across domains.
Clarity of Expression & Communication (Verbal clarity, logical flow, use of technical terms, confidence)	15	Poor articulation; unclear/hesitant; incomplete answers or mumbling.	Somewhat clear but disorganized; needs repetition often.	Clear and logical most of the time; minor hesitations.	Fluent, well-structured answers; confident delivery.	Highly articulate, confident, professional; excellent logical flow.
Overall Confidence, Attitude & Responsiveness (Body language, honesty, eagerness to learn)	15	Nervous/unresponsive; defensive or silent on difficult questions.	Somewhat confident but anxious; partial responses.	Generally confident; admits gaps reasonably.	Confident and composed; handles pressure well.	Highly confident, positive attitude; shows strong learning mindset.

Total: 100 Marks

Guidelines for Preparation & Conduct

- Students should revise **all core theory + lab courses** from S1 to S6.

- Focus on fundamentals and advanced topics.
- Viva is usually scheduled in the last 1–2 weeks of the 7th semester.
- No written component; purely oral (may include diagrams/derivations on board).



CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CEM7x	MINOR PROJECT	0	0	3	12	6	2024

Preamble

The course aims to

- Assess students' ability to transform theoretical knowledge into a functional working model.
- Enable experience in organizing and implementing small-scale projects.
- Facilitate design and development of a moderately complex project (hardware or hardware-software combination) with practical, sustainable applications.

Course Plan

In groups of up to 4 students, design and develop a moderately complex system that addresses a real-world need or application (a functional working prototype/model is required). The project must meaningfully incorporate fundamental product design principles, including innovation, reliability, and aesthetics/ergonomics.

Students (in consultation with faculty/advisor):

- Identify topic of interest.
- Conduct literature review and gather information.
- State objectives and develop methodology.
- Perform design/fabrication/coding/programming.
- Demonstrate novelty/results/outputs (with SDG alignment where applicable).

Progress evaluated via minimum two reviews by committee (constituted by HoD). Submit project report at semester end. Demonstrate product against full specifications. Weightage given to innovative concepts, reliability, aesthetics/ergonomics, and societal/SDG relevance.

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Apply acquired knowledge in the selected technology area for project development and implementation. (Apply)
CO 2	Identify, discuss, and justify technical/design aspects of the project systematically. (Analyze)
CO 3	Reproduce, improve, and refine technical aspects for engineering projects. (Apply)
CO 4	Collaborate effectively as a team in technical project development. (Apply)
CO 5	Communicate and report project activities/findings effectively (written/oral). (Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	3	3	2	2	3	1	1	1	1	2
CO 2	3	3	3	2	1	3	1	1	1	2	2
CO 3	3	3	3	2	2	3	1	1	1	1	2
CO 4						1	2	3	2	3	2
CO 5					1	1	1	2	3	2	2

Evaluation Guidelines Total: 150 marks (CIE 75 + ESE 75). Minimum pass as per university norms.

Split-up of CIE (75 Marks)

- Attendance : 10 Marks
- Marks awarded based on guide's evaluation : 15 Marks
- Project Report : 10 Marks
- Evaluation by Committee : 40 Marks

(Committee: 3 members – HoD/senior faculty, Academic coordinator/program coordinator, project guide/coordinator.)

Split-up of ESE (75 Marks)(1-hour duration)

- Level of completion : 10 Marks
- Demonstration of functionality/specifications : 25 Marks

- Project Report : 10 Marks
- Viva-voce : 20 Marks
- Presentation : 10 Marks

Enhanced Rubrics for All Evaluation Components

1. Guide's Evaluation (CIE – 15 Marks) Holistic assessment by guide (regular monitoring, involvement, progress).

Parameters	Marks Allocation (out of 15)	Poor (0–3)	Fair (4–7)	Good (8–11)	Very Good (12–14)	Outstanding (15)
Project Planning, Scheduling & Task Distribution [CO4/ PO8, PO10]	4	No plan/WBS; unbalanced/unclear roles.	Basic plan; skewed distribution.	Reasonable plan/timelines; mostly balanced.	Detailed WBS/timelines; equitable distribution documented.	Comprehensive planning; excellent equitable allocation; strong team coordination.
Technical Progress & Implementation [CO1, CO3 / PO1-PO5]	5	Minimal progress; major gaps in design/fabrication.	Partial implementation; basic functionality.	Good progress; most objectives met partially.	Strong implementation; refined technical aspects.	Excellent execution; innovative/refined design with SDG relevance.
Individual & Team Involvement [CO4 / PO8]	3	Low/ no participation by some members.	Uneven contribution.	Good involvement; fair equity.	Consistent active participation.	Outstanding collaboration; leadership evident.
Documentation & Regular Reviews [CO5 / PO9, PO11]	3	Poor/irregular records; no updates.	Basic records; inconsistent.	Good records; regular updates.	Detailed logs/reviews.	Exemplary documentation; reflective & timely.

2. Evaluation by Committee (CIE – 40 Marks)

Panel assessment (reviews, interim progress, knowledge, involvement).

Parameters	Marks (out of 40)	Poor (0–10)	Fair (11–20)	Good (21–28)	Very Good (29–35)	Outstanding (36–40)
Technical Depth & Justification [CO1-CO3 / PO1-PO4]	15	Superficial; no justifica- tion/ gaps.	Basic explanation; limited depth.	Reasonable justification; some analysis.	Strong technical discussion/ systematic approach.	Excellent depth; critical analysis; innovative/ SDG - aligned.
Innovation & Practical Relevance [CO1, CO3 / PO3, PO6]	10	No novelty; routine.	Limited innovation.	Some novelty/ practical aspects.	Good innovation; practical/ SDG relevance.	Highly innovative; strong societal/ SDG impact.
Team Work & Involvement [CO4 / PO8]	8	Poor col- laboration.	Uneven in- volvement.	Good team effort.	Strong col- laboration.	Exemplary teamwork/ leadership.
Communication & Presenta- tion Readiness [CO5 / PO9]	7	Poor clarity.	Needs im- provement.	Adequate.	Clear & structured.	Professional & confident.

3. ESE Components – Enhanced Rubrics (75 Marks Total)

- **Level of Completion (10 Marks)** [CO1-CO3]
 - Poor (0-2): Incomplete; major unfinished parts.
 - Fair (3-5): Partially complete; significant gaps.
 - Good (6-7): Mostly complete; minor issues.
 - Very Good (8): Fully complete with good quality.
 - Outstanding (9-10): Exceptionally complete; exceeds expectations (innovative/SDG features).
- **Demonstration of Functionality/Specifications (25 Marks)** [CO1, CO3 / PO3]
 - Poor (0-6): Non-functional; fails specs.
 - Fair (7-12): Basic functionality; many failures.
 - Good (13-18): Functional; meets most specs with issues.
 - Very Good (19-22): Reliable demo; meets all key specs.
 - Outstanding (23-25): Flawless; innovative features; reliable/SDG-aligned performance.

- **Project Report (10 Marks – CIE + ESE combined consideration)** [CO5 / PO9]
 - Poor (0-2): Poor organization; incomplete/missing sections.
 - Fair (3-5): Basic format; language/references weak.
 - Good (6-7): Systematic; mostly consistent.
 - Very Good (8): Well-organized; good references.
 - Outstanding (9-10): Professional; excellent structure/readability; proper citations/SDG discussion.
- **Viva-voce (20 Marks)** [CO2, CO5 / PO2, PO9]
 - Poor (0-5): Unable to explain basics; no understanding.
 - Fair (6-10): Limited answers; frequent prompting.
 - Good (11-14): Answers most questions reasonably.
 - Very Good (15-17): Confident; good depth/explanation.
 - Outstanding (18-20): Excellent articulation; integrates concepts; handles challenges fluently.
- **Presentation (10 Marks)** [CO5 / PO9]
 - Poor (0-2): Poor delivery/structure.
 - Fair (3-5): Needs major improvement.
 - Good (6-7): Clear & logical.
 - Very Good (8): Professional flow.
 - Outstanding (9-10): Engaging, confident; excellent visuals/technical clarity.

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CEH71	ADVANCED STEEL DESIGN	3	1	0	5	4	2024

Preamble

This course provides advanced knowledge of steel structural behaviour and design based on Limit State principles. It covers stability, composite and cold-formed steel members, connections, and practical detailing as per IS codes, enabling students to analyse, design, and interpret real-world steel structures.

Prerequisites: Design of Steel Structures

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Explain the behaviour of steel members and advanced design concepts (Cognitive Knowledge Level: Understand)
CO 2	Analyse stability and buckling behaviour of steel members (Cognitive Knowledge Level: Analyse)
CO 3	Design advanced steel members such as beam-columns and plate girders (Cognitive Knowledge Level: Apply)
CO 4	Illustrate the basic design concepts of composite and cold-formed steel structures (Cognitive Knowledge Level: Understand)
CO 5	Design steel connections and prepare basic structural detailing (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	2									1
CO 2	3	3		2				1			1
CO 3	3	2	3		2		3				2
CO 4	2		1			2	3				1
CO 5	3	2	3		2	2			1		1

Assessment Pattern

ADVANCED STEEL DESIGN			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember			
Understand	40	30	30
Apply	30	50	40
Analyse	30	20	30
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course Project : 10 marks

Self Study : 5 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question carries 14 marks and can have maximum 2 sub-divisions.

SYLLABUS

Module 1: Review of Steel Design Basics & Behaviour (9 Hours)

Review of steel properties and stress-strain behaviour, Limit State Design philosophy (IS 800:2007 – brief review), Elastic vs plastic behaviour of steel members, Failure modes: yielding, buckling, fracture, Introduction to plastic hinges and collapse mechanism

Module 2: Stability of Steel Members (9 Hours)

Effective length, Buckling of columns – concept and modes, Lateral torsional buckling of beams, Beam-columns: axial load with bending. Introduction to second-order effects (P- Δ effect)

Module 3: Design of Steel Girders (9 Hours)

Design of beam-columns, Plate girders: components, web buckling, stiffeners, Gantry girders – loading and design procedure, Industrial steel frames – overview, design examples as per IS code.

Module 4: Composite and Cold-Formed Steel Structures (9 Hours)

Introduction to steel-concrete composite construction, Composite beams and shear connectors (design concepts), Advantages of composite construction, Cold-formed steel sections – characteristics and design concepts.

Module 5: Connections, Detailing & Practical Design (9 Hours)

Connections - bolted and welded - Moment Resistant connections - Eccentric connections - Beam to beam connections - Beam to column connections - Beam and column splices – concept only, Ductile detailing principles.

Introduction to fire and fatigue considerations, Case studies of steel structures, Preparation of basic steel design drawings

Text Books:

1. Duggal, S. K., Design of Steel Structures, Tata McGraw-Hill Education, New Delhi.
2. Subramanian, N., Design of Steel Structures, Oxford University Press, India.
3. Arya, A. S. and Ajmani, J. L., Design of Steel Structures, Nem Chand & Bros., Roorkee.

References:

1. Dayaratnam, P., Design of Steel Structures, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
2. Salmon, C. G., Johnson, J. E., and Malhas, F. A., Steel Structures – Design and Behaviour, Pearson Education.
3. Trahair, N. S., Bradford, M. A., and Nethercot, D. A., The Behaviour and Design of Steel Structures, CRC Press.
4. Johnson, R. P., Composite Structures of Steel and Concrete, Wiley India.
5. Hancock, G. J., Murray, T. M., and Ellifritt, D. S., Cold-Formed Steel Structures, CRC Press.

Indian Standard Codes:

1. IS 800:2007 – General Construction in Steel – Code of Practice.
2. IS 801:1975 – Code of Practice for Use of Cold-Formed Light Gauge Steel Structural Members.
3. IS 806:1968 – Code of Practice for Use of Steel Tubes in General Building Construction.
4. IS 875 (Part 1–5) – Code of Practice for Design Loads.
5. IS 1893 (Part 1):2016 – Criteria for Earthquake Resistant Design of Structures.
6. IS 816:1969 – Code of Practice for Use of Metal Arc Welding for General Construction.
7. IS 1367 (Part 1–18) – Technical Supply Conditions for Threaded Steel Fasteners.
8. IS 6623:2004 – High Strength Structural Bolts.
9. IS 1024:1999 – Code of Practice for Welding of Structures Subjected to Dynamic Loads.
10. IS 1641:1988 – Fire Safety of Buildings – General Requirements.

Handbooks:

1. SP 6 (Part 1 & 2):1964 – Handbook for Structural Engineers – Steel Sections.
2. SP 38:1987 – Handbook of Typified Designs for Structures with Steel Roof Trusses

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	9 Hours
1.1	Review of steel properties and stress-strain behaviour.	2
1.2	Limit State Design philosophy (IS 800:2007 – brief review),	2
1.3	Elastic vs plastic behaviour of steel members.	1
1.4	Failure modes: yielding, buckling, fracture.	2
1.5	Introduction to plastic hinges and collapse mechanism.	2
2	Module 2	9 Hours
2.1	Effective length, Buckling of columns – concept and modes.	2
2.2	Lateral torsional buckling of beams.	2
2.3	Beam-columns: axial load with bending.	3
2.4	Introduction to second-order effects (P- Δ effect).	2
3	Module 3	9 Hours
3.1	Design of beam-columns.	2
3.2	Plate girders: components, web buckling, stiffeners.	3
3.3	Gantry girders – loading and design procedure.	2
3.4	Industrial steel frames – overview, design examples as per IS code.	2
4	Module 4	9 Hours
4.1	Introduction to steel-concrete composite construction.	2
4.2	Composite beams and shear connectors (design concepts), Advantages of composite construction.	4

4.3	Cold-formed steel sections – characteristics and design concepts	3
5	Module 5	9 Hours
5.1	Connections - bolted and welded - Moment Resistant connections- Eccentric connections	2
5.2	Beam to beam connections - Beam to column connections- Beam and column splices – concept only	2
5.3	Ductile detailing principles.	2
5.4	Introduction to fire and fatigue considerations,	1
5.5	Case studies of steel structures, Preparation of basic steel design drawings	2
Total		45 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Explain the stress–strain behaviour of structural steel and its significance in design.
2. Describe the Limit State Design philosophy adopted in IS 800:2007.
3. Explain the different failure modes of steel members with neat sketches.

Course Outcome 2 (CO 2):

1. Analyse the buckling behaviour of steel columns under axial compression.
2. Analyse the factors influencing lateral torsional buckling of steel beams.
3. Analyse the behaviour of beam-columns subjected to combined axial load and bending.

Course Outcome 3 (CO 3):

1. Design a steel beam-column subjected to combined axial load and bending as per IS 800:2007.
2. Design a plate girder indicating the selection of web, flange, and stiffeners.
3. Apply IS 800:2007 provisions to design a gantry girder for given loading conditions.

Course Outcome 4 (CO 4):

1. Illustrate the concept of steel–concrete composite construction and its advantages.
2. Illustrate the function of shear connectors in composite beams with neat sketches.
3. Illustrate the characteristics and applications of cold-formed steel sections.

Course Outcome 5 (CO 5):

1. Design a bolted connection for a steel beam-to-column joint.
2. Design a welded connection subjected to eccentric loading. .
3. Prepare a basic structural detailing drawing for a steel connection showing essential components.

MODEL QUESTION PAPER

QP CODE:

Pages: 2

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

SEVENTH SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CEH71

ADVANCED STEEL DESIGN

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Explain the stress–strain behaviour of structural steel.
2. Differentiate between elastic and plastic behaviour of steel members.
3. State the basic principles of Limit State Design as per IS 800:2007.
4. What are plastic hinges? Explain their significance in collapse mechanism.
5. Define effective length of a column.
6. What is lateral torsional buckling of beams?
7. What is the P– Δ effect in steel structures?
8. List the components of a plate girder.
9. State the advantages of steel–concrete composite construction.
10. What are the characteristics of cold-formed steel sections?

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. a) Explain the Limit State Design philosophy adopted in IS 800:2007. (7)
b) Explain various failure modes of steel members with neat sketches. (7)

OR

12. a) Explain elastic and plastic analysis of steel members. (7)
b) Describe the concept of plastic hinges and collapse mechanism. (7)

MODULE 2

13. a) Analyse the buckling behaviour of a steel column and explain the significance of effective length. (14)

OR

14. a) Analyse the factors affecting lateral torsional buckling of beams. (7)
b) Analyse the behaviour of beam-columns subjected to combined axial load and bending. (7)

MODULE 3

15. a) Design a steel beam-column subjected to combined axial load and bending as per IS 800:2007. Assume suitable data wherever required. (14)

OR

16. a) Explain the components of a plate girder and discuss web buckling. (7)
b) Outline the basic design procedure of a gantry girder. (7)

MODULE 4

17. a) Explain the concept of steel-concrete composite construction with advantages. (7)
b) Explain the role of shear connectors in composite beams. (7)

OR

18. a) Explain the characteristics and applications of cold-formed steel sections. (7)
b) Explain the basic design concepts of cold-formed steel members. (7)

MODULE 5

19. a) Design a bolted connection for a beam-to-column joint. Assume suitable data. (7)
b) Explain the principles of ductile detailing in steel structures. (7)

OR

20. a) Explain fire and fatigue considerations in steel structures. (7)
b) Prepare a neat sketch showing basic steel connection detailing. (7)

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE1H72	HERITAGE STRUCTURES	3	1	0	5	4	2024

Preamble

This course introduces the principles of heritage conservation, covering the significance of heritage structures, traditional materials and construction techniques, structural assessment, restoration methods, and legal frameworks. It aims to develop an understanding of sustainable strategies for preserving historic built environments.

Prerequisites: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Understand the concepts, significance, classification, and ethics of heritage conservation, including UNESCO heritage criteria. (Cognitive Knowledge Level- Understand)
CO 2	Understand traditional materials, construction techniques, architectural styles, and structural systems of heritage buildings. (Cognitive Knowledge Level – Understand)
CO 3	Analyse the structural behaviour, damage mechanisms, and assessment techniques of heritage structures. (Cognitive Knowledge Level – Analyse)
CO 4	Analyse the conservation principles, restoration methods, strengthening, and adaptive reuse of heritage buildings. (Cognitive Knowledge Level – Analyse)
CO 5	Understand legal frameworks, conservation policies, and community roles in heritage preservation. (Cognitive Knowledge Level – Understand)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	1				2	3		1		2
CO 2	3	2	1	1		2					2
CO 3	3	2	1	2	2	2					2
CO 4	3	2	2	2	2	3	2	2	1	1	2
CO 5	2	1				3	3	2	2	1	2

Assessment Pattern

HERITAGE STRUCTURES			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember			
Understand	60	40	60
Apply	20	20	20
Analyse	20	40	20
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course Project	: 10 marks
Self Study	: 5 marks

End Semester Examination Pattern There will be two parts: Part A and Part B.

Part A contain 10 questions, with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module, of which students should answer any one. Each question carries 14 marks and can have a maximum of 2 sub-divisions.

SYLLABUS

Module 1: Introduction to Heritage and Conservation (8 hours)

Definition of heritage structures, Types of heritage structures, History and Evolution of conservation, Importance of conservation and preservation, UNESCO World heritage sites- criteria and classification, Indian and global heritage structures, Ethical considerations in conservation.

Module 2: Architectural and Structural aspects of Heritage buildings (10 hours)

Traditional building materials- Stone, Brick, timber, lime, mortar and metals , Construction techniques in historic structures, Architectural styles and their evolution- Gothic, Mugal, Art Deco, Indo-Saracenic, Load bearing Systems in ancient structures.

Module 3: Structural Behaviour and Damage assessment (9 Hours)

Common structural issues in heritage building, Types of damage- Cracks, foundation settlement, material deterioration, Environmental Impact- Weathering, pollution, seismic activity.

Structural Inspection Techniques- Visual Inspection, Material Testing, Non- destructive testing (NDT), Seismic vulnerability assessment. Case studies on condition assessment and structural diagnosis of heritage structures.

Module 4: Conservation Techniques and Restoration methods (9 Hours)

Principles of conservation- Minimal intervention, reversibility, compatibility, Strengthening techniques- Grouting, jacketing, retrofitting, Seismic retrofitting of heritage structures, Traditional and Modern materials in restoration, Adaptive reuse of heritage structures. Case studies on the application of conservation principles in heritage buildings

Module 5: Legal and Policy Framework for Heritage Conservation (9 Hours)

National and International conservation laws, UNESCO guidelines and ICOMOS charters, Heritage regulation India - ASI guidelines, State heritage policies, Role of local communities in Conservation.

Text Books:

1. Feilden, B.M., Conservation of Historic Buildings, Butterworth-Heinemann Ltd., 1994.
2. Croci, G., The Conservation and Structural Restoration of Architectural Heritage,

Computational Mechanics Publications, 1998.

3. Toma Azevic, M., Earthquake-resistant Design of Masonry Buildings, Imperial College Press, 1999.
4. Vincent Shacklock, Architectural Conservation: Issues and Developments, Donhead Publishing Ltd., 2006.
5. Aylin Orbasli, Architectural Conservation: Principles and Practice, Wiley Publishers Ltd., 2007.

Reference:

1. S. Syngellakis, Retrofitting of Heritage Structures: Design and evaluation of strengthening techniques, Wit Press, 2013.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	8 hours
1.1	Definition of heritage structures, Types of heritage structures	2
1.2	History and Evolution of conservation, Importance of conservation and preservation	2
1.3	UNESCO World heritage sites- criteria and classification	1
1.4	Indian and global heritage structures	2
1.5	Ethical considerations in conservation	1
2	Module 2	10 hours
2.1	Traditional building materials - Stone, Brick, timber, lime, mortar and metals	3
2.2	Construction techniques in historic structures	2
2.3	Architectural styles and their evolution- Gothic, Mugal, Art Deco, Indo-Saracenic	3
2.4	Load bearing Systems in ancient structures.	2

3	Module 3	9 hours
3.1	Common structural issues in heritage building	1
3.2	Types of damage- Cracks, foundation settlement, material deterioration, Environmental Impact - Weathering, pollution, seismic activity	2
3.3	Structural Inspection Techniques- Visual Inspection, Material Testing	1
3.4	Non - destructive testing (NDT), Seismic vulnerability assessment	3
3.5	Case studies on condition assessment and structural diagnosis of heritage structures.	2
4	Module 4	9 hours
4.1	Principles of conservation - Minimal intervention, reversibility, compatibility	2
4.2	Strengthening techniques - Grouting, jacketing, retrofitting	2
4.3	Seismic retrofitting of heritage structures	2
4.4	Traditional and Modern materials in restoration, Adaptive reuse of heritage structures	2
4.5	Case studies on the application of conservation principles in heritage buildings	1
5	Module 5	9 hours
5.1	National and International conservation laws	3
5.2	UNESCO guidelines and ICOMOS charters	3
5.3	Heritage regulation India - ASI guidelines, State heritage policies, Role of local communities in Conservation	3
Total		45 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Classify different types of heritage structures with examples.
2. Explain the evolution of heritage conservation practices.
3. Discuss the UNESCO criteria for World Heritage Site classification.

Course Outcome 2 (CO 2):

1. Describe common historic construction techniques used in ancient buildings.
2. Explain the evolution of major architectural styles such as Gothic, Mughal, and Indo-Saracenic.
3. Explain the role of lime mortar, timber, and metals in historic construction.

Course Outcome 3 (CO 3):

1. Analyse common structural defects observed in heritage buildings.
2. Examine the causes and effects of cracks and foundation settlement in historic structures.
3. Analyse the impact of environmental factors on material deterioration.

Course Outcome 4 (CO 4):

1. Compare different strengthening techniques used in heritage restoration.
2. Analyse the role of traditional and modern materials in restoration works.
3. Evaluate the effectiveness of seismic retrofitting methods for heritage structures.

Course Outcome 5 (CO 5):

1. Discuss the role of UNESCO and ICOMOS in heritage preservation.
2. Explain the ASI guidelines for conservation of heritage buildings in India.
3. Discuss the role of state heritage policies in preservation practice.

MODEL QUESTION PAPER

QP CODE:

Pages: 2

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

SEVENTH SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CEH72

HERITAGE STRUCTURES

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Define heritage structures and classify their types.
2. State the importance of conservation and preservation of heritage buildings.
3. Briefly explain Gothic and Mughal architectural styles.
4. List the traditional building materials commonly used in heritage structures.
5. List any three common structural issues in heritage buildings.
6. What are the causes of cracks in heritage structures?
7. Explain seismic retrofitting methods for heritage buildings.
8. Define adaptive reuse of heritage structures with one example.
9. What are the roles of UNESCO and ICOMOS in heritage conservation?
10. Mention the significance of ASI guidelines in India.

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. Explain the concept of heritage conservation, its significance, and the ethical considerations involved in preserving heritage structures.

OR

12. a) Explain UNESCO World Heritage criteria. (7)
b) Classify heritage sites with suitable examples. (7)

MODULE 2

13. Describe the traditional building materials used in heritage structures and explain their structural significance.

OR

14. a) Explain construction techniques used in historic structures. (7)
b) Describe load-bearing systems in ancient structures. (7)

MODULE 3

15. Explain the impact of weathering, pollution, and seismic activity on heritage structures.

OR

16. a) Describe visual inspection and material testing methods. (7)
b) Explain non-destructive testing and seismic vulnerability assessment. (7)

MODULE 4

17. a) Explain the principles of minimal intervention and reversibility. (7)
b) Discuss compatibility requirements in restoration. (7)

OR

18. Discuss strengthening techniques such as grouting, jacketing, and retrofitting used in heritage structures.

MODULE 5

19. Discuss the role of local communities and state heritage policies in sustainable heritage conservation.

OR

20. a) Explain national conservation laws in India. (7)
b) Discuss international conservation laws and charters. (7)

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CEH73	URBAN PLANNING	3	1	0	5	4	2024

Preamble

Urban planning is essential for the organized and sustainable development of cities and towns in response to rapid urbanization and population growth. This course introduces the fundamental principles, planning techniques, development regulations, and modern approaches required for effective urban development and management.

Prerequisites: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Explain the basic concepts, principles and evolution of urban planning, including the impact of urbanization and planning approaches for sustainable urban development. (Cognitive Knowledge Level: Understand)
CO 2	Describe the planning techniques, surveys, data collection methods and development applications related to housing, public buildings and industrial layouts. (Cognitive Knowledge Level: Understand)
CO 3	Apply zoning principles, development control regulations, building bye-laws and URDPFI guidelines in urban planning practices. (Cognitive Knowledge Level: Apply)
CO 4	Apply urban transport systems, traffic management measures and re-planning strategies for improving urban mobility and infrastructure. (Cognitive Knowledge Level: Apply)
CO 5	Explain the planning framework, types of development plans, master plan preparation, and the role of public participation and modern tools in urban planning. (Cognitive Knowledge Level: Understand)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	2	2	1			2	3	1	1	1	1
CO 2	2	2	2	1	2	2	2	1	1	1	1
CO 3	2	3	3	1	1	2	2	1	1	1	2
CO 4	2	2	2	2	1	2	3	1	1	1	1
CO 5	2	2	2	1	2	2	3	1	1	2	2

Assessment Pattern

URBAN PLANNING			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	20	20	30
Understand	50	50	50
Apply	30	30	20
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course Project	: 10 marks
Self Study	: 5 marks

End Semester Examination Pattern

There will be two parts: Part A and Part B. Part A contain 10 questions, with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module, of which students should answer any one. Each question carries 14 marks and can have a maximum of 2 sub-divisions.

SYLLABUS

Module 1: Introduction to Urban Planning (8 hours)

Need, objectives and principles of planning – Evolution of towns and planning practices – Urbanization, industrialization and urban development – Urban growth: problems and benefits – Migration (push-pull factors) and impacts – Town Planning Acts in India – Planning concepts: Ideal Town, Garden City, New Towns, Conservative Surgery – Smart Cities Mission – Climate-resilient urban planning.

Module 2: Planning Techniques and Development Applications (9 hours)

Town planning surveys and data collection methods – Planning drawings, reports, GIS and remote sensing – Introduction to development planning – Housing: residential layouts, low-cost and rural housing – Housing agencies and national housing policy – Slums: problems, clearance and improvement – Public buildings: location and functional design – Industrial areas and layouts.

Module 3: Zoning and Development Control (9 Hours)

Zoning: objectives, principles, types and zoning maps – Zonal and neighbourhood planning – Subdivision regulations – FSI/FAR – Building bye-laws: objectives and importance – Development Control Regulations (DCR) – Building standards and controls – Introduction to URDPFI guidelines.

Module 4: Urban Roads, Traffic and Re-Planning (9 Hours)

Urban roads: classification, hierarchy and right-of-way – Traffic characteristics and studies – Traffic management and parking planning – Pedestrian and non-motorized transport – Intelligent Transport Systems – Cycling infrastructure and walkability indices – Re-planning of towns – Urban renewal, redevelopment and rehabilitation – Improvement schemes – Case studies: Delhi Metro, Ahmedabad BRTS.

Module 5: Planning Framework, Plan Concepts and Public Participation (10 Hours)

Planning framework and process – Components, techniques and types of development plans – Master plan: concept, elements, preparation and implementation – Development, perspective and zonal plans – Regional and neighbourhood planning – Spatial and performance standards – New Urbanism – Participatory and inclusive planning – Public participation – Case studies: Chandigarh, Kochi Smart City, AMRUT – Emerging tools: Geo-BIM, IoT and Digital Twins.

Text Books:

1. Rangwala S.C, 2023, Town Planning
2. Kulsreshtha, 2012, Urban and Regional Planning in India: A handbook for professionals
3. Rao P., 2012, Urban Planning: Theory & Practice (PB)
4. GK Hiraskar, 2022, Fundamentals Of Town Planning

References:

1. Ministry of Urban Affairs, Govt. of India, Urban and Regional Development Plan Formulation and Implementation Guidelines -2014
2. Urban and Regional Development Plan Formulations and implementation (URDPFI) guidelines, 2015
3. Richard T. Legates and Frederic Stout, The city reader
4. Vidyadhar K. Phatak, Urban Planning in India's New Development Strategy

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	8 hours
1.1	Need, objectives and principles of urban planning.	1
1.2	Evolution of towns and planning practices.	1
1.3	Urbanization, industrialization and urban development, Problems of urban growth and benefits of planning.	2
1.4	Migration: push and pull factors and their impacts.	1
1.5	Town Planning Acts in India - Planning concepts: Ideal Town, Garden City, New Towns, Conservative Surgery.	2
1.6	Smart Cities Mission and climate-resilient urban planning.	1

2	Module 2	9 hours
2.1	Town planning surveys and data collection methods.	2
2.2	Planning drawings and reports, GIS and remote sensing in urban planning.	2
2.3	Introduction to development planning.	1
2.4	Housing: residential layouts, low-cost housing and rural housing.	1
2.5	Housing agencies in India and national housing policy - Slums: problems, clearance and improvement.	1
2.6	Public buildings: location and functional design – Industrial areas and layouts.	2
3	Module 3	9 hours
3.1	Zoning: objectives, principles, types and zoning maps.	2
3.2	Zonal planning and neighbourhood planning.	2
3.3	Subdivision regulations - Floor Space Index (FSI) / Floor Area Ratio (FAR).	1
3.4	Building bye-laws: objectives and importance.	1
3.5	Development Control Regulations (DCR).	1
3.6	Building standards and controls – Introduction to URDPFI guidelines.	2
4	Module 4	9 hours
4.1	Urban roads: classification, hierarchy and right-of-way.	2
4.2	Traffic characteristics and traffic studies.	1
4.3	Traffic management measures and parking planning.	1
4.4	Pedestrian and non-motorized transport facilities.	1
4.5	Intelligent Transport Systems - Cycling infrastructure and walkability indices.	1

4.6	Re-planning of towns – Urban renewal, redevelopment and rehabilitation.	1
4.7	Improvement schemes – Case studies: Delhi Metro, Ahmedabad BRTS.	2
5	Module 5	10 hours
5.1	Planning framework and planning process - Components, techniques and types of development plans.	2
5.2	Master plan: concept, elements, preparation and implementation.	2
5.3	Development plan, perspective plan and zonal plan - Regional and neighbourhood planning.	1
5.4	Spatial and performance standards – New Urbanism .	1
5.5	Participatory and inclusive planning – Public participation .	1
5.6	Case studies: Chandigarh, Kochi Smart City, AMRUT.	2
5.7	Emerging tools: Geo-BIM, IoT and Digital Twins.	1
Total		45 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Explain the need, objectives and principles of urban planning in modern cities.
2. Describe the factors influencing urbanization and their impact on urban development.
3. Explain the concepts of Garden City and New Towns in urban planning.

Course Outcome 2 (CO 2):

1. Describe the different types of town planning surveys and methods of data collection used in urban planning.
2. Explain the role of GIS and remote sensing in urban planning and development.
3. Discuss the major housing problems in urban areas and the role of housing agencies in India.

Course Outcome 3 (CO 3):

1. Apply the concept of Floor Space Index (FSI) / Floor Area Ratio (FAR) in urban land development planning.
2. Illustrate how zoning regulations help in controlling land use and urban growth.
3. Apply building bye-laws and development control regulations in planning a residential area.

Course Outcome 4 (CO 4):

1. Analyse the classification and hierarchy of urban roads and their role in urban transportation.
2. Examine different traffic management measures used to improve urban mobility.
3. Analyse the importance of urban renewal and redevelopment in improving existing towns.

Course Outcome 5 (CO 5):

1. Explain the planning process and the components involved in the preparation of a master plan.
2. Differentiate between development plan, perspective plan and zonal plan.
3. Explain the importance of public participation and modern tools such as Geo-BIM and IoT in urban planning.

MODEL QUESTION PAPER

QP CODE:

Pages: 3

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

SEVENTH SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CEH73

URBAN PLANNING

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. State the major objectives of urban planning..
2. Identify the push and pull factors influencing migration to urban areas.
3. List the different types of surveys conducted in town planning.
4. State any three applications of GIS in urban planning.
5. Define zoning and state its significance in urban planning.
6. What is Floor Space Index (FSI)?
7. What is meant by road hierarchy in urban transportation planning?
8. List any three traffic management measures used in urban areas.
9. What is a master plan?
10. What is meant by participatory planning?

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. a) Examine the need and importance of urban planning in addressing rapid urbanization. (8)
b) Explain the evolution of town planning practices with suitable examples. (6)

OR

12. a) Illustrate the Garden City concept and explain its relevance in modern urban planning. (8)
b) Assess the role of climate-resilient planning in sustainable urban development. (6)

MODULE 2

13. a) Describe the process of conducting town planning surveys and the methods used for data collection. (8)
b) Examine the role of GIS and remote sensing technologies in urban planning and decision-making. (6)

OR

14. a) Explain the major housing problems faced in urban areas and suggest planning measures to address them. (8)
b) Discuss the planning considerations involved in the location and functional design of public and industrial areas. (6)

MODULE 3

15. a) Examine the objectives and principles of zoning and explain how zoning helps regulate urban land use. (8)
b) Analyse the role of Floor Space Index (FSI) and subdivision regulations in controlling urban development. (6)

OR

16. a) Discuss the importance of building bye-laws in ensuring safe and planned urban growth. (8)
b) Explain the significance of Development Control Regulations (DCR) and UR-DPFI guidelines in urban planning practice. (6)

MODULE 4

17. a) Analyse the classification and hierarchy of urban roads and their importance in urban mobility. (8)
b) Examine the different traffic studies used in urban transportation planning. (6)

OR

18. a) Discuss various traffic management strategies for reducing congestion in urban areas. (8)
b) Explain the need for urban renewal and redevelopment in improving existing urban areas. (6)

MODULE 5

19. a) Explain the planning process and the key components involved in preparing development plans. (8)
b) Discuss the preparation and implementation stages of a master plan. (6)

OR

20. a) Compare development plan, perspective plan and zonal plan used in urban planning. (8)
b) Examine the importance of public participation and modern planning tools in sustainable urban development. (6)

KNOWLEDGE IS POWER

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CEH74	LEAN CONSTRUCTION	3	1	0	5	4	2024

Preamble

The construction industry is increasingly challenged to deliver projects that are efficient, cost-effective, sustainable, and of high quality. This course introduces students to the fundamental concepts of lean construction, focusing on the identification and elimination of waste, enhancement of value, and continuous improvement of processes. This course aims to equip students with the knowledge and skills required to apply lean principles effectively in the construction industry.

Prerequisites: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Understand the fundamental concepts of lean construction, lean thinking principles, and differences between manufacturing and construction supply chains. (Cognitive Knowledge Level: Understand)
CO 2	Apply productivity measurement techniques to evaluate workflow, resource utilization, and waste identification in construction processes. (Cognitive Knowledge Level: Apply)
CO 3	Apply the concepts of project life cycle and Lean Project Delivery System (LPDS) in planning and execution of construction projects. Apply lean design principles such as Design Structure Matrix (DSM) and Target Value Delivery (TVD) in optimizing design processes. (Cognitive Knowledge Level: Apply)
CO 4	Understand the concepts of integrated project delivery (IPD). Analyze the key issues in implementing lean construction in the construction industry using case studies. (Cognitive Knowledge Level: Understand)
CO 5	Understand the concepts of BIM and its integration with lean construction practices. Apply digital technologies to support lean workflows and project management. Apply value engineering techniques to optimize cost, function, and performance in construction projects (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	2	1	1	1	1	2			2	1
CO 2	3	3	2	3	2	1	2		2	1	3
CO 3	2	3	2	2	1	2	3	2	1	1	2
CO 4	2	3	2	3	1	2	2	2	3	2	3
CO 5	3	3	3	2	3	2	2	1	2	2	3

Assessment Pattern

LEAN CONSTRUCTION			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	20	20	30
Understand	50	50	50
Apply	30	30	20
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course Project : 10 marks

Self Study : 5 marks

End Semester Examination Pattern

There will be two parts: Part A and Part B. Part A contain 10 questions, with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module, of which students should answer any one. Each question carries 14 marks and can have a maximum of 2 sub-divisions.

SYLLABUS

Module 1: Introduction to Lean Principles (9 hours)

Introduction to Lean construction - fundamental concepts, manufacturing vs construction supply chains, Lean thinking - value, value stream, flow, pull, perfection, Productivity measurements-work sampling, foreman delay surveys, Work diagnostics - workflow analysis, resource utilization, waste identification - types of waste, performance measurement, Mapping of lean principles into construction, six sigma.

Module 2: Lean Tools in Construction (9 hours)

Lean Tools in Construction: Last Planner System, Value stream mapping, 5S methodology (Sort, Set in order, Shine, Standardize, Sustain), Just-in-Time concepts, Continuous improvement (Kaizen), Root cause analysis case studies -5 Whys, Problem solving, case studies.

Module 3: Project Life Cycle and Lean Project Delivery System (9 Hours)

Project life cycle and lean project delivery system, last planner system, production planning, measurement, big room approach. Lean Design: introduction to lean design, design structure matrix, target value delivery, early stakeholder involvement, lean supply chain, lean procurement strategies.

Module 4: Lean Integration (9 Hours)

Lean Integration: integrated project delivery, collaborative contracting, Lean Construction and safety, Issues in lean implementation in the construction industry, case studies. Lean Construction and sustainable development, Lean and Green, Location based management system, case studies.

Module 5: Enabling Lean Through Information Technology and Value Engineering (10 Hours)

BIM & Lean, Synergy between Building Information Modelling and lean practices. Digital Transformation: Use of IoT, digital twins, and construction ERPs to support lean workflows, case studies. Culture and Implementation, Value Engineering Techniques in Construction Management: General and Specific Techniques.

Text Books:

1. Modern Construction-Lean project delivery and integrated practices. Forbes, L., Ahmed, S, CRC Press, New York, 2011.
2. Lean Construction: Core concepts and New Frontiers, Patricia Tzortzopoulos, Mike Kagioglou and Lauri Koskela, Routledge, Taylor and Francis Group, 2020

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	8 hours
1.1	Introduction to Lean construction - fundamental concepts, manufacturing vs construction supply chain	2
1.2	Lean thinking - value, value stream, flow, pull, perfection.	2
1.3	Productivity measurements-work sampling, foreman delay surveys	1
1.4	Work diagnostics- workflow analysis, resource utilization, waste identification-types of waste, performance measurement	2
1.5	Mapping of lean principles into construction and six sigma.	2
2	Module 2	9 hours
2.1	Lean Tools in Construction: Last Planner System, Value stream mapping.	2
2.2	5S methodology (Sort, Set in order, Shine, Standardize, Sustain).	2
2.3	Just-in-Time concepts, Continuous improvement (Kaizen), Root cause analysis case studies	3
2.4	5 Whys, Problem solving, case studies.	2

3	Module 3	9 hours
3.1	Project life cycle and lean project delivery system, last planner system	2
3.2	Production planning, measurement, big room approach	2
3.3	Lean Design: introduction to lean design, design structure matrix, target value delivery.	2
3.4	Early stakeholder involvement and lean supply chain,	2
3.5	Lean procurement strategies.	1
4	Module 4	9 hours
4.1	Lean Integration: integrated project delivery, collaborative contracting	2
4.2	Lean Construction and safety.	1
4.3	Issues in lean implementation in the construction industry, case studies.	2
4.4	Lean Construction and sustainable development, Lean and Green.	2
4.5	Location based management system, case studies	2
5	Module 5	10 hours
5.1	BIM Lean, Synergy between Building Information Modelling and lean practices.	2
5.2	Digital Transformation: Use of IoT, digital twins	2
5.3	Construction ERPs to support lean workflows, case studie.	2
5.4	Culture and Implementation, Value Engineering Techniques	1
5.5	Construction Management: General and Specific Techniques.	2
Total		45 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Explain in detail the principles of lean thinking and their application in construction projects.
2. Discuss the core concepts of lean construction and how they improve project performance.
3. Explain the concept of value, value stream, flow, pull, and perfection with suitable examples from construction.

Course Outcome 2 (CO 2):

1. Explain how work sampling can be applied to measure productivity on a construction site.
2. Discuss the steps involved in identifying waste in construction processes.
3. Explain the concept of resource utilization with practical examples.

Course Outcome 3 (CO 3):

1. Explain how the project life cycle can be applied in construction project planning.
2. Discuss the role of target value delivery in cost control and value optimization.
3. Explain how lean project delivery system differs from traditional project delivery methods.

Course Outcome 4 (CO 4):

1. Explain the concept of Integrated Project Delivery.
2. Describe the principles of collaborative contracting in lean construction.
3. Explain the role of stakeholder collaboration in lean construction.

Course Outcome 5 (CO 5):

1. Explain how BIM can be integrated with lean construction practices.
2. Discuss how construction ERP systems support project management.
3. Explain the principles of value engineering with examples.

MODEL QUESTION PAPER

QP CODE:

Pages: 3

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

SEVENTH SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CEH74

LEAN CONSTRUCTION

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. List the five principles of lean thinking.
2. What is meant by waste identification?
3. What is meant by Value Stream Mapping?
4. State any three advantages of Kaizen in construction.
5. List the stages of a project life cycle.
6. Define design optimization in construction.
7. Enumerate on collaborative contracting.
8. List any three benefits of location-based management system
9. Define collaborative modeling in BIM.
10. List any three Value Engineering techniques.

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. a) Compare manufacturing and construction supply chains in detail, highlighting challenges in construction and possible improvements using lean concepts. (6)
b) Explain the concept of Six Sigma and discuss its application in reducing defects and improving quality in construction projects (8)

OR

12. a) Explain the various productivity measurement techniques in construction such as work sampling and foreman delay surveys. (7)
b) Discuss the role of Lean construction in improving productivity and minimizing waste in construction projects. (7)

MODULE 2

13. a) Explain the 5S methodology (Sort, Set in order, Shine, Standardize, Sustain) and its application in construction site management. (8)
b) Discuss three lean tools to integrate and improve the construction project performance. (6)

OR

14. a) Describe the process of Root Cause Analysis (RCA) and explain the 5 Whys technique with a suitable construction case study. (8)
b) Discuss the challenges and benefits of implementing Lean tools in the construction industry. (6)

MODULE 3

15. a) Explain the stages of the project life cycle and discuss how lean principles can be applied in each stage of a construction project. (8)
b) Discuss the importance of early stakeholder involvement in Lean design and its impact on project success. (6)

OR

16. a) Describe the Design Structure Matrix (DSM) and explain how it helps in optimizing design processes. (8)
b) Explain the concept of Lean supply chain management and its application in construction projects. (6)

MODULE 4

17. a) Explain the concept of Integrated Project Delivery (IPD) and discuss its advantages over traditional project delivery methods. (7)
- b) Discuss the concept of Lean and Green and explain how it helps in reducing environmental impact in construction projects. (7)

OR

18. a) Describe the flowline technique and its application in location-based scheduling. (7)
- b) Discuss how integrated project delivery, lean construction, and sustainability concepts can be integrated for efficient project delivery. (7)

MODULE 5

19. a) Explain the role of digital transformation in construction, and how does IoT, digital twins and ERP systems in supporting Lean workflows. (10)
- b) Discuss the importance of organizational culture in the successful implementation of Lean construction. (4)

OR

20. a) Explain the concept of Value Engineering (VE) and discuss its importance in construction management. (7)
- b) Evaluate the role of Value Engineering and Lean practices in achieving cost optimization and value enhancement in construction projects. (7)

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CEH75	INTELLIGENT TRANSPORTATION SYSTEMS	3	1	0	5	4	2024

Preamble

This course introduces the fundamental concepts and applications of Intelligent Transportation Systems (ITS) for improving the safety, efficiency, and sustainability of transportation networks. It covers system architecture, sensing technologies, traffic management strategies, and emerging mobility solutions such as connected and automated vehicles. The course prepares students to understand and apply technology-driven approaches in modern transportation planning and operations.

Prerequisites: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Explain the fundamental concepts, objectives, user services, and institutional context of Intelligent Transportation Systems (ITS) and their role in improving transportation safety, efficiency, and sustainability. (Cognitive Knowledge Level: Understand)
CO 2	Analyze traffic operations, capacity, and their relationship with crash occurrence.(Cognitive Knowledge Level: Understand)
CO 3	Apply appropriate traffic data collection methods and data processing techniques to support traffic state estimation and performance monitoring. (Cognitive Knowledge Level: Apply)
CO 4	Understand advanced traffic management and operational strategies to improve traffic flow, incident management, and congestion control. (Cognitive Knowledge Level: Understand)
CO 5	Explain the concepts of connected and automated vehicle systems and apply basic principles to understand emerging mobility solutions and smart transportation technologies. (Cognitive Knowledge Level: Understand)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	2	-	-	-	-	-	-	-	-	-
CO2	2	3	1	2	-	-	-	-	-	-	-
CO3	1	2	3	2	2	-	-	-	-	1	-
CO4	1	3	2	3	1	-	-	-	-	1	-
CO5	-	2	3	2	1	3	2	2	-	2	1

Assessment Pattern

INTELLIGENT TRANSPORTATION SYSTEMS			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	30	30	30
Understand	50	50	50
Apply	20	20	20
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course Project	: 10 marks
Self Study	: 5 marks

End Semester Examination Pattern

There will be two parts: Part A and Part B. Part A contain 10 questions, with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module, of which students should answer any one. Each question carries 14 marks and can have a maximum of 2 sub-divisions.

SYLLABUS

Module 1: Fundamentals of Intelligent Transportation Systems (9 hours)

Concept, evolution and objectives of ITS; global and national ITS initiatives; ITS user services classification; safety, efficiency and sustainability perspectives; role of ITS in transport planning and operations; overview of system architecture and integration concepts; institutional and regulatory context.

Module 2: ITS Architecture and System Framework (9 hours)

Logical, physical and functional architecture; subsystems and interfaces; interoperability and standards; communication frameworks; system integration principles; deployment planning; project lifecycle considerations; evaluation and performance assessment frameworks.

Module 3: Sensing, Data Systems and Traffic State Estimation (9 Hours)

Traffic data collection technologies including fixed and mobile sensors; probe vehicle data; video analytics; data fusion and quality assessment; GIS applications in transportation; real-time traffic state estimation; travel time reliability; performance indicators and monitoring.

Module 4: Advanced Traffic Management and Operations (9 Hours)

Adaptive and coordinated signal control; ramp metering; incident detection and management; traveler information systems; congestion management strategies; demand management approaches; simulation and operational performance evaluation.

Module 5: Connected, Automated and Emerging Mobility Systems (9 Hours)

Vehicle-to-vehicle and vehicle-to-infrastructure communication concepts; connected vehicle ecosystem; automated driving systems overview; cybersecurity and privacy considerations; human factors; economic evaluation of ITS projects; case studies and emerging trends in smart mobility.

Text Books:

1. Chowdhury, M.A. and Sadek, A.W., *Fundamentals of Intelligent Transportation Systems Planning*, 2nd edn., Artech House, 2003.
2. Sussman, J.M., *Perspectives on Intelligent Transportation Systems*, Springer, New York, 2005.

References:

1. Klein, L.A., *Sensor Technologies and Data Requirements for ITS*, Artech House, 2001.
2. Tyagi, A.K. and Sreenath, N., *Intelligent Transportation Systems: Theory and Practice*, 1st edn., CBS Publishers & Distributors, New Delhi, 2017.
3. World Road Association (PIARC), *ITS Handbook*, PIARC, 2015.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	9 hours
1.1	Concept, evolution and objectives of ITS; global and national ITS initiatives; ITS user services classification	3
1.2	Role of ITS in transport planning and operations , safety, efficiency and sustainability perspective	3
1.3	Overview of system architecture and integration concepts; Institutional and regulatory context.	3
2	Module 2	9 hours
2.1	Logical, physical and functional architecture; subsystems and interface	3
2.2	Interoperability and standards; communication frameworks; system integration principles	3
2.3	Deployment planning; project lifecycle considerations; evaluation and performance assessment frameworks	3
3	Module 3	9 hours
3.1	Traffic data collection technologies including fixed and mobile sensors; probe vehicle data; video analytics, GIS applications in transportation	3
3.2	Data fusion and quality assessment	3

3.3	Real-time traffic state estimation; travel time reliability; performance indicators and monitoring	3
4	Module 4	9 hours
4.1	Adaptive and coordinated signal control; ramp metering; incident detection and management	3
4.2	Traveler information systems; congestion management strategies; demand management approaches	3
4.3	Simulation and operational performance evaluation	3
5	Module 5	9 hours
5.1	Vehicle-to-vehicle and vehicle-to-infrastructure communication concepts; connected vehicle ecosystem	3
5.2	Automated driving systems overview; cyber-security and privacy considerations; human factors	3
5.3	Economic evaluation of ITS projects; case studies and emerging trends in smart mobility	3
Total		45 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Define Intelligent Transportation Systems (ITS). State its main objectives.
2. What are ITS user services? List any four ITS user service categories.
3. Explain the concept and evolution of Intelligent Transportation Systems (ITS). Discuss the objectives of ITS from safety, efficiency, and sustainability perspectives.

Course Outcome 2 (CO 2):

1. Differentiate between logical, physical, and functional architecture in Intelligent Transportation Systems.
2. What are subsystems and interfaces in ITS? State their significance.
3. Explain the components of ITS architecture. Describe logical, physical, and functional architectures and their roles in system development.

Course Outcome 3 (CO 3):

1. What is travel time reliability? List any two performance indicators used to evaluate traffic conditions.
2. Define data fusion. Why is data quality assessment important in traffic data systems?
3. Discuss travel time reliability measures and performance indicators used for monitoring traffic system performance.

Course Outcome 4 (CO 4):

1. What is adaptive signal control? How does it differ from coordinated signal control?
2. Define ramp metering. State its primary objective in traffic management.
3. Explain the role of traveler information systems in managing congestion and improving traffic operations.

Course Outcome 5 (CO 5):

1. Define Vehicle-to-Vehicle (V2V) and Vehicle-to-Infrastructure (V2I) communication. State their main applications.
2. What is a connected vehicle ecosystem? List its key components.
3. Explain the importance of human factors in the safe operation of automated vehicles.

MODEL QUESTION PAPER

QP CODE:

Pages: 2

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

SEVENTH -SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CEH75

INTELLIGENT TRANSPORTATION SYSTEMS

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. State the role of ITS in transport planning and operations.
2. What is meant by ITS system architecture? Mention its basic components.
3. Why are standards necessary for ITS implementation?
4. List the major stages in the ITS project lifecycle.
5. Classify traffic data collection technologies into fixed and mobile sensors. Give two examples of each.
6. What is probe vehicle data? State its advantages in traffic monitoring.
7. List any two methods used for detecting traffic incidents.
8. List four congestion management strategies used in urban traffic systems.
9. List any four cybersecurity and privacy concerns associated with connected and automated vehicles.
10. What are automated driving systems (ADS)? State the role of human factors in automated vehicle operation.

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. Discuss the importance of system architecture and integration in ITS. Explain the institutional and regulatory framework required for successful implementation of ITS initiatives.

OR

12. Describe the classification of ITS user services.

MODULE 2

13. Discuss interoperability and communication frameworks in ITS.

OR

14. a) Discuss project lifecycle considerations and methods used for evaluation and performance assessment of ITS systems. (8)
b) Describe the process of ITS deployment planning. (6)

MODULE 3

15. a) Describe the concept of data fusion and GIS applications in transportation. (8)
b) Explain real-time traffic state estimation methods. (6)

OR

16. Explain various traffic data collection technologies used in Intelligent Transportation Systems.

MODULE 4

17. a) Explain adaptive and coordinated signal control systems. (8)
b) Discuss their role in improving traffic flow and reducing congestion. (6)

OR

18. a) Describe incident detection and management procedures. (8)
b) Explain the role of simulation techniques in evaluating operational performance of traffic systems. (6)

MODULE 5

19. Explain the concepts of Vehicle-to-Vehicle (V2V) and Vehicle-to-Infrastructure (V2I) communication.

OR

20. Discuss the economic evaluation of ITS projects.

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CEH76	SOIL DYNAMICS AND MACHINE FOUNDATION	3	1	0	5	4	2024

Preamble

This course introduces the principles of soil dynamics and their application to machine foundation and seismic design in civil engineering. It covers dynamic soil behaviour, vibration analysis, soil-structure interaction, and design of foundations subjected to dynamic and earthquake loads. Emphasis is placed on understanding dynamic soil properties, analyzing foundation response, and applying design codes, enabling students to develop safe and efficient solutions for vibration-sensitive and earthquake-resistant structures.

Prerequisites: Soil Mechanics, Foundation Engineering, Engineering Mechanics

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Understand the dynamic soil properties and their impact on soil behavior under dynamic loading. (Cognitive Knowledge Level: Understand)
CO 2	Get proficiency in analyzing and controlling dynamic loads and vibrations in engineering applications. (Cognitive Knowledge Level: Apply)
CO 3	Design and analyze machine foundations for various types of machinery, considering dynamic loads and vibrations. (Cognitive Knowledge Level: Apply)
CO 4	Understand seismic soil-structure interaction and the ability to design earthquake-resistant foundations. (Cognitive Knowledge Level: Understand)
CO 5	Get knowledge of soil dynamics, machine foundations, and the ability to apply and integrate these principles into complex engineering scenarios. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	2	2	-	-	1	-	-	-	-	-
CO 2	3	3	3	2	2	-	1	-	-	-	-
CO 3	2	3	3	-	-	-	2	1	-	-	-
CO 4	3	3	2	2	2	2	-	-	-	-	-
CO 5	2	2	2	2	-	-	-	-	-	-	-

Assessment Pattern

SOIL DYNAMICS AND MACHINE FOUNDATION			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	20	20	20
Understand	40	40	30
Apply	40	40	50
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course Project : 10 marks

Self Study : 5 marks

/

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question carries 14 marks and can have maximum 2 sub-divisions.

SYLLABUS

Module 1: Introduction to Soil Dynamics: (9 Hours)

Fundamentals of Soil Dynamics, Overview of soil dynamics and its importance in civil engineering, Soil behavior under dynamic loading conditions (cyclic loading, impact loading), Key concepts in soil dynamics (dynamic modulus, damping ratio)

Dynamic Properties of Soils, Measurement and determination of dynamic soil properties (shear modulus, damping), Laboratory tests (cyclic triaxial tests, resonant column tests), Field tests (dynamic cone penetration test, shear wave velocity measurement)

Soil Response to Dynamic Loads, Analysis of soil response to dynamic loads (load frequencies, amplitudes), Effects of soil type and conditions on dynamic response

Module 2: Dynamic Load Analysis and Vibration: (9 Hours)

Dynamic Load Analysis, Principles of dynamic load analysis (forces, accelerations, frequencies), Methods for analyzing dynamic loads (time history analysis, frequency domain analysis), Applications in civil engineering (earthquakes, machinery, traffic loads)

Vibration Analysis and Control, Vibration fundamentals (vibration modes, resonance, damping), Techniques for vibration analysis and control (isolation, damping devices), Impact of vibrations on structures and foundations

Module 3: Machine Foundations: (9 Hours)

Design of Machine Foundations, Principles of machine foundation design (dynamic loads, vibrations), Types of machine foundations (isolated, block, raft foundations), Design methods for different types of machinery (rotating machinery, impact machinery)

Dynamic Behavior of Machine Foundations, Analysis of machine foundation response (dynamic stiffness, natural frequency), Effects of soil properties on machine foundation performance, Methods for improving foundation performance (soil improvement, isolation)

Design Codes and Standards, Relevant codes and standards for machine foundation design (e.g., IS codes, AISC), Compliance with design standards and best practices, Example problems and design exercises

Module 4: Seismic Analysis and Design of Foundations: (9 Hrs)

Seismic Soil-Structure Interaction, Principles of seismic soil-structure interaction (SSI), Methods for analyzing SSI (dynamic analysis, response spectra), Design considerations for foundations under seismic loading

Seismic Design of Foundations, Design methods for earthquake-resistant foundations

(shallow, deep foundations), Analysis of foundation performance during seismic events, Case studies of seismic foundation design

Seismic Codes and Guidelines, Application of seismic design codes and guidelines (e.g., IS 1893, Eurocodes), Integration of seismic design principles into foundation design

Module 5: Advanced Topics and Case Studies: (9 Hrs)

Advanced Soil Dynamics, Recent advancements in soil dynamics research and technology, Advanced analysis techniques (numerical modeling, dynamic soil-structure interaction), Emerging trends in soil dynamics and their applications

Case Studies and Practical Applications, Detailed analysis of real-world projects involving soil dynamics and machine foundations, Lessons learned from complex cases and their impact on design practices, Integration of theoretical principles with practical applications

Text Books:

1. Soil Dynamics and Earthquake Engineering by Anil K. Chopra
2. Foundation Analysis and Design by Joseph E. Bowles
3. Principles of Soil Dynamics by Braja M. Das
4. IS 1893: Code of Practice for Earthquake Resistant Design and Construction of Buildings
5. AISC and other relevant design codes for foundation and vibration analysis
6. **Software:** Familiarization with soil dynamics and foundation design software (e.g., PLAXIS, SAP2000, ETABS)

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
	MODULE 1	9
1.1	Fundamentals of Soil Dynamics: Overview of soil dynamics and its importance in civil engineering, Soil behavior under dynamic loading conditions (cyclic loading, impact loading), Key concepts in soil dynamics (dynamic modulus, damping ratio)	3
1.2	Dynamic Properties of Soils: Measurement and determination of dynamic soil properties (shear modulus, damping), Laboratory tests (cyclic triaxial tests, resonant column tests), Field tests (dynamic cone penetration test, shear wave velocity measurement)	3
1.3	Soil Response to Dynamic Loads: Analysis of soil response to dynamic loads (load frequencies, amplitudes), Effects of soil type and conditions on dynamic response	3
	MODULE 2	9
2.1	Dynamic Load Analysis: Principles of dynamic load analysis (forces, accelerations, frequencies), Methods for analyzing dynamic loads (time history analysis, frequency domain analysis), Applications in civil engineering (earthquakes, machinery, traffic loads)	5
2.2	Vibration Analysis and Control: Vibration fundamentals (vibration modes, resonance, damping), Techniques for vibration analysis and control (isolation, damping devices), Impact of vibrations on structures and foundations	4
	MODULE 3	9
3.1	Design of Machine Foundations: Principles of machine foundation design (dynamic loads, vibrations), Types of machine foundations (isolated, block, raft foundations), Design methods for different types of machinery (rotating machinery, impact machinery)	3

3.2	Dynamic Behavior of Machine Foundations: Analysis of machine foundation response (dynamic stiffness, natural frequency), Effects of soil properties on machine foundation performance, Methods for improving foundation performance (soil improvement, isolation)	3
3.3	Design Codes and Standards: Relevant codes and standards for machine foundation design (e.g., IS codes, AISC), Compliance with design standards and best practices, Example problems and design exercises	3
	MODULE 4	9
4.1	Seismic Soil-Structure Interaction: Principles of seismic soil-structure interaction (SSI), Methods for analyzing SSI (dynamic analysis, response spectra), Design considerations for foundations under seismic loading	3
4.2	Seismic Design of Foundations: Design methods for earthquake-resistant foundations (shallow, deep foundations), Analysis of foundation performance during seismic events, Case studies of seismic foundation design	3
4.3	Seismic Codes and Guidelines: Application of seismic design codes and guidelines (e.g., IS 1893, Eurocodes), Integration of seismic design principles into foundation design	3
	MODULE 5	9
5.1	Advanced Soil Dynamics: Recent advancements in soil dynamics research and technology, Advanced analysis techniques (numerical modeling, dynamic soil-structure interaction), Emerging trends in soil dynamics and their applications	4
5.2	Case Studies and Practical Applications: Detailed analysis of real-world projects involving soil dynamics and machine foundations, Lessons learned from complex cases and their impact on design practices, Integration of theoretical principles with practical applications	5
Total		45 Hours

MODEL QUESTION PAPER

QP CODE:

Pages: 3

Reg.No.:

Name:

**MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM**

SEVENTH SEMESTER B. TECH. DEGREE EXAMINATION, YEAR

Course Code: B24CEH76

SOIL DYNAMICS AND MACHINE FOUNDATION

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Define soil dynamics.
2. What is dynamic modulus of soil?
3. Define damping ratio.
4. What is cyclic loading?
5. Define resonance.
6. What is natural frequency?
7. List types of machine foundations.
8. Define seismic soil-structure interaction (SSI).
9. What is response spectrum?
10. Mention any two field tests for dynamic soil properties.

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. (a) Explain fundamentals of soil dynamics and soil behaviour under dynamic loading. (7 marks)
(b) Describe methods for determining dynamic soil properties (lab and field tests). (7 marks)

OR

12. (a) Explain soil response to dynamic loads considering frequency and amplitude. (7 marks)
(b) Discuss effects of soil type and conditions on dynamic response. (7 marks)

MODULE 2

13. (a) Explain principles of dynamic load analysis. (6 marks)
(b) A machine of mass 1000 kg is supported on a spring with stiffness 20000 N/m. Determine the natural frequency of the system. (8 marks)

OR

14. (a) Explain vibration fundamentals (modes, damping, resonance). (7 marks)
(b) Discuss vibration control techniques and their applications. (7 marks)

MODULE 3

15. (a) Explain design principles of machine foundations. (7 marks)
(b) Discuss dynamic behaviour of machine foundations and influence of soil properties. (7 marks)

OR

16. (a) Explain different types of machine foundations. (7 marks)
(b) A machine foundation has stiffness $k = 15000$ N/m and mass = 500 kg. Calculate natural frequency and comment on resonance condition. (7 marks)

MODULE 4

17. (a) Explain seismic soil-structure interaction (SSI). (7 marks)
(b) Discuss design considerations for foundations under seismic loading. (7 marks)

OR

18. (a) Explain seismic design methods for foundations. (7 marks)

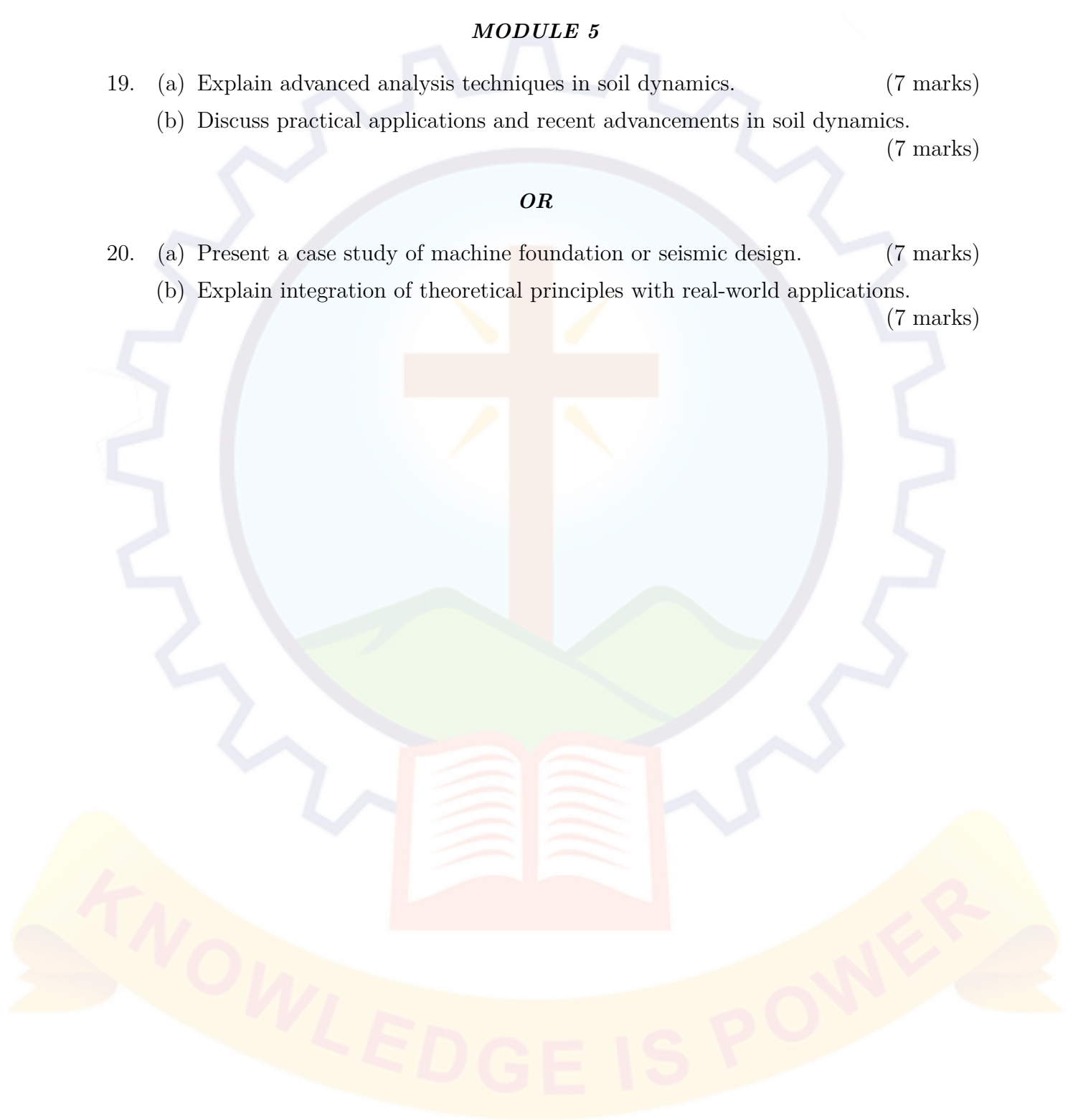
- (b) Discuss application of seismic codes (IS 1893) in foundation design. (7 marks)

MODULE 5

19. (a) Explain advanced analysis techniques in soil dynamics. (7 marks)
(b) Discuss practical applications and recent advancements in soil dynamics. (7 marks)

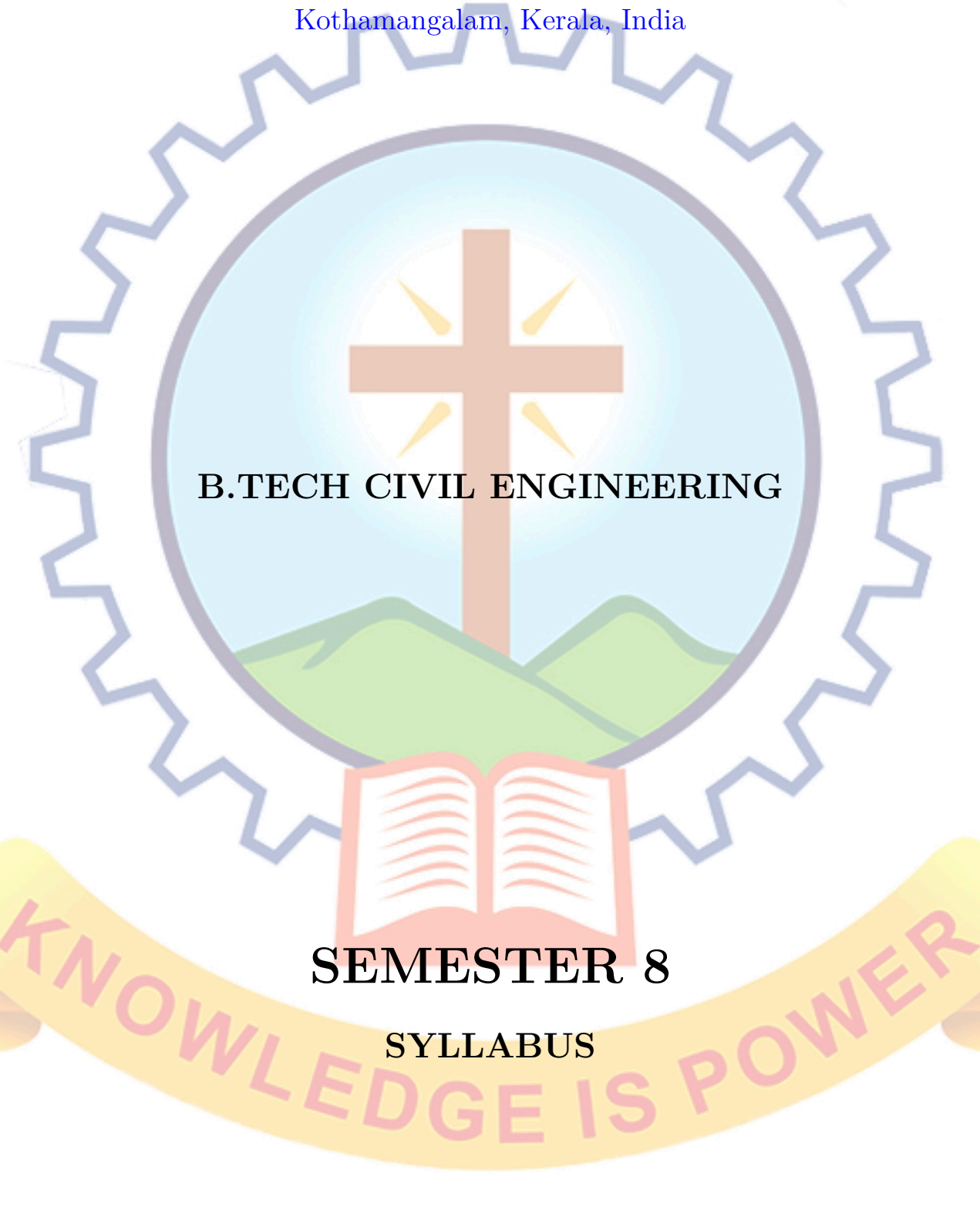
OR

20. (a) Present a case study of machine foundation or seismic design. (7 marks)
(b) Explain integration of theoretical principles with real-world applications. (7 marks)



MAR ATHANASIOUS COLLEGE OF ENGINEERING

Government Aided, Autonomous Institution
Kothamangalam, Kerala, India



B.TECH CIVIL ENGINEERING

SEMESTER 8

SYLLABUS

KNOWLEDGE IS POWER

SEMESTER 8

SLOT	COURSE NO.	COURSES	L-T-P-S	HOURS	CREDIT
A,B,C	B24MC400X	INTERNSHIP & MOOC COURSES (3 NUMBERS)	0-0-0-0	0	9
OR					
A	B24CE4P5x	PROGRAM ELECTIVE V	2-1-0-4	3	3
B	B24CE4P6x	PROGRAM ELECTIVE VI	2-1-0-4	3	3
C	B24CE4G3x	OPEN ELECTIVE III	2-1-0-4	3	3
AND					
H	B24CE4L14	PROJECT PHASE II	0-0-12-3	12	6
N	B24CEM8x	MINOR PROJECT	0-0-3-12	3	6
M	B24CEH8x	HONOURS PROJECT	0-0-6-9	6	6
TOTAL				30	15

PROGRAMME ELECTIVE V

COURSE NO.	COURSES
B24CE4P51	CONSTRUCTION PLANNING AND MANAGEMENT
B24CE4P52	SUSTAINABILITY AND ENVIRONMENTAL HEALTH
B24CE4P53	EARTHQUAKE RESISTANT DESIGN OF STRUCTURES
B24CE4P54	TRAFFIC ENGINEERING AND SAFETY
B24CE4P55	GEO-TECHNICAL INVESTIGATION
B24CE4P56	GEOINFORMATICS

PROGRAMME ELECTIVE VI

COURSE NO.	COURSES
B24CE4P61	CHARACTERISATION OF CONSTRUCTION MATERIALS
B24CE4P62	DESIGN OF ENVIRONMENTAL FACILITIES
B24CE4P63	APPLIED SOIL MECHANICS
B24CE4P64	ADVANCED ANALYSIS AND DESIGN USING ETABS
B24CE4P65	URBAN TRANSPORTATION PLANNING
B24CE4P66	ARCHITECTURAL MODELLING AND ADVANCED BIM

OPEN ELECTIVE III

COURSE NO.	COURSES
B24CE4G31	ENVIRONMENTAL HEALTH AND SAFETY
B24CE4G32	LAND USE AND TRANSPORT PLANNING
B24CE4G33	CONDITION ASSESSMENT OF STRUCTURES

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE4P51	CONSTRUCTION PLANNING AND MANAGEMENT	2	1	0	4	3	2024

Preamble

The course provides comprehensive knowledge of construction planning, scheduling, and management practices essential for successful execution of civil engineering projects. It emphasizes modern planning tools, resource optimization, project control techniques, and effective inventory management. The course equips students with practical skills to manage time, cost, materials, and manpower efficiently in construction projects.

Prerequisites: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Understand the fundamentals of construction project management, project life cycle, and organisational structures. (Cognitive Knowledge Level: Understand)
CO 2	Analyse construction planning and scheduling using CPM and PERT techniques. (Cognitive Knowledge Level: Analyse))
CO 3	Apply resource management principles including labour, equipment, and materials planning. (Cognitive Knowledge Level: Apply)
CO 4	Analyse inventory and materials management techniques for effective construction logistics. (Cognitive Knowledge Level: Analyse)
CO 5	Evaluate project cost control, monitoring techniques, safety, and quality management practices. (Cognitive Knowledge Level: Evaluate)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	2	2	1	1					1	1
CO 2	3	3	2	2	2					1	
CO 3	3	3	3	2	2				1	1	
CO 4	3	3	2	2	2					1	1
CO 5	3	3	2	2	2	1	1	1	1	1	

Assessment Pattern

CONSTRUCTION PLANNING AND MANAGEMENT			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember			
Understand	40	40	30
Apply	40	40	30
Analyse	20	10	20
Evaluate		10	20
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course Project	: 10 marks
Self Study	: 5 marks

End Semester Examination Pattern

There will be two parts: Part A and Part B. Part A contain 10 questions, with 2 questions from each module, having 3 marks for each question. Students should answer all questions.

Part B contains 2 questions from each module, of which students should answer any one. Each question carries 14 marks and can have a maximum of 2 sub-divisions.

SYLLABUS

Module 1: Introduction to Construction Management (8 hours)

Construction industry characteristics and challenges – Functions of construction management – Project life cycle – Role and responsibilities of project manager – Project stakeholders – Organisational structures in construction: line, functional, and matrix – Construction contracts and tendering overview.

Module 2: Construction Planning and Scheduling (8 hours)

Construction planning concepts – Work Breakdown Structure (WBS) – Bar charts and milestone charts – Network planning fundamentals – Critical Path Method (CPM): network representation, time analysis, floats – Programme Evaluation and Review Technique (PERT): probability concepts – Comparison of CPM and PERT

Module 3: Resource Management in Construction (7 Hours)

Resources in construction projects – Labour productivity and factors affecting productivity – Equipment planning and selection – Resource allocation – Resource levelling and smoothing – Manpower planning – Introduction to lean construction and waste minimization

Module 4: Inventory and Materials Management(8 Hours)

Materials planning and control – Importance of inventory management in construction – Inventory costs – Economic Order Quantity (EOQ) – ABC and VED analysis – Storage, handling, and transportation of construction materials – Stores layout and material logistics – Material wastage control

Module 5: Cost Control, Quality and Safety Management(5 Hours)

Project cost estimation and budgeting – Cash flow analysis – Time-cost trade-off – Project monitoring and control – Earned Value Analysis – Quality management systems in construction – Safety management: causes of accidents, prevention and safety regulations.

Text Books:

1. K.K. Chitkara – Construction Project Management, Tata McGraw-Hill, 2019
2. P.K. Gupta – Construction Planning and Management, CBS Publishers, 2014
3. K.K. Kharbanda – Project Management, Tata McGraw-Hill, 2019.

References:

1. B.C.Punmia & K K Khandelwal, Project Planning with CPM and PERT, Laxmi Publication, New Delhi, 2016.

2. Charles D Fledderman, Engineering Ethics, Prentice Hall, 2012
3. Gahlot and Dhir, Construction Planning and Management, New Age International, 1992

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	8 hours
1.1	Construction industry characteristics and challenges	1
1.2	Functions of construction management – Project life cycle – Role and responsibilities of project manager	2
1.3	Project stakeholders – Organisational structures in construction: line, functional, and matrix	2
1.4	Construction contracts and tendering overview	3
2	Module 2	8 hours
2.1	Construction planning concepts – Work Breakdown Structure (WBS) – Bar charts and milestone charts	3
2.2	Network planning fundamentals – Critical Path Method (CPM): network representation, time analysis	3
2.3	floats – Programme Evaluation and Review Technique (PERT): probability concepts – Comparison of CPM and PERT.	2
3	Module 3	7 hours
3.1	Resources in construction projects – Labour productivity and factors affecting productivity	2
3.2	Equipment planning and selection – Resource allocation – Resource levelling and smoothing	2
3.3	Manpower planning – Introduction to lean construction and waste minimization	3

4	Module 4	8 hours
4.1	Materials planning and control – Importance of inventory management in construction	1
4.2	Inventory costs – Economic Order Quantity (EOQ) –	2
4.3	ABC and VED analysis – Storage, handling, and transportation of construction materials	3
4.4	Stores layout and material logistics – Material wastage control	2
5	Module 5	5 hours
5.1	Project cost estimation and budgeting	1
5.2	Cash flow analysis – Time–cost trade-off – Project monitoring and control – Earned Value Analysis	2
5.3	Quality management systems in construction – Safety management: causes of accidents, prevention and safety regulations	2
Total		36 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Explain project lifecycle in construction.
2. Compare line and matrix organization.

Course Outcome 2 (CO 2):

1. Develop a CPM network and find critical path.
2. Explain PERT with probabilistic time estimates.

Course Outcome 3 (CO 3):

1. Discuss factors affecting labour productivity.
2. Explain resource levelling with example.

Course Outcome 4 (CO 4):

1. Derive EOQ and explain assumptions.
2. Discuss ABC analysis in construction.

Course Outcome 5 (CO 5):

1. Explain Earned Value Analysis.
2. Discuss safety management practices.

MODEL QUESTION PAPER

QP CODE:

Pages: 3

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

EIGHTH SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CE4P51

CONSTRUCTION PLANNING AND MANAGEMENT

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Define Work Breakdown Structure and explain its importance in project planning.
2. Differentiate between deterministic and probabilistic time estimation in network scheduling.
3. Define critical path and explain its significance in project control.
4. What is resource levelling and how does it differ from resource smoothing?
5. Define Economic Order Quantity and list its assumptions.
6. What is Earned Value Analysis and why is it important?
7. Define project life cycle and list its major phases.
8. What is float? Distinguish between total float and free float.
9. Define labour productivity and state factors affecting it.
10. What are direct and indirect costs in construction projects?

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. a) Explain in detail the construction project life cycle with suitable examples. (7)
b) Discuss the roles and responsibilities of a project manager in large-scale infrastructure projects. (7)

OR

12. a) Compare line organization, functional organization, and matrix organization structures with advantages and limitations. (7)
b) Explain different types of construction contracts and their implications on project risk allocation. (7)

MODULE 2

13. a) Explain in detail the principles of network planning in construction projects using Activity-on-Arrow representation. Discuss how precedence relationships are established and their significance in project scheduling. (7)
b) Critically analyze the concept of critical path in project scheduling. Explain its importance in project monitoring and control, and discuss the consequences of delays in critical and non-critical activities. (7)

OR

14. a) Explain the Programme Evaluation and Review Technique in detail, including optimistic, most likely, and pessimistic time estimates. (7)
b) For an activity with time estimates: optimistic = 6 days, most likely = 9 days, pessimistic = 18 days: (i) Calculate expected time (ii) Calculate variance (iii) Determine probability of completion within 10 days. (7)

MODULE 3

15. a) Explain resource allocation, resource levelling, and resource smoothing with suitable diagrams. (7)
b) A construction project requires 120 labourers, but only 80 labourers are available. Develop a strategy for optimal manpower utilization and discuss its impact on project duration. (7)

OR

16. a) Discuss factors affecting labour productivity in construction projects and methods to improve productivity. (7)
b) Explain equipment selection criteria and justify selection for a highway construction project involving earthwork and compaction. (7)

MODULE 4

17. a) Derive the Economic Order Quantity formula from first principles and explain all assumptions. (7)
- b) A project consumes 12,000 units of material per year. Ordering cost is 500 per order and holding cost is 10 per unit per year: (i) Calculate Economic Order Quantity (ii) Number of orders per year (iii) Total inventory cost. (7)

OR

18. a) Explain ABC analysis and VED analysis in material management and compare their applications. (7)
- b) Discuss storage, handling, and transportation techniques for minimizing material wastage in large construction projects. (7)

MODULE 5

19. a) Explain Earned Value Analysis with definitions of Planned Value, Earned Value, and Actual Cost. (7)
- b) A project has the following data: Planned Value = Rs.10,00,000 Earned Value = Rs.8,00,000 Actual Cost = Rs.9,50,000 Calculate: (i) Cost Variance (ii) Schedule Variance (iii) Cost Performance Index (iv) Schedule Performance Index Interpret the results. (7)

OR

20. a) Explain time-cost trade-off in construction projects with suitable example. (7)
- b) Discuss safety management practices in construction, including causes of accidents and preventive measures. Also explain the role of safety regulations in ensuring compliance. (7)

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE4P52	SUSTAINABILITY AND ENVIRONMENTAL HEALTH	2	1	0	4	3	2024

Preamble

This course introduces the principles of sustainability, environmental health, and occupational safety in engineering and workplace settings. It covers health risks, hazard control, pollution prevention, waste management, and resource-efficient practices for safer and sustainable environments. The course helps students understand the role of engineering in protecting human health and promoting long-term sustainability.

Prerequisites: NIL

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Explain the fundamental concepts of sustainability, environmental health, and their relevance to engineering practices. (Cognitive Knowledge Level: Understand)
CO 2	Describe occupational health hazards, exposure pathways, and worker well-being measures in industrial and construction environments. (Cognitive Knowledge Level: Understand)
CO 3	Apply hazard identification techniques, risk assessment methods, and control measures for improving workplace safety. (Cognitive Knowledge Level: Apply)
CO 4	Apply pollution prevention, waste management, and resource conservation strategies for sustainable industrial operations. (Cognitive Knowledge Level: Apply)
CO 5	Analyze the integration of safety, health, and sustainability principles in workplace design and environmental management systems. (Cognitive Knowledge Level: Analyze)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	2	1	3	1	1	3	3	1	1	1	1
CO 2	2	1	3	1	1	3	2	1	1	1	1
CO 3	3	2	3	2	2	3	2	1	2	1	1
CO 4	3	2	3	2	2	3	3	2	1	1	1
CO 5	3	2	3	3	2	3	3	2	2	1	1

Assessment Pattern

SUSTAINABILITY AND ENVIRONMENTAL HEALTH			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	50		20
Understand	50	50	40
Apply		30	20
Analyse		20	20
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course Project : 10 marks

Self Study : 5 marks

End Semester Examination Pattern

There will be two parts: Part A and Part B. Part A contain 10 questions, with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module, of which students should answer any one. Each question carries 14 marks and can have a maximum of 2 sub-divisions.

SYLLABUS

Module 1: Fundamentals of Sustainability and Environmental Health (6 hours)

Concepts and principles of sustainability; Environmental, economic, and social dimensions of sustainability; Relationship between environmental quality and human health; Sustainable Development Goals relevant to civil engineering (SDG 3, SDG 11, SDG 12); Applications in green buildings, sustainable infrastructure, and low-carbon development.

Module 2: Occupational Health and Worker Well-being (7 hours)

Occupational health in industrial and construction sectors; Physical, chemical, biological, and ergonomic health risks; Common occupational diseases and disorders; Basics of toxicology, exposure pathways, and occupational exposure limits; Industrial hygiene principles and health surveillance; Safer material substitution and worker well-being initiatives.

Module 3: Workplace Hazard Identification and Risk Control (8 Hours)

Types of workplace hazards: chemical, biological, physical, electrical, and radiation; Hazard identification techniques and risk assessment methods; Hierarchy of controls; Engineering controls: ventilation, isolation, and enclosure; Administrative controls, hygiene practices, and safe work procedures; Emergency preparedness and incident prevention.

Module 4: Pollution Prevention and Sustainable Waste Management (8 Hours)

Air and water pollution: sources, pollutants, and health impacts; Pollution prevention strategies in industrial and construction activities; Effluent standards and sustainable water management; Water conservation, reuse, and recycling; Solid waste classification and management; Circular economy, waste minimization, and resource recovery.

Module 5: Safe, Healthy, and Sustainable Work Environments (7 Hours)

Workplace safety audits and inspections; Welfare facilities and occupational health services; First aid and emergency response systems; Personal protective equipment: selection, use, and limitations; Resource conservation and cleaner production; Integration of safety, health, and sustainability in workplace design and management.

Text Books:

1. Peavy, H. S., Rowe, D. R., and Tchobanoglous, G. (2013). Environmental Engineering. McGraw-Hill Education, New Delhi.

2. Goel, P. K. (2010). Occupational Health and Industrial Safety. New Age International Publishers, New Delhi.
3. Gangrade, K. D., and Singh, S. P. (2012). Environmental Management and Safety Engineering. Standard Publishers Distributors, New Delhi.
4. Hammer, M. J., and Hammer, M. J. Jr. (2011). Water and Wastewater Technology, 7th Edition. Pearson Education, India.
5. Lees, F. P. (2012). Loss Prevention in the Process Industries, 4th Edition. Butterworth-Heinemann, Oxford.

References:

1. Levy, B. S., Wegman, D. H., Baron, S. L., and Sokas, R. K. (2017). Occupational and Environmental Health: Recognizing and Preventing Disease and Injury, 7th Edition. Oxford University Press, New York.
2. Jackson, R. J., and Frumkin, H. (2006). Urban Sprawl and Public Health: Designing, Planning, and Building for Healthy Communities. Island Press, Washington DC.
3. Reese, C. D. (2015). Occupational Health and Safety Management: A Practical Approach, 3rd Edition. CRC Press, Boca Raton.
4. Arezes, P., Baptista, J. S., Barroso, M., Carneiro, P., Cordeiro, P., Costa, N., Melo, R. B., and Miguel, A. S. (2019). Occupational and Environmental Safety and Health. Springer, Cham.
5. Government of India. (2020). Occupational Safety, Health and Working Conditions Code. Ministry of Labour and Employment, New Delhi.
6. Central Pollution Control Board (CPCB). Latest Manuals and Guidelines on Air Pollution, Water Pollution, and Waste Management. Government of India, New Delhi.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	6 hours
1.1	Concepts and principles of sustainability; Environmental, economic, and social dimensions of sustainability	2
1.2	Relationship between environmental quality and human health	1
1.3	Sustainable Development Goals relevant to civil engineering (SDG 3, SDG 11, SDG 12)	1
1.4	Applications in green buildings, sustainable infrastructure, and low-carbon development.	2
2	Module 2	7 hours
2.1	Occupational health in industrial and construction sectors; Physical, chemical, biological, and ergonomic health risks	3
2.2	Common occupational diseases and disorders; Basics of toxicology, exposure pathways, and occupational exposure limits	2
2.3	Industrial hygiene principles and health surveillance; Safer material substitution and worker well-being initiatives.	2
3	Module 3	8 hours
3.1	Types of workplace hazards: chemical, biological, physical, electrical, and radiation	2
3.2	Hazard identification techniques and risk assessment methods	2
3.3	Hierarchy of controls; Engineering controls: ventilation, isolation, and enclosure	2
3.4	Administrative controls, hygiene practices, and safe work procedures; Emergency preparedness and incident prevention.	2
4	Module 4	8 hours

4.1	Air and water pollution: sources, pollutants, and health impacts	2
4.2	Pollution prevention strategies in industrial and construction activities	2
4.3	Effluent standards and sustainable water management; Water conservation, reuse, and recycling	2
4.4	Solid waste classification and management; Circular economy, waste minimization, and resource recovery.	2
5	Module 5	7 hours
5.1	Workplace safety audits and inspections; Welfare facilities and occupational health services; First aid and emergency response systems	3
5.2	Personal protective equipment: selection, use, and limitations	2
5.3	Resource conservation and cleaner production	1
5.4	Integration of safety, health, and sustainability in workplace design and management.	1
Total		36 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Explain the concept of sustainable development and its relevance to the construction sector.
2. List any six eco-friendly materials and briefly mention their typical applications in buildings.
3. Discuss how the use of local and indigenous materials can reduce the embodied energy and carbon footprint of a building.

Course Outcome 2 (CO 2):

1. Explain the principles of modular construction and outline its advantages for affordable housing.
2. With sketches, describe any two alternative roofing systems suitable for eco-friendly buildings.
3. Discuss the role of organizations such as COSTFORD and Nirmithi Kendra in promoting cost-effective and sustainable building technologies.

Course Outcome 3 (CO 3):

1. Define embodied energy and carbon footprint of building materials with suitable examples.
2. Compare the environmental impact of a conventional reinforced concrete frame structure with an alternative low-embodied-energy system.
3. Explain the basic steps involved in life-cycle costing and how it can be applied to compare a green building with a conventional building.

Course Outcome 4 (CO 4):

1. List the main features of any two green building rating systems used in India.
2. Explain the importance of sustainable site selection and planning in green building design.
3. Discuss how energy-efficient and water-efficient design strategies are incorporated in green building rating criteria.

Course Outcome 5 (CO 5):

1. Describe any three solar passive design strategies suitable for warm-humid climates.
2. Explain the significance of ECBC 2018 in improving the energy performance of commercial buildings in India.
3. Using a simple case study, illustrate how passive measures and ECBC provisions together can reduce the operational energy demand of a building.

MODEL QUESTION PAPER

QP CODE:

Pages: 3

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

FIRST SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CE4P52

SUSTAINABILITY AND ENVIRONMENTAL HEALTH

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. State the three dimensions of sustainability with suitable examples.
2. Outline the influence of environmental quality on human health.
3. List the major occupational health risks in industrial and construction sectors.
4. Summarize the importance of occupational exposure limits in workplaces.
5. Classify common workplace hazards under suitable categories.
6. State the hierarchy of controls used for hazard management.
7. List major sources of air and water pollution from industrial activities.
8. Outline the principles of circular economy in waste management.
9. State the objectives of workplace safety audits and inspections.
10. Summarize the role of Personal Protective Equipment in workplace safety.

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. a) Explain the concepts, principles, and dimensions of sustainability. (8)
b) Discuss the relevance of SDG 3, SDG 11, and SDG 12 to engineering practice. (6)

OR

12. a) Describe the relationship between environmental quality and human health. (8)
b) Analyze applications of sustainability in green buildings and low-carbon development. (6)

MODULE 2

13. a) Explain physical, chemical, biological, and ergonomic health risks in workplaces. (8)
b) Discuss common occupational diseases and preventive measures. (6)

OR

14. a) Describe toxicology principles, exposure pathways, and occupational exposure limits. (8)
b) Analyze industrial hygiene principles and worker well-being initiatives. (6)

MODULE 3

15. a) Explain hazard identification techniques and risk assessment methods. (8)
b) Apply the hierarchy of controls for hazard reduction. (6)

OR

16. a) Discuss engineering controls such as ventilation, isolation, and enclosure. (8)
b) Analyze administrative controls and emergency preparedness measures. (6)

MODULE 4

17. a) Explain sources, pollutants, and health impacts of air and water pollution. (8)
b) Apply water conservation, reuse, and recycling methods. (6)

OR

18. a) Classify solid wastes and discuss suitable management methods (8)

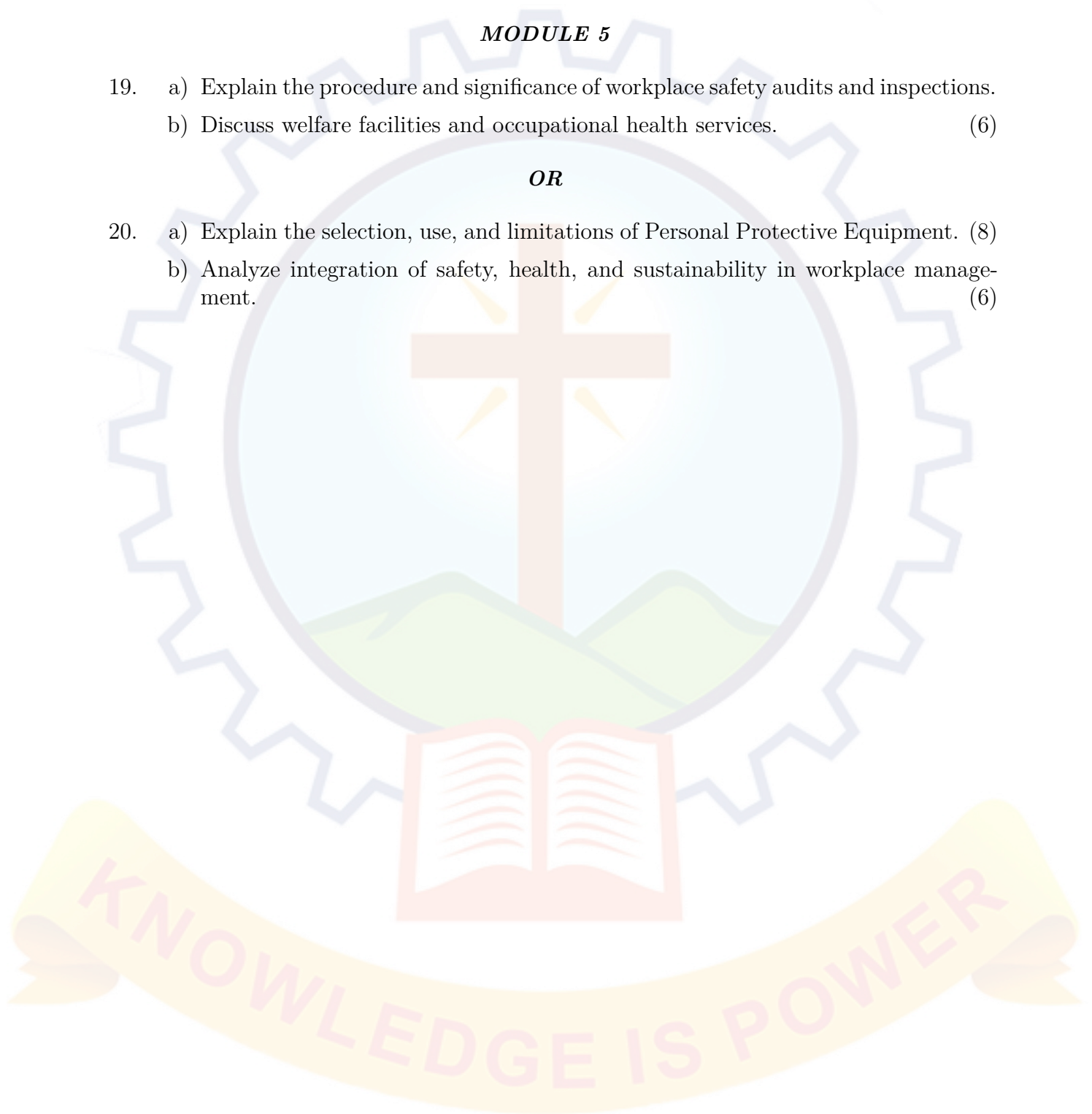
- b) Analyze circular economy approaches for waste minimization and resource recovery. (6)

MODULE 5

19. a) Explain the procedure and significance of workplace safety audits and inspections.
b) Discuss welfare facilities and occupational health services. (6)

OR

20. a) Explain the selection, use, and limitations of Personal Protective Equipment. (8)
b) Analyze integration of safety, health, and sustainability in workplace management. (6)



CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE4P53	EARTHQUAKE RESISTANT DESIGN OF STRUCTURES	2	1	0	4	3	2024

Preamble

The course offers a comprehensive understanding of the fundamental principles behind the earthquake-resistant design of structures. It introduces engineering aspects of earthquakes, including their characterization and impacts. The syllabus encompasses the design and detailing in accordance with the Indian Standards. Additionally, the course covers earthquake-resistant construction techniques for masonry structures and methods for retrofitting existing buildings.

Prerequisites: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Understand the fundamental mechanism and effects of earthquakes, interpret seismic measurements and analyse the characteristics of response spectra essential for earthquake-resistant design. (Cognitive Knowledge Level: Understand)
CO 2	Analyse the influence of structural and architectural irregularities on seismic behavior, understand the philosophy of capacity design and apply the principles of earthquake-resistant construction to ensure structural safety and integrity. (Cognitive Knowledge Level: Apply)
CO 3	Compute seismic forces on real-life structures using IS code provisions, analyse structural response through static methods, and evaluate base shear distribution in reinforced concrete buildings. (Cognitive Knowledge Level: Apply)
CO 4	Apply the principles of ductility and torsional behavior in earthquake-resistant design, and implement appropriate detailing, repair, and retrofitting techniques as per Indian Standards. (Cognitive Knowledge Level: Apply)
CO 5	Employ earthquake-resistant construction practices for masonry structures and utilize suitable repair and retrofitting techniques to enhance their seismic performance. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	2	2			2		2	1		1
CO 2	3		3			2		1		1	
CO 3	3	3	3	2	1			2		1	
CO 4	3		3	1	1		3	2	1	1	2
CO 5	3	2	3	2	2	2	3	2	1	1	2

Assessment Pattern

EARTHQUAKE RESISTANT DESIGN OF STRUCTURES			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember			
Understand	40	30	30
Apply	30	50	40
Analyse	30	20	30
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course Project : 10 marks

Self Study : 5 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question carries 14 marks and can have maximum 2 sub-divisions.

SYLLABUS

Module 1: Introduction to Earthquakes and Seismic Response (6 Hours)

Earthquakes: Mechanism, Elastic rebound theory, Seismic waves, Effects of earthquakes. Size of earthquake – intensity & magnitude, concept of Richter scale. Measurement of earthquakes – seismographs and accelerograph Strong motion characteristics, response spectrum, characteristics of response spectrum, design spectrum, construction of tripartite response spectrum

Module 2: Earthquake-Resistant Design Principles (8 Hours)

Structural irregularities, Effect of architectural features, Damages during past earthquakes. Concept of capacity design, Strong Column and weak beam, Philosophy of earthquake resistant construction. Principle of earthquake resistant construction.

Module 3: Seismic Analysis of Structures as per IS 1893 (Part 1):2016 (8 Hours)

Seismic force computation using IS code provisions. Static method of analysis, Response spectrum analysis – theoretical aspects. Introduction to pushover analysis and performance-based design. Performance of RC structures during EQ, Base shear calculation as per IS 1893 (Part 1):2016, Zone factor, Importance factor, Response reduction factor, Fundamental time-period estimation, Distribution of lateral forces over height.

Module 4: Ductile Detailing and Earthquake-Resistant Construction Practices (6 Hours)

Torsional behavior of buildings - Codal provisions. Ductility – significance in earthquake resistant design, Ductility factors, Ductile detailing considerations as per IS:13920. Detailing of structural members & joints, Repair and retrofitting of RCC structures, Response reduction techniques, Base isolation. **Module 5: Seismic Performance and Retrofitting of**

Masonry Structures (8 Hours)

Performance of masonry structures during earthquakes, box action, influence of openings, role of horizontal and vertical bands, rocking of masonry piers. Repair and retrofitting of masonry structures .

Text Books:

1. Duggal, S. K., Design of Steel Structures, Tata McGraw-Hill Education, New Delhi.

2. Subramanian, N., Design of Steel Structures, Oxford University Press, India.
3. Arya, A. S. and Ajmani, J. L., Design of Steel Structures, Nem Chand & Bros., Roorkee.

References:

1. S. K. Duggal, “Earthquake Resistant Design of Structures”, Oxford University Press, New Delhi.
2. Pankaj Agarwal and Manish Shrikhande, “Earthquake Resistant Design of Structures”, Prentice Hall of India Private Limited, New Delhi, India.
3. Anil K. Chopra, “Dynamics of Structures”. Theory and Applications to Earthquake Engineering, Pearson Education, India.
4. IITK-GSDMA Guidelines, “Earthquake Tips” EQ01–EQ23, Department of Civil Engineering, IIT Kanpur, and Building Materials and Technology Promotion Council (BMTPC), Government of India.

Indian Standard Codes:

1. IS 800:2007 – General Construction in Steel – Code of Practice..
2. IS 801:1975 – Code of Practice for Use of Cold-Formed Light Gauge Steel Structural Members.
3. IS 806:1968 – Code of Practice for Use of Steel Tubes in General Building Construction.
4. IS 875 (Part 1–5) – Code of Practice for Design Loads.
5. IS 1893 (Part 1):2016 – Criteria for Earthquake Resistant Design of Structures.
6. IS 816:1969 – Code of Practice for Use of Metal Arc Welding for General Construction.
7. IS 1367 (Part 1–18) – Technical Supply Conditions for Threaded Steel Fasteners.
8. IS 6623:2004 – High Strength Structural Bolts.
9. IS 1024:1999 – Code of Practice for Welding of Structures Subjected to Dynamic Loads.
10. IS 1641:1988 – Fire Safety of Buildings – General Requirements.

Handbooks:

1. SP 6 (Part 1 & 2):1964 – Handbook for Structural Engineers – Steel Sections.
2. SP 38:1987 – Handbook of Typified Designs for Structures with Steel Roof Trusses

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	6 Hours
1.1	Earthquakes: Mechanism, Elastic rebound theory, Seismic waves, Effects of earthquakes.	1
1.2	Size of earthquake – intensity, magnitude, concept of Richter scale.	2
1.3	Measurement of earthquakes – seismographs and accelerograph	1
1.4	Strong motion characteristics, response spectrum, characteristics of response spectrum, design spectrum, construction of tripartite response spectrum	1
2	Module 2	8 Hours
2.1	Structural irregularities, Effect of architectural features, Damages during past earthquakes.	3
2.2	Concept of capacity design, Strong Column and weak beam	2
2.3	Philosophy of earthquake resistant construction. Principle of earthquake resistant construction.	3
3	Module 3	8 Hours
3.1	Seismic force computation using IS code provisions. Static method of analysis, Response spectrum analysis – theoretical aspects.	2
3.2	Introduction to pushover analysis and performance-based design.	2
3.3	Performance of RC structures during EQ, Base shear calculation as per IS 1893 (Part 1):2016	2
3.3	Zone factor, Importance factor, Response reduction factor, Fundamental time-period estimation, Distribution of lateral forces over height.	2

4	Module 4	6 Hours
4.1	Torsional behavior of buildings - Codal provisions. Ductility – significance in earthquake resistant design, Ductility factors, Ductile detailing considerations as per IS:13920.	1
4.2	Detailing of structural members joints,	2
4.3	Repair and retrofitting of RCC structures,	2
4.4	Response reduction techniques, Base isolation.	1
5	Module 5	8 Hours
5.1	Performance of masonry structures during earthquakes, box action	3
5.2	Influence of openings, role of horizontal and vertical bands, rocking of masonry piers.	2
5.3	Repair and retrofitting of masonry structures	3
Total		36 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Explain the Elastic Rebound Theory and discuss its significance in understanding earthquake mechanisms.
2. Describe the different types of seismic waves and explain how each contributes to structural damage during an earthquake.

Course Outcome 2 (CO 2):

1. Examine the effects of plan and vertical irregularities on the seismic performance of buildings with suitable examples. Discuss the role of PCA in data compression and information extraction from multispectral images.
2. Apply the strong column–weak beam principle to propose modifications for an irregular RC frame structure.

Course Outcome 3 (CO 3):

1. Analyse the variation of design base shear with building height and fundamental time period as per IS 1893 (Part 1):2016 for different soil types.
2. Explain the steps involved in response spectrum analysis and analyse how it differs from the equivalent static method.

Course Outcome 4 (CO 4):

1. Illustrate ductile detailing provisions for a beam–column joint as per IS 13920:2016 and justify their importance in seismic performance.
2. Suggest appropriate retrofitting techniques to strengthen a torsionally irregular RC building damaged during an earthquake.

Course Outcome 5 (CO 5):

1. Suggest suitable seismic strengthening measures for a load-bearing masonry wall with large openings.
2. Recommend appropriate repair and retrofitting methods for restoring the box action of a damaged masonry building.

MODEL QUESTION PAPER

QP CODE:

Pages: 3

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

EIGHTH SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CE4P53

EARTHQUAKE RESISTANT DESIGN OF STRUCTURES

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. How does movement of the mantle contribute to the formation of earthquake.
2. State the Elastic Rebound Theory and explain its significance in earthquake generation.
3. Define structural irregularities and mention their types as per IS 1893.
4. Explain the concept of capacity design and its importance in earthquake-resistant structures.
5. What is base shear? Mention the parameters influencing its calculation as per IS 1893 (Part 1):2016.
6. Define fundamental time period and describe its importance in seismic analysis.
7. State the significance of ductility in seismic design of RC structures.
8. What is torsional irregularity? Mention how it affects structural performance during earthquakes.
9. Explain the term box action in masonry structure
10. What is the role of horizontal and vertical bands in improving seismic performance of masonry buildings?

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. a) Explain the mechanism of earthquakes and describe different types of seismic waves. . (7)
b) Discuss the construction and significance of response spectra and the concept of tripartite spectrum. (7)

OR

12. a) Explain how earthquake magnitude and intensity are measured using Richter scale and seismographs. (7)
b) Discuss the effects of earthquakes on buildings and infrastructure with suitable examples. (7)

MODULE 2

13. a) Describe structural and architectural irregularities and their influence on seismic performance. (7)
b) Explain the principle of strong column–weak beam and its role in earthquake-resistant design. (7)

OR

14. a) Discuss the philosophy of earthquake-resistant construction and the concept of capacity design. (7)
b) Summarize the types of damage observed in past earthquakes due to poor architectural planning. (7)

MODULE 3

15. a) Explain the procedure for seismic force computation using the Equivalent Static Method as per IS 1893 (Part 1):2016. (7)
b) Derive the expression for design base shear and explain how it is distributed over building height (7)

OR

16. a) Discuss the Response Spectrum Method of analysis and its advantages over static analysis. (7)
b) Explain the significance of zone factor, importance factor, and response reduction factor in seismic design. (7)

MODULE 4

17. a) Explain the concept of steel–concrete composite construction with advantages. (7)
b) Explain the role of shear connectors in composite beams. (7)

OR

18. a) Describe the repair and retrofitting techniques adopted for earthquake-damaged RC structures. (7)
b) Explain the response reduction techniques, focusing on the concept and application of base isolation. (7)

MODULE 5

19. a) Explain the seismic performance of masonry structures and the importance of box action. (7)
b) Discuss how openings affect the seismic strength and stability of masonry buildings. (7)

OR

20. a) Describe the rocking behavior of masonry piers under earthquake loading. (7)
b) Explain the methods of repair and retrofitting used to enhance the seismic resistance of masonry structures. (7)

KNOWLEDGE IS POWER

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE4P54	TRAFFIC ENGINEERING AND SAFETY	2	1	0	4	3	2024

Preamble

This course focuses on the integration of traffic engineering principles with road safety analysis and design. It equips students with the ability to evaluate traffic operations, analyze crash data, and propose engineering and management measures to improve safety in transportation systems.

Prerequisites: B24CE2T06 -Highway and Pavement Engineering

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Explain road user behavior and vehicle characteristics influencing traffic safety. (Cognitive Knowledge Level: Understand)
CO 2	Analyze traffic operations, capacity, and their relationship with crash occurrence.(Cognitive Knowledge Level: Understand)
CO 3	Design and evaluate traffic control devices and intersection safety measures. (Cognitive Knowledge Level: Apply)
CO 4	Perform accident analysis and conduct road safety audits. (Cognitive Knowledge Level: Apply)
CO 5	Propose engineering, enforcement, and policy-based safety improvements. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	2	-	-	-	-	-	-	-	-	-
CO2	2	3	1	2	-	-	-	-	-	-	-
CO3	1	2	3	2	2	-	-	-	-	1	-
CO4	1	3	2	3	1	-	-	-	-	1	-
CO5	-	2	3	2	1	3	2	2	-	2	1

Assessment Pattern

TRAFFIC ENGINEERING AND SAFETY			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	30	30	30
Understand	50	50	50
Apply	20	20	20
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course Project : 10 marks

Self Study : 5 marks

End Semester Examination Pattern

There will be two parts: Part A and Part B. Part A contain 10 questions, with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module, of which students should answer any one. Each question carries 14 marks and can have a maximum of 2 sub-divisions.

SYLLABUS

Module 1: Road User, Vehicle Characteristics and Safety Implications (7 hours)

Driver behavior and reaction time; perception–reaction process; human factors in crashes; vehicle performance characteristics including braking, acceleration and maneuverability; interaction between driver, vehicle and roadway; influence of traffic stream parameters on safety; speed, flow and density relationships; fundamental diagrams

Module 2: Traffic Operations and Capacity from a Safety Perspective (7 hours)

Capacity and level of service concepts with safety considerations; speed studies and their role in crash analysis; gap acceptance and intersection behavior; intersection analysis for safety criteria; relationship between congestion and crash occurrence; operational measures influencing conflict probability; safety performance measures in interrupted and uninterrupted flow.

Module 3: Traffic Control Devices and Safe Intersection Design (7 Hours)

Traffic signs, road markings and signals; signal timing and phase design considerations for safety; channelization and intersection design principles; control of conflict points; access management; speed management through geometric and operational design; safety evaluation of control measures.

Module 4: Accident Analysis and Road Safety Assessment(8 Hours)

Accident data systems and reporting; collision diagrams and condition diagrams; statistical analysis of accident data; crash severity and frequency models; identification of black spots; road safety audit procedures; safety inspection methodologies; safety performance indicators and evaluation techniques.

Module 5: Engineering, Management and Policy Measures for Safety Improvement(7 Hours)

Engineering measures for accident reduction; geometric design and safety principles; traffic calming techniques; pedestrian and vulnerable road user safety; enforcement and education strategies; vehicle safety standards; post-crash response systems; safety management frameworks; monitoring and evaluation of safety interventions.

Text Books:

1. Garber, N.J. and Hoel, L.A., *Traffic and Highway Engineering*, 5th edn., Cengage Learning, 2015.
2. Roess, R.P., Prassas, E.S. and McShane, W.R., *Traffic Engineering*, 4th edn., Pearson, 2011.
3. Khanna, S.K., Justo, C.E.G. and Veeraragavan, A., *Highway Engineering*, 10th edn., Nem Chand & Bros., New Delhi, 2015.
4. Kadiyali, L.R., *Traffic Engineering and Transport Planning*, 7th edn., Khanna Publishers, New Delhi, 2017.

References:

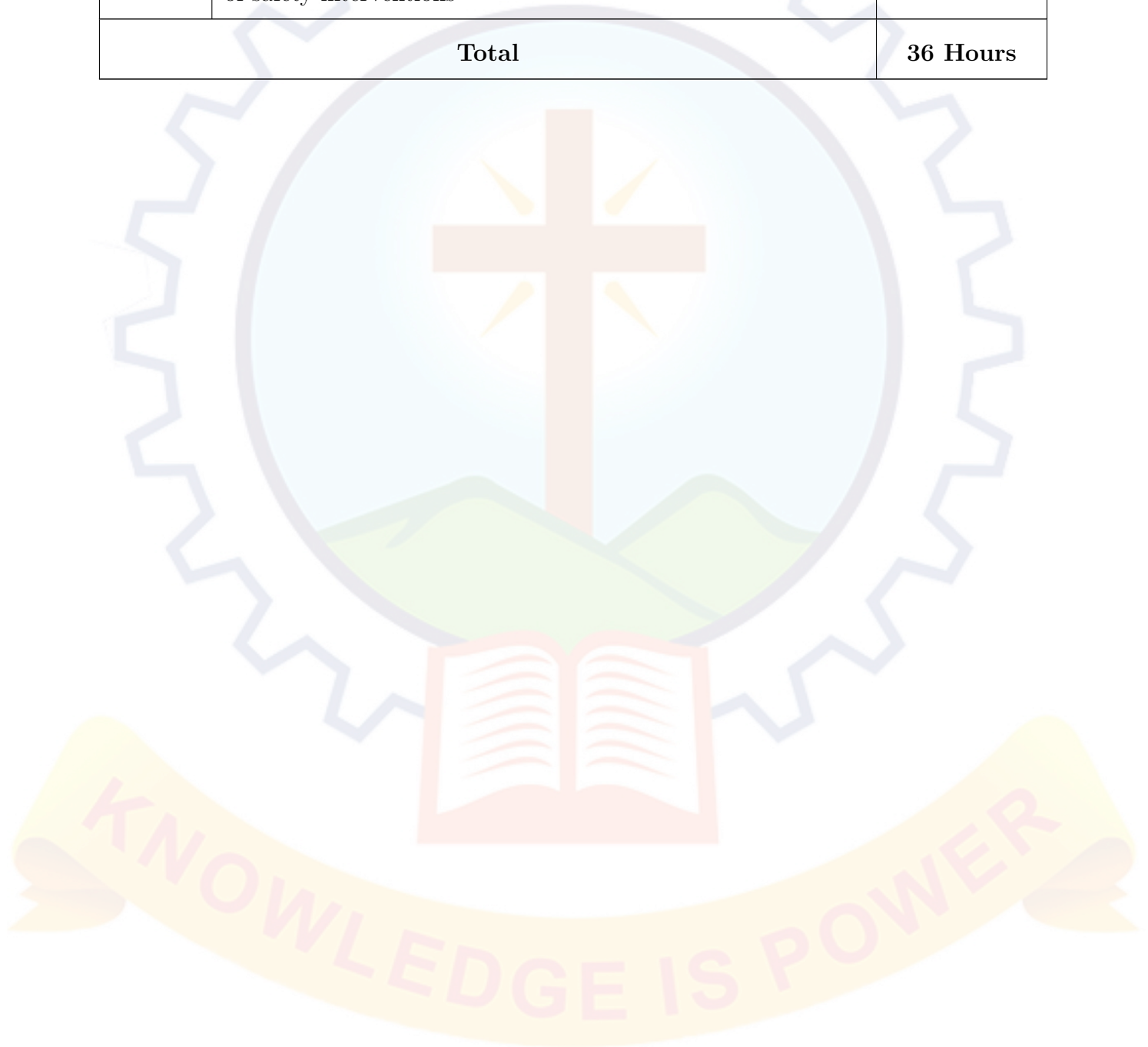
1. Transportation Research Board, *Highway Capacity Manual (HCM)*, 6th edn., National Academy of Sciences, Washington, D.C., 2016.
2. American Association of State Highway and Transportation Officials (AASHTO), *Highway Safety Manual*, 1st edn., AASHTO, Washington, D.C., 2010.
3. Indian Roads Congress (IRC), *Guidelines on Traffic Control Devices*, IRC:67, New Delhi, 2012.
4. Indian Roads Congress (IRC), *Road Safety Audit Manual*, IRC:SP:88, New Delhi, 2010.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	7 hours
1.1	Driver behavior and reaction time; perception–reaction process; human factors in crashes; vehicle performance characteristics including braking, acceleration and maneuverability; interaction between driver, vehicle and roadway	3
1.2	Speed, flow and density relationships; fundamental diagrams	2
1.3	Innfluence of traffic stream parameters on safety	2
2	Module 2	7 hours

2.1	Capacity and level of service concepts with safety considerations	1
2.2	Speed studies and their role in crash analysis	2
2.3	Gap acceptance and intersection behavior; intersection analysis for safety criteria;	2
2.4	Relationship between congestion and crash occurrence; operational measures influencing conflict probability; safety performance measures in interrupted and uninterrupted flow	2
3	Module 3	7 hours
3.1	Traffic signs, road markings and signals, signal timing and phase design considerations for safety	2
3.2	Channelization and intersection design principles; control of conflict points;	2
3.3	Access management; speed management through geometric and operational design	1
3.4	Safety evaluation of control measures	2
4	Module 4	8 hours
4.1	Accident data systems and reporting; collision diagrams and condition diagrams	2
4.2	Statistical analysis of accident data; crash severity and frequency model	2
4.3	Identification of black spots; road safety audit procedures; safety inspection methodologies	2
4.4	safety performance indicators and evaluation techniques	2
5	Module 5	7 hours
5.1	Engineering measures for accident reduction; geometric design and safety principles; traffic calming technique	2
5.2	Pedestrian and vulnerable road user safety	1

5.3	Enforcement and education strategies; vehicle safety standards;	1
5.4	Post-crash response systems	1
5.5	Safety management frameworks; monitoring and evaluation of safety interventions	2
Total		36 Hours



CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Define perception–reaction time (PRT). List the stages involved in the perception–reaction process.
2. What are human factors in traffic crashes? Mention any four driver-related human factors affecting road safety.
3. Explain the fundamental relationships between speed, flow, and density. Draw and describe the fundamental diagrams of traffic flow and explain how traffic stream parameters influence roadway safety.

Course Outcome 2 (CO 2):

1. Define capacity and Level of Service (LOS).
2. Discuss how congestion affects crash occurrence and overall traffic performance.
3. Explain intersection analysis procedures based on safety criteria and driver decision-making.

Course Outcome 3 (CO 3):

1. Classify traffic signs based on their function. Give two examples for each category.
2. What is channelization? State its purpose in improving intersection safety.
3. Explain the role of traffic signs, road markings, and traffic signals in improving roadway safety. Discuss important considerations in signal timing and phase design from a safety perspective.

Course Outcome 4 (CO 4):

1. List the essential information typically included in accident reporting formats.
2. Define a black spot (accident-prone location). State the criteria used for its identification.
3. Describe the steps involved in conducting a road safety audit.

Course Outcome 5 (CO 5):

1. Discuss the role of geometric design principles in improving road safety.
2. Who are vulnerable road users (VRUs)? List the safety measures provided for their protection
3. Discuss the role of geometric design principles in improving road safety. Explain various engineering measures adopted for accident reduction.

MODEL QUESTION PAPER

QP CODE:

Pages: 3

Reg.No.:

Name:

**MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM**

EIGHTH SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CE4P54

TRAFFIC ENGINEERING AND SAFETY

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. List the main vehicle performance characteristics that influence traffic safety.
2. Define speed, flow, and density in traffic engineering. State their standard units.
3. Distinguish between critical gap and follow-up time at intersections.
4. List the factors that influence Level of Service at a roadway facility.
5. Define signal phase and cycle length. How do they influence traffic safety?
6. List any three measures used in access control of highways.
7. Differentiate between collision diagrams and condition diagrams.
8. List any four safety performance indicators used in road safety evaluation.
9. Define traffic calming.
10. What is a post-crash response system? Mention its key components.

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. Explain driver behavior and reaction time. Describe the perception–reaction process in detail and discuss how human factors contribute to traffic crashes.

OR

12. Discuss vehicle performance characteristics such as braking, acceleration, and maneuverability. Explain how the interaction between driver, vehicle, and roadway affects overall traffic safety.

MODULE 2

13. Explain the concepts of capacity and Level of Service (LOS) with respect to roadway safety. Discuss how congestion affects crash occurrence and overall traffic performance.

OR

14. a) Describe safety performance measures used in both interrupted flow and uninterrupted flow conditions. (8)
b) List any four operational measures that influence traffic conflict probability at intersections. (6)

MODULE 3

15. a) Describe the principles of channelization and intersection design. (8)
b) Explain how safety evaluation of traffic control measures is carried out using appropriate performance indicators. (6)

OR

16. a) Explain how proper geometric design helps in controlling conflict points and reducing crash risk. (8)
b) Discuss speed management techniques through geometric and operational design. (6)

MODULE 4

17. a) Explain the procedures for accident data collection and reporting. (8)
b) Discuss the statistical methods used in accident data analysis. (6)

OR

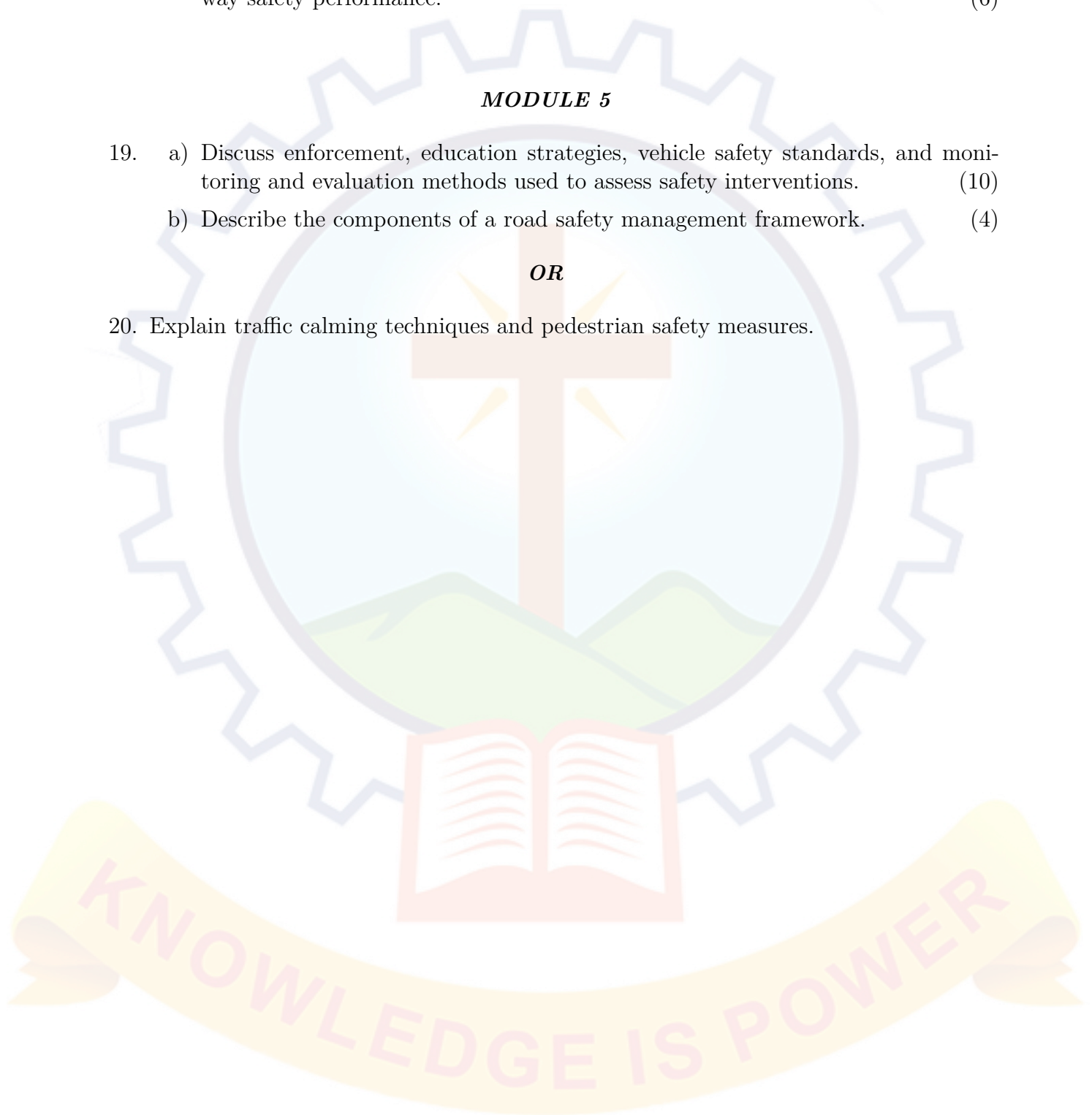
18. a) Describe the preparation and use of collision diagrams and condition diagrams in accident analysis. (8)
- b) Explain safety inspection methodologies and techniques used for evaluating roadway safety performance. (6)

MODULE 5

19. a) Discuss enforcement, education strategies, vehicle safety standards, and monitoring and evaluation methods used to assess safety interventions. (10)
- b) Describe the components of a road safety management framework. (4)

OR

20. Explain traffic calming techniques and pedestrian safety measures.



CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE4P55	GEOTECHNICAL INVESTIGATION	2	1	0	4	3	2024

Preamble

This course introduces the principles and practices of geotechnical investigation essential for safe and efficient civil engineering design. It covers planning of site exploration, soil classification, subsurface exploration techniques, sampling methods, in-situ and laboratory testing, and groundwater assessment. Emphasis is placed on interpretation of field and laboratory data to estimate bearing capacity, settlement, and foundation suitability, enabling students to develop reliable geotechnical reports and engineering recommendations.

Prerequisites: Soil Mechanics, Foundation Engineering

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Understand why and how site investigation is planned (Cognitive Knowledge Level: Understand)
CO 2	Gain practical knowledge of borehole operations and sampling methods. (Cognitive Knowledge Level: Understand)
CO 3	Interpret SPT data and understand basic in-situ test applications (Cognitive Knowledge Level: Apply)
CO 4	Understand which lab tests are required for investigation and how results are used. (Cognitive Knowledge Level: Understand)
CO 5	Learn how to convert field data into engineering recommendations (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	2	2	2	-	-	-	-	-	-	-	-
CO 2	2	3	3	2	2	-	-	-	-	-	-
CO 3	3	3	3	-	2	-	-	-	-	-	-
CO 4	3	3	3	-	-	2	1	-	-	-	-
CO 5	2	2	2	2	-	-	-	-	-	-	-

Assessment Pattern

GEOTECHNICAL INVESTIGATION			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	20	20	20
Understand	40	40	30
Apply	40	40	50
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course Project	: 10 marks
Self Study	: 5 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question carries 14 marks and can have maximum 2 sub-divisions.

SYLLABUS

Module 1: Fundamentals of Geotechnical Investigation : (6 Hours)

Objectives and Planning, Importance of site investigation, Stages: preliminary and detailed investigation, Planning borehole locations and depth

Soil Formation and Classification (Brief Review), Soil types and engineering behavior, IS soil classification system (focus on IS, brief mention of USCS)

Site Reconnaissance, Surface inspection, Collection of existing data, Identification of geotechnical hazards (landslides, liquefaction – concept only)

Module 2: Subsurface Exploration and Sampling : (8 Hours)

Methods of Subsurface Exploration, Trial pits and trenches, Auger boring, Wash boring, Rotary drilling (basic idea only)

Soil Sampling, Disturbed vs undisturbed samples, Split spoon sampler, Shelby tube sampler, Sample preservation and labelling

Groundwater Investigation, Determination of water table, Observation wells and piezometers (basic concept)

Module 3: In-Situ Testing Methods: (8 Hours)

Standard Penetration Test (SPT), Procedure, N-value interpretation, Corrections (overburden and dilatancy – simplified), Correlations for bearing capacity and ϕ

Cone Penetration Test (CPT) (Introductory), Principle and working, Soil profiling, Comparison with SPT

Other Field Tests (Brief Overview), Plate load test, Vane shear test, Field density test.

Module 4: Laboratory Testing for Investigation : (7 Hrs)

Index Properties (Brief Review), Moisture content, Specific gravity, Atterberg limits, Grain size distribution

Compaction and Permeability, Proctor test (concept and curves), Constant head and falling head tests

Shear Strength and Consolidation (Overview Level), Direct shear test, Triaxial test types (UU, CU, CD – conceptual only), Oedometer test (settlement estimation concept)

Module 5: Interpretation and Report Preparation (7 Hrs)

Geotechnical Investigation Report, Structure of report, Bore log presentation, Soil profile development

Interpretation of Results, Estimation of bearing capacity (using SPT correlation), Settlement estimation (basic concept), Recommendations for foundation type

Case Discussion, One building project example, Common investigation mistakes

Text Books:

1. Principles of Geotechnical Engineering by Braja M. Das
2. Site Investigation by Clayton, Matthews & Simons
3. Geotechnical Engineering: Principles and Practices by Donald P. Coduto
4. IS 1892: Code of Practice for Subsurface Investigation
5. ASTM and Eurocode standards for soil testing and site investigation
6. **Software:**
 - (a) Familiarization with geotechnical software for data analysis (e.g., GEO5, Rocscience, gINT)

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
	MODULE 1	6
1.1	Importance of site investigation, Stages: preliminary and detailed investigation, Planning borehole locations and depth	1
1.2	Soil Formation and Classification: Soil types and engineering behavior, IS soil classification system (focus on IS, brief mention of USCS)	2
1.3	Site Reconnaissance: Surface inspection, Collection of existing data, Identification of geotechnical hazards (landslides, liquefaction - concept only)	3
	MODULE 2	8
2.1	Methods of Subsurface Exploration: Trial pits and trenches, Auger boring, Wash boring, Rotary drilling (basic idea only)	2
2.2	Soil Sampling: Disturbed vs undisturbed samples, Split spoon sampler, Shelby tube sampler, Sample preservation and labeling	3
2.3	Groundwater Investigation: Determination of water table, Observation wells and piezometers (basic concept)	3

	MODULE 3	8
3.1	Standard Penetration Test: Procedure, N-value interpretation, Corrections (overburden and dilatancy - simplified), Correlations for bearing capacity and ϕ	2
3.2	Cone Penetration Test (Introductory): Principle and working, Soil profiling, Comparison with SPT	3
3.3	Other Field Tests (Brief Overview): Plate load test, Vane shear test, Field density test	3
	MODULE 4	7
4.1	Index Properties (Brief Review): Moisture content, Specific gravity, Atterberg limits, Grain size distribution	2
4.2	Compaction and Permeability: Proctor test (concept and curves), Constant head and falling head tests	2
4.3	Shear Strength and Consolidation (Overview Level): Direct shear test, Triaxial test types (UU, CU, CD - conceptual only), Oedometer test (settlement estimation concept)	3
	MODULE 5	7
5.1	Geotechnical Investigation Report: Structure of report, Bore log presentation, Soil profile development	2
5.2	Interpretation of Results: Estimation of bearing capacity (using SPT correlation), Settlement estimation (basic concept), Recommendations for foundation type	2
5.3	Case Discussion: One building project example, Common investigation mistakes	3
	Total	36 Hours

MODEL QUESTION PAPER

QP CODE:

Pages: 3

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

EIGHTH SEMESTER B. TECH DEGREE EXAMINATION, YEAR

Course Code: B24CE4P55

GEOTECHNICAL INVESTIGATION

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. What is the purpose of site investigation?
2. Define preliminary and detailed investigation.
3. What is soil reconnaissance?
4. Distinguish between disturbed and undisturbed samples.
5. What is split spoon sampler used for?
6. Define SPT N-value.
7. What is a piezometer?
8. List any two index properties of soil.
9. What is a bore log?
10. Mention any two common mistakes in site investigation.

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. (a) Explain the objectives and importance of site investigation. (7 marks)

- (b) Discuss stages of investigation and planning of borehole locations and depth. (7 marks)

OR

12. (a) Explain soil classification using IS system. (7 marks)
(b) Describe site reconnaissance and identification of geotechnical hazards. (7 marks)

MODULE 2

13. (a) Explain different methods of subsurface exploration. (7 marks)
(b) Describe types of soil samples and sampling techniques (split spoon & Shelby tube). (7 marks)

OR

14. (a) Explain auger boring and wash boring methods with advantages and limitations. (7 marks)
(b) Describe methods of groundwater investigation including observation wells and piezometers. (7 marks)

MODULE 3

15. (a) Explain the procedure of Standard Penetration Test (SPT). (6 marks)
(b) An SPT test gives $N = 18$ at a depth where overburden correction factor is 1.2. Calculate the corrected N-value and comment on soil density. (8 marks)

OR

16. (a) Explain the principle and working of CPT and compare with SPT. (7 marks)
(b) Describe any two field tests: Plate load test, Vane shear test (7 marks)

MODULE 4

17. (a) Explain Atterberg limits and their significance. (7 marks)
(b) Describe Proctor compaction test and explain the compaction curve. (7 marks)

OR

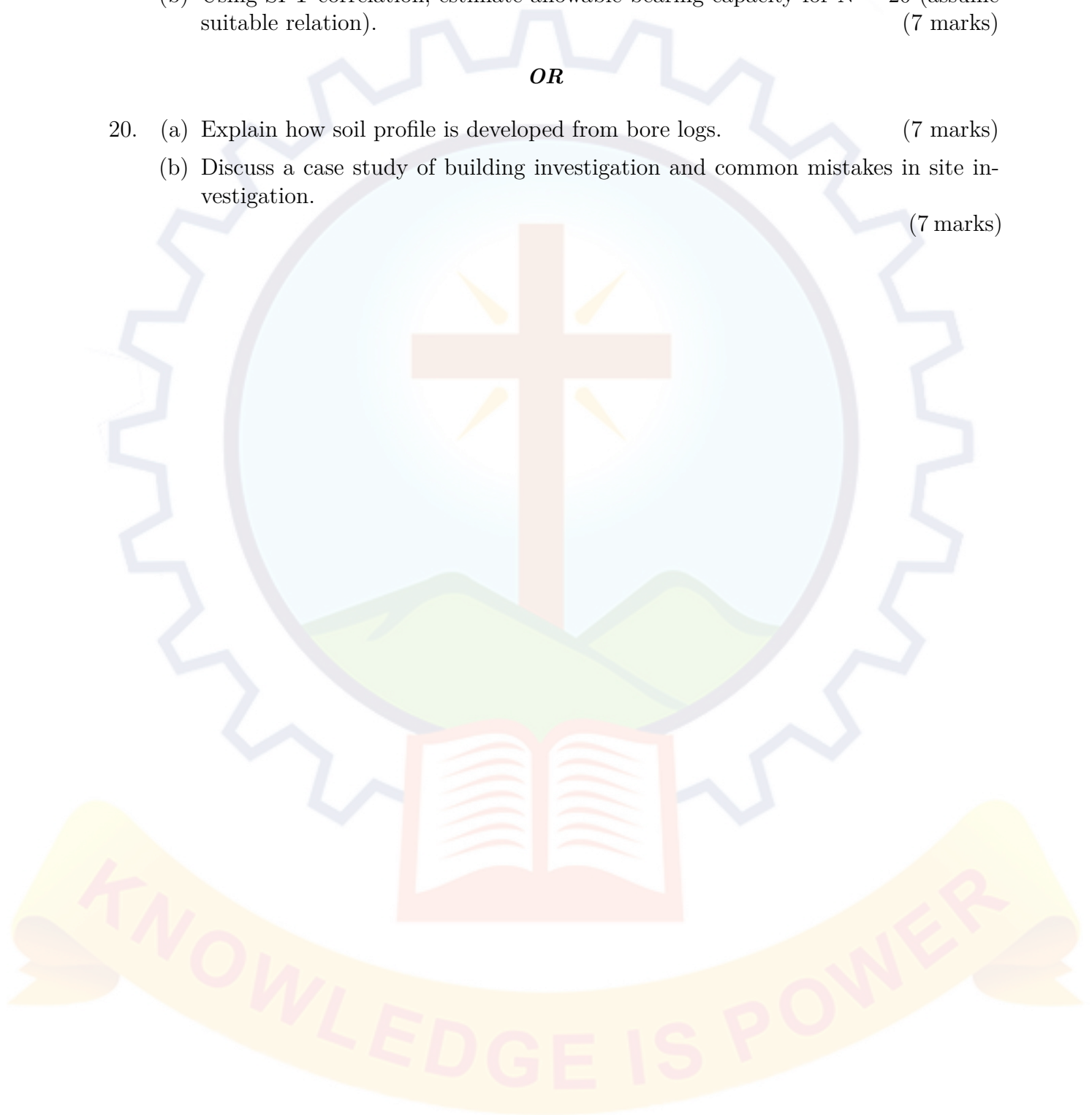
18. (a) Explain permeability tests (constant head and falling head). (7 marks)
(b) Describe triaxial tests (UU, CU, CD) and oedometer test (concept). (7 marks)

MODULE 5

19. (a) Explain the structure of a geotechnical investigation report. (7 marks)
(b) Using SPT correlation, estimate allowable bearing capacity for $N = 20$ (assume suitable relation). (7 marks)

OR

20. (a) Explain how soil profile is developed from bore logs. (7 marks)
(b) Discuss a case study of building investigation and common mistakes in site investigation. (7 marks)



CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE4P56	GEOINFORMATICS	2	1	0	4	3	2024

Preamble

Geoinformatics integrates Geographic Information Systems (GIS) and Remote Sensing (RS) techniques for efficient spatial data acquisition, management, and analysis. This course provides a comprehensive understanding of spatial data models, database management, image processing, and analytical tools used in geospatial technologies. It also emphasizes practical applications of GIS and RS in engineering, environmental management, urban planning, and decision-making through project-based learning.

Prerequisites: Surveying and Geomatics

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Explain GIS and RS fundamentals, including data models and acquisition techniques. (Cognitive Knowledge Level: Understand)
CO 2	Apply database management, topology, and spatial analysis for geospatial data processing. (Cognitive Knowledge Level: Apply)
CO 3	Apply different data acquisition systems and describe the applications of remote sensing in various engineering domains. (Cognitive Knowledge Level: Apply)
CO 4	Demonstrate image interpretation and preprocessing techniques including correction, enhancement, classification. (Cognitive Knowledge Level: Understand)
CO 5	Apply GIS techniques to develop solutions for real-world engineering problems. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	2	1		2	1					1
CO 2	2	3	2	2	3	2					1
CO 3	2	3	2	2	2	3					2
CO 4	2	2	1	2	3	2					1
CO 5	2	2	3	3	3	3	2	2	2	2	2

Assessment Pattern

GEOINFORMATICS			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	30	30	30
Understand	40	40	40
Apply	30	30	30
Analyse	-	-	-
Evaluate			-
Create			-

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course Project : 10 marks

Self Study : 5 marks

End Semester Examination Pattern

There will be two parts: Part A and Part B. Part A contain 10 questions, with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module, of which students should answer any one. Each question carries 14 marks and can have a maximum of 2 sub-divisions.

SYLLABUS

Module 1: GIS and Remote Sensing (7 hours)

Fundamentals of GIS: Information Systems, Data Models – Spatial and Non-spatial, Components, Data Collection and Input, Data Conversion, Metadata. Vector and raster data models, TIN data model.

Physics of RS– Sources of Energy, Active and Passive Radiation, Electromagnetic Radiation - Reflectance, Transmission, Absorption, Thermal Emissions, Interaction with Atmosphere, Atmospheric windows, Satellite orbits and types of satellites.

Module 2: Database Management, Topology and Spatial Analysis (9 hours)

Database Structures, Files, Standard Data Formats, Compression Techniques, Introduction to GIS software such as ArcGIS and QGIS. Topology: Types of Errors, Editing and Error Rectification, Types of Topology, Modelling topological Relationships.

Spatial Analysis- Proximity, Overlay and Buffer Analysis, Network Analysis – Route alignment, Canal alignment, Digital Elevation Models. Map composition, map elements and map scales, 3D Analyst, Interpolation Methods.

Module 3: Data Acquisition Systems and Applications (7 hours)

Optical, Thermal and Microwave systems; Resolutions- spatial, spectral, radiometric and temporal, LiDAR data acquisition and processing.

Applications of Remote Sensing in various Engineering and Science domains such as Agriculture, Forest, Soil, Geology, Land Use/Land Cover (LU/LC), Water Resources, Urban, Disaster Management, etc.

Module 4: Data Products and Image Pre-processing (7 hours)

Data products and their characteristics, Basic Principles of Visual Interpretation, Image interpretation strategies and keys, Ground truth, Ortho-rectification. Digital Image Processing- Image histograms and scatterplot, Geometric, Atmospheric and radiometric corrections, Image enhancements – contrast manipulation, spatial filtering, and image ratios, Concepts of Image classification.

Module 5: Project Planning and Implementation (6 hours)

Phases of planning, specifications and procedure for analysis and design projects. Application of GIS in various fields- Urban planning, agriculture, disaster management, forest management, site suitability analysis for infrastructure projects.

Text Books:

1. Lillesand, T.M. and Kiefer, R.W., 2015, Remote Sensing and Image Interpretation, 7th Edition, Wiley, New York.
2. James B. Campbell and Randolph H. Wynne, 2022, Introduction to Remote Sensing, Sixth Edition, The Guilford Press.
3. Kang Tsung Chang, 2018, Introduction to Geographic Information Systems, 9th Edition, Tata McGraw Hill Publishing Company Ltd., New Delhi.
4. C.P. Lo and Albert K. W. Yeung, 2016, Concepts and Techniques of Geographic Information Systems, Second Edition, Prentice Hall India Pvt. Ltd.

References:

1. Burrough, P.A., 2005, Principles of GIS for Land Resource Assessment, Oxford Publications.
2. John E. Harmon and Steven J. Anderson, 2003, The Design and Implementation of Geographic Information Systems, John Wiley & Sons.
3. Paul Bolstad, 2019, GIS Fundamentals: A First Text on Geographic Information Systems, 6th Edition, XanEdu Publishing Inc.
4. Paul Longley, 2015, Geographic Information Systems and Science, 4th Edition, John Wiley & Sons.
5. Michael J. De Smith, Michael F. Goodchild and Paul A. Longley, 2018, Geospatial Analysis: A Comprehensive Guide, 6th Edition, Winchelsea Press.
6. Christian Matzler, 2006, Thermal Microwave Radiation: Applications for Remote Sensing, The Institution of Engineering and Technology, London.
7. Schowengerdt, R. A., 2007, Remote Sensing: Models and Methods for Image Processing, Academic Press.
8. Cracknell, A.P., 2007, Introduction to Remote Sensing, 2nd Edition, Taylor & Francis, London.
9. Freek D. van der Meer, 2004, Remote Sensing and Digital Image Processing.
10. Charles Elachi and Jakob van Zyl, 2006, Introduction to the Physics and Techniques of Remote Sensing, John Wiley & Sons.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	7 hours
1.1	Fundamentals of GIS: Information systems, spatial and non-spatial data models, components.	2
1.2	Data collection, input methods, data conversion and meta-data.	1
1.3	Vector, raster and TIN data models.	1
1.4	Physics of Remote Sensing: Energy sources, EMR, reflectance, absorption, transmission.	1
1.5	Atmospheric interaction, spectral signatures, satellite orbits and types.	2
2	Module 2	9 hours
2.1	Database structures, file systems, standard formats, compression techniques.	2
2.2	Introduction to GIS software (ArcGIS, QGIS).	1
2.3	Topology: errors, editing, rectification.	2
2.4	Types of topology.	1
2.5	Spatial analysis: proximity, overlay and buffer analysis.	1
2.6	Network analysis, DEM, map composition and scale.	1
2.7	3D Analyst and interpolation methods.	1
3	Module 3	7 hours
3.1	Remote sensing systems: optical, thermal and microwave.	2
3.2	Resolution concepts: spatial, spectral, radiometric and temporal.	1

3.3	LiDAR data acquisition and processing.	1
3.4	Applications in agriculture, forestry, soil and geology.	1
3.5	Applications in LU/LC, water resources, urban and disaster management.	2
4	Module 4	7 hours
4.1	Data products and principles of visual interpretation.	1
4.2	Image interpretation strategies, keys and ground truth.	1
4.3	Ortho-rectification and preprocessing techniques.	1
4.4	Image histograms, scatterplots and corrections (geometric, atmospheric, radiometric).	2
4.5	Image enhancement and classification concepts.	2
5	Module 5	6 hours
5.1	Project planning phases, specifications and procedures.	2
5.2	GIS applications: urban planning, agriculture and disaster management.	1
5.3	GIS applications: forest management, site suitability and infrastructure projects.	1
5.4	Case-based discussion and mini project planning.	2
Total		36 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Explain the components of a Geographic Information System and their functions in spatial data handling.
2. Compare vector, raster, and TIN data models with suitable examples and applications.
3. Describe the electromagnetic radiation principles involved in remote sensing and their interaction with the atmosphere.
4. Explain different types of satellite orbits and their relevance in remote sensing applications.

Course Outcome 2 (CO 2):

1. Describe different database structures and standard data formats used in GIS.
2. Explain topology in GIS and discuss common errors and methods for their rectification.
3. Discuss the application of network analysis in route and canal alignment problems.
4. Explain the process of map composition and the importance of map elements and scales.

Course Outcome 3 (CO 3):

1. Explain different remote sensing systems (optical, thermal, microwave) and their characteristics.
2. Describe the various types of resolution in remote sensing and their significance in data interpretation.
3. Describe the working principle and applications of LiDAR in geospatial data acquisition.

Course Outcome 4 (CO 4):

1. Explain the basic principles of visual image interpretation and interpretation keys.
2. Describe different types of image corrections (geometric, atmospheric, radiometric) and their importance.
3. Explain the concept of image classification and its applications in GIS.

Course Outcome 5 (CO 5):

1. Describe the phases involved in planning and executing a GIS project.
2. Discuss the role of GIS in urban planning and infrastructure development.
3. Describe the application of GIS in site suitability analysis for engineering projects.

MODEL QUESTION PAPER

QP CODE:

Pages: 3

Reg.No.:

Name:

**MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM**

EIGHTH SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CE4P56

GEOINFORMATICS

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Define GIS and list its main components.
2. Differentiate between raster and vector data models.
3. Define topology and mention any two types of topology errors.
4. What is buffer analysis? Give one application.
5. Define spatial resolution in remote sensing and state its importance.
6. What is LiDAR? Mention one application.
7. Define image interpretation and list any two interpretation keys.
8. What is geometric correction in image processing?
9. List the phases involved in a GIS project.
10. Mention any three applications of GIS in civil engineering.

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. a) Explain the components of GIS and their functions in spatial data handling. (8)
b) Compare vector, raster and TIN data models with suitable examples. (6)

OR

12. a) Describe the principles of electromagnetic radiation in remote sensing. (8)
b) Explain spectral reflectance and its importance in identifying Earth surface features. (6)

MODULE 2

13. a) Explain database structures and standard data formats used in GIS. (8)
b) Discuss topology errors and methods for their rectification. (6)

OR

14. a) Explain spatial analysis techniques such as buffer, overlay and proximity analysis. (8)
b) Discuss the application of network analysis in route alignment problems. (6)

MODULE 3

15. a) Explain different remote sensing systems (optical, thermal and microwave). (8)
b) Discuss various types of resolution in remote sensing. (6)

OR

16. a) Describe LiDAR data acquisition and its working principle. (8)
b) Discuss applications of remote sensing in agriculture and water resources. (6)

MODULE 4

17. a) Explain the principles of visual image interpretation and interpretation keys. (8)
b) Describe different types of image corrections used in preprocessing. (6)

OR

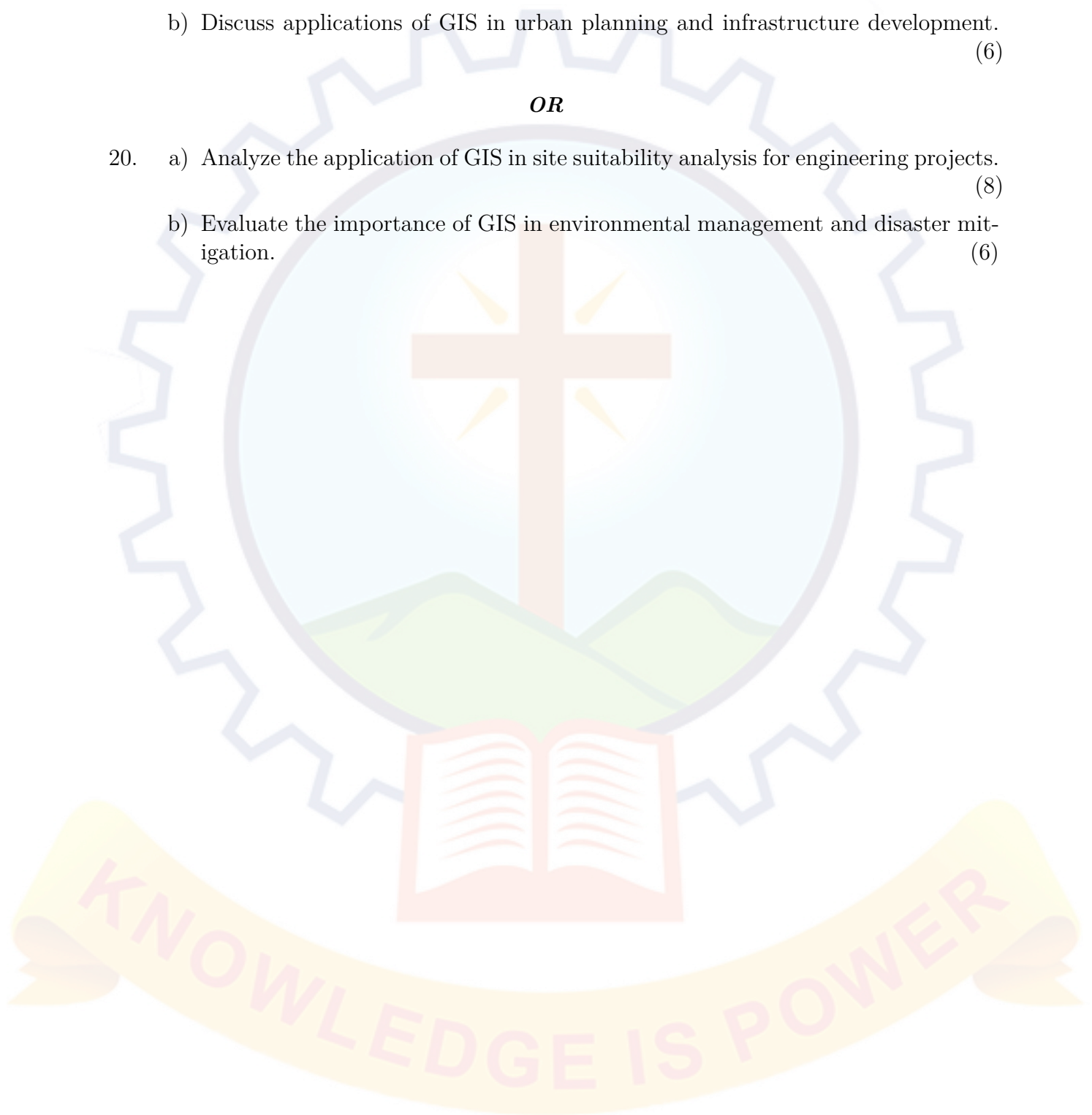
18. a) Discuss image enhancement techniques such as contrast manipulation and spatial filtering. (8)
b) Explain image classification and its applications in GIS. (6)

MODULE 5

19. a) Explain the phases involved in planning and implementation of a GIS project. (8)
b) Discuss applications of GIS in urban planning and infrastructure development. (6)

OR

20. a) Analyze the application of GIS in site suitability analysis for engineering projects. (8)
b) Evaluate the importance of GIS in environmental management and disaster mitigation. (6)



CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE4P61	CHARACTERISATION OF CONSTRUCTION MATERIALS	2	1	0	4	3	2024

Preamble

This course introduces advanced experimental techniques used for the characterization of construction materials. It focuses on understanding the relationship between material structure, composition, and performance using thermal, diffraction, microscopy, spectroscopy, and electrochemical methods.

Prerequisites: Introduction to Civil Engineering

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Understand the need, scope, and principles of construction materials characterization. (Cognitive Knowledge Level: Understand)
CO 2	Analyse phase composition using XRD and calorimetry. (Cognitive Knowledge Level: Analyse)
CO 3	Evaluate thermal behavior, surface area, and pore structure. (Cognitive Knowledge Level: Evaluate)
CO 4	Analyse microstructural features using microscopy and image analysis. (Cognitive Knowledge Level: Analyse)
CO 5	Apply spectroscopy and electrochemical techniques for the characterization of construction materials. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	2	1			2	1		1		2
CO 2	3	3	1	3	2				1		2
CO 3	2	3	2	3	2	2			1		2
CO 4	2	3	1	3	3			1	1		2
CO 5	2	2	2	2	3	1			1		2

Assessment Pattern

CHARACTERISATION OF CONSTRUCTION MATERIALS			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	10	10	10
Understand	50	50	50
Apply	30	30	20
Analyse	10	10	20
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course Project : 10 marks

Self Study : 5 marks

End Semester Examination Pattern

There will be two parts: Part A and Part B. Part A contain 10 questions, with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module, of which students should answer any one. Each question carries 14 marks and can have a maximum of 2 sub-divisions.

SYLLABUS

Module 1: Fundamentals of Material Characterisation (7 hours)

Need and scope of materials characterization – Levels of characterization (atomic, microstructural, macrostructural) – Structure of construction materials – Structure–property–performance relationships – Calorimetry: basic principle and types – Heat of hydration of cementitious materials – Applications in cement and concrete.

Module 2: Introduction to XRD and Thermal Analysis (8 hours)

Introduction to X-rays – Simple concept of crystal structure – Basic principle of XRD (Bragg's law – concept only) – Identification of major cement compounds (qualitative understanding only) – Applications of XRD in cement and concrete. Introduction to thermal behaviour of materials – Differential Thermal Analysis (DTA) – Thermogravimetric Analysis (TGA) – Differential Scanning Calorimetry (DSC) – Interpretation of simple thermal curves – Applications in cementitious materials.

Module 3: Surface, Porosity and Microstructural Characterisation (7 Hours)

Particle size distribution – Surface area measurement (basic BET concept) – Porosity and pore size distribution – Principle of Mercury Intrusion Porosimetry – Importance of pore structure in durability – Optical microscopy: principle – Scanning Electron Microscopy (SEM): components and basic imaging modes – SEM of cementitious materials

Module 4: Characterisation of Geomaterials and Pavement Materials (7 Hours)

Soil as three-phase system – Water content, void ratio, degree of saturation – Grain size distribution – Atterberg limits – IS soil classification – Compaction (Proctor test, OMC, MDD) – Shear strength (Mohr–Coulomb concept) – Consolidation (basic concept) – Rock characterization: RQD, RMR, UCS, Point load test – Bitumen characterization: penetration, softening point, ductility, viscosity – Performance tests (DSR & BBR – concept only) – Aging tests (RTFOT, PAV – overview) – Modified bitumen (introductory concept).

Module 5: Spectroscopic and Electrochemical Characterisation (7 Hours)

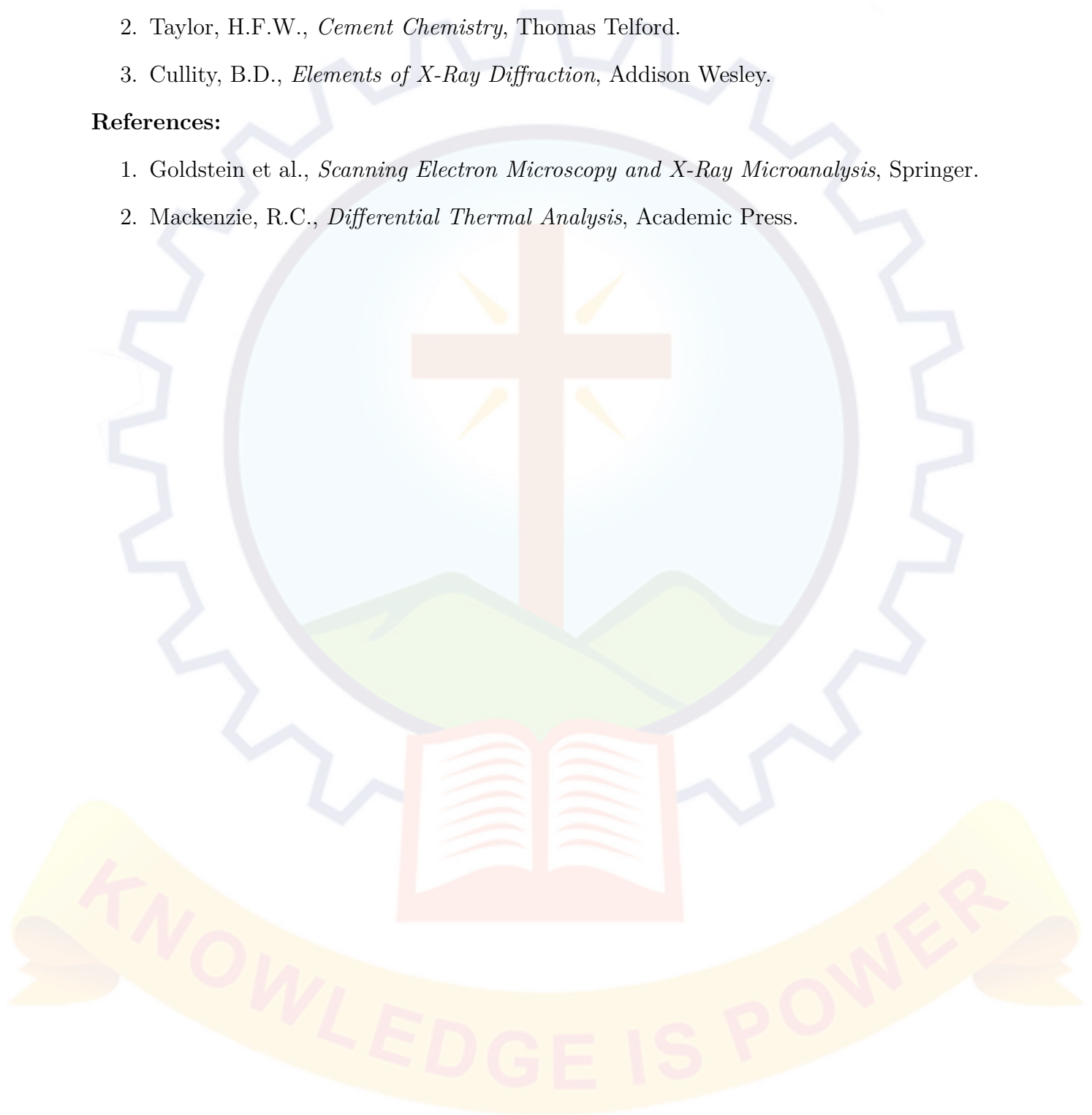
Introduction to spectroscopy – AAS, AES (concept only) – UV–Visible spectroscopy – IR & FTIR (functional group identification) – NMR (basic concept) – Electrical impedance analysis (basic principle) – Corrosion testing methods – Half-cell potential – Electrochemical Impedance Spectroscopy (EIS – overview).

Text Books:

1. Mehta, P.K. and Monteiro, P.J.M., *Concrete: Microstructure, Properties and Materials*, McGraw-Hill.
2. Taylor, H.F.W., *Cement Chemistry*, Thomas Telford.
3. Cullity, B.D., *Elements of X-Ray Diffraction*, Addison Wesley.

References:

1. Goldstein et al., *Scanning Electron Microscopy and X-Ray Microanalysis*, Springer.
2. Mackenzie, R.C., *Differential Thermal Analysis*, Academic Press.



COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1: Fundamentals of Material Characterisation	7 hours
1.1	Need and scope of materials characterization; levels of characterization (atomic, microstructural, macrostructural).	2
1.2	Structure of construction materials; structure–property–performance relationships.	2
1.3	Calorimetry: basic principle and types.	1
1.4	Heat of hydration of cementitious materials and applications in cement and concrete.	2
2	Module 2: Introduction to XRD and Thermal Analysis	8 hours
2.1	Introduction to X-rays; simple concept of crystal structure.	1
2.2	Basic principle of XRD (Bragg’s law – concept only).	2
2.3	Identification of major cement compounds (qualitative understanding only).	1
2.4	Applications of XRD in cement and concrete.	1
2.5	Introduction to thermal behaviour of materials – DTA, TGA, DSC.	2
2.6	Interpretation of simple thermal curves and applications in cementitious materials.	1
3	Module 3: Surface, Porosity and Microstructural Characterisation	7 hours
3.1	Particle size distribution; surface area measurement (basic BET concept).	2
3.2	Porosity and pore size distribution; Mercury Intrusion Porosimetry.	2

3.3	Importance of pore structure in durability.	1
3.4	Optical microscopy: principle.	1
3.5	Scanning Electron Microscopy (SEM): components, imaging modes and applications in cementitious materials.	1
4	Module 4: Characterisation of Geomaterials and Pavement Materials	7 hours
4.1	Soil as three-phase system; water content, void ratio, degree of saturation.	1
4.2	Grain size distribution; Atterberg limits; IS soil classification.	2
4.3	Compaction (Proctor test, OMC, MDD); shear strength (Mohr–Coulomb concept).	2
4.4	Consolidation (basic concept); rock characterization (RQD, RMR, UCS, Point load test).	1
4.5	Bitumen characterization: penetration, softening point, ductility, viscosity; performance and aging tests (overview).	1
5	Module 5: Spectroscopic and Electrochemical Characterisation	7 hours
5.1	Introduction to spectroscopy – AAS, AES (concept only).	1
5.2	UV–Visible spectroscopy; IR and FTIR (functional group identification).	2
5.3	NMR (basic concept).	1
5.4	Electrical impedance analysis (basic principle); corrosion testing methods.	2
5.5	Half-cell potential; Electrochemical Impedance Spectroscopy (EIS – overview).	1
Total		36 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Explain the need and scope of materials characterization in construction engineering.
2. Describe the different levels of characterization (atomic, microstructural, and macrostructural) with suitable examples.
3. Discuss the structure–property–performance relationship in construction materials with reference to cementitious systems.

Course Outcome 2 (CO 2):

1. Explain the basic principle of X-ray diffraction and the concept of Bragg's law.
2. Analyse how XRD can be used to identify major cement compounds in hydrated cement paste.
3. Discuss the principles of calorimetry and thermal analysis techniques (DTA, TGA, DSC) and their applications in cement and concrete.

Course Outcome 3 (CO 3):

1. Explain the concept of surface area measurement and pore size distribution in construction materials.
2. Evaluate the importance of pore structure in determining durability of cementitious materials.
3. Discuss the principles of Mercury Intrusion Porosimetry and its role in characterizing porous materials.

Course Outcome 4 (CO 4):

1. Explain the working principle of optical microscopy and scanning electron microscopy (SEM).
2. Analyse the microstructural features of cementitious materials using SEM images.
3. Discuss the characterization of geomaterials and pavement materials using standard tests (soil, rock, and bitumen).

Course Outcome 5 (CO 5):

1. Explain the basic principles of spectroscopy techniques such as UV–Visible and FTIR in material characterization.
2. Describe electrochemical techniques such as half-cell potential and impedance analysis used in corrosion assessment.
3. Discuss how spectroscopic and electrochemical methods can be applied to evaluate the durability of construction materials.

MODEL QUESTION PAPER

QP CODE:

Pages: 3

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

EIGHTH SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CE4P61

CHARACTERISATION OF CONSTRUCTION MATERIALS

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Define materials characterization and explain its importance in civil engineering.
2. List the different levels of characterization and give one example for each.
3. State Bragg's law and mention its significance in XRD analysis.
4. List any three thermal analysis techniques used in material characterization.
5. Define surface area of materials and mention one method used for its measurement.
6. What is porosity? State its significance in determining durability of materials.
7. Define water content and void ratio in soils.
8. List any three tests used for characterization of bitumen.
9. Define spectroscopy and mention any two spectroscopic techniques.
10. List any three electrochemical methods used for corrosion assessment.

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. a) Explain the need and scope of materials characterization in construction engineering. (8)
b) Discuss structure–property–performance relationships in construction materials with suitable examples. (6)

OR

12. a) Describe the different levels of characterization (atomic, microstructural, macrostructural) with examples. (8)
b) Explain the principle of calorimetry and its applications in cement and concrete. (6)

MODULE 2

13. a) Explain the basic principle of X-ray diffraction and the concept of Bragg's law. (8)
b) Discuss the applications of XRD in identifying cement compounds. (6)

OR

14. a) Describe the principles of thermal analysis techniques (DTA, TGA, DSC). (8)
b) Explain how thermal curves are interpreted for cementitious materials. (6)

MODULE 3

15. a) Explain particle size distribution and surface area measurement using BET concept. (8)
b) Discuss the importance of pore structure in durability of materials. (6)

OR

16. a) Describe the principle of Mercury Intrusion Porosimetry. (8)
b) Explain the working principle of SEM and its applications in cementitious materials. (6)

MODULE 4

17. a) Explain the three-phase system of soils and related parameters. (8)
b) Discuss Atterberg limits and their engineering significance. (6)

OR

18. a) Describe compaction characteristics (OMC and MDD) and shear strength (Mohr–Coulomb concept). (8)
b) Explain any three tests used for characterization of bitumen. (6)

MODULE 5

19. a) Explain the principles of UV–Visible spectroscopy and FTIR in material characterization. (8)
b) Discuss corrosion testing methods using electrochemical techniques. (6)

OR

20. a) Describe electrical impedance analysis and Electrochemical Impedance Spectroscopy (EIS). (8)
b) Explain half-cell potential method for corrosion assessment. (6)

KNOWLEDGE IS POWER

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE4P62	DESIGN OF ENVIRONMENTAL FACILITIES	2	1	0	4	3	2024

Preamble

This course introduces the planning and design principles of environmental infrastructure required for sustainable urban and institutional development. It covers the design aspects of water supply, wastewater and sanitation systems, solid waste management, and stormwater drainage facilities. The course also addresses regulatory frameworks, environmental protection measures, sustainability considerations, and operation and maintenance of environmental facilities. Students will gain practical knowledge in designing basic environmental infrastructure systems following relevant standards and guidelines.

Prerequisites: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Explain the role, planning principles, and regulatory framework governing environmental facilities. (Cognitive Knowledge Level: Understand)
CO 2	Apply basic design principles for water supply systems and rainwater harvesting facilities. (Cognitive Knowledge Level: Apply)
CO 3	Apply design principles for wastewater collection systems and on-site sanitation facilities. (Cognitive Knowledge Level: Apply)
CO 4	Apply design concepts for solid waste management facilities and stormwater drainage systems. (Cognitive Knowledge Level: Apply)
CO 5	Explain environmental protection measures, sustainability considerations, and operation and maintenance of environmental facilities. (Cognitive Knowledge Level: Understand)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	1				2	3	1			
CO 2	3	2	3	1	2	2	3	1		1	2
CO 3	3	2	3	1	2	2	3	1		1	2
CO 4	3	2	3	1	2	2	3	1		1	2
CO 5	2	1				2	3	2	1	1	1

Assessment Pattern

DESIGN OF ENVIRONMENTAL FACILITIES			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	20	20	30
Understand	50	50	50
Apply	30	30	20
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course Project	: 10 marks
Self Study	: 5 marks

End Semester Examination Pattern

There will be two parts: Part A and Part B. Part A contain 10 questions, with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module, of which students should answer any one. Each question carries 14 marks and can have a maximum of 2 sub-divisions.

SYLLABUS

Module 1: Planning and Regulatory Framework (7 hours)

Role and importance of environmental facilities – Integrated planning of water supply, wastewater, solid waste, and drainage systems – Design population and design period – Demand forecasting – Site selection and land requirement – Centralized and decentralized environmental facilities – Overview of relevant standards and guidelines: CPHEEO, NBC, IS codes, CPCB/SPCB norms.

Module 2: Design of Water Supply and Rainwater Harvesting (7 hours)

Layout planning of water supply schemes – Design of intake structures – Pumping stations – Clear water reservoirs and overhead tanks – Hydraulic considerations in distribution systems (pressure, zoning, continuity) – Design of rooftop and surface rainwater harvesting systems – Water supply design for institutional and campus-level facilities.

Module 3: Design of Wastewater and Sanitation Facilities (8 Hours)

Design of sewer systems (alignment, slope, depth, self-cleansing velocity) – Design of on-site sanitation systems: septic tanks, soak pits, Imhoff tanks – Layout planning of sewage treatment plants – Sludge handling and drying beds – Decentralized wastewater treatment systems (DEWATS).

Module 4: Design of Solid Waste and Stormwater Facilities (7 Hours)

Design of solid waste storage, collection, and transfer systems – Transfer station design – Composting yard and bio methanation plant design (basic) – Sanitary landfill design including liner systems, leachate and gas management – Design of stormwater drainage systems and flood mitigation facilities.

Module 5: Environmental Protection, Sustainability, and O&M (7 Hours)

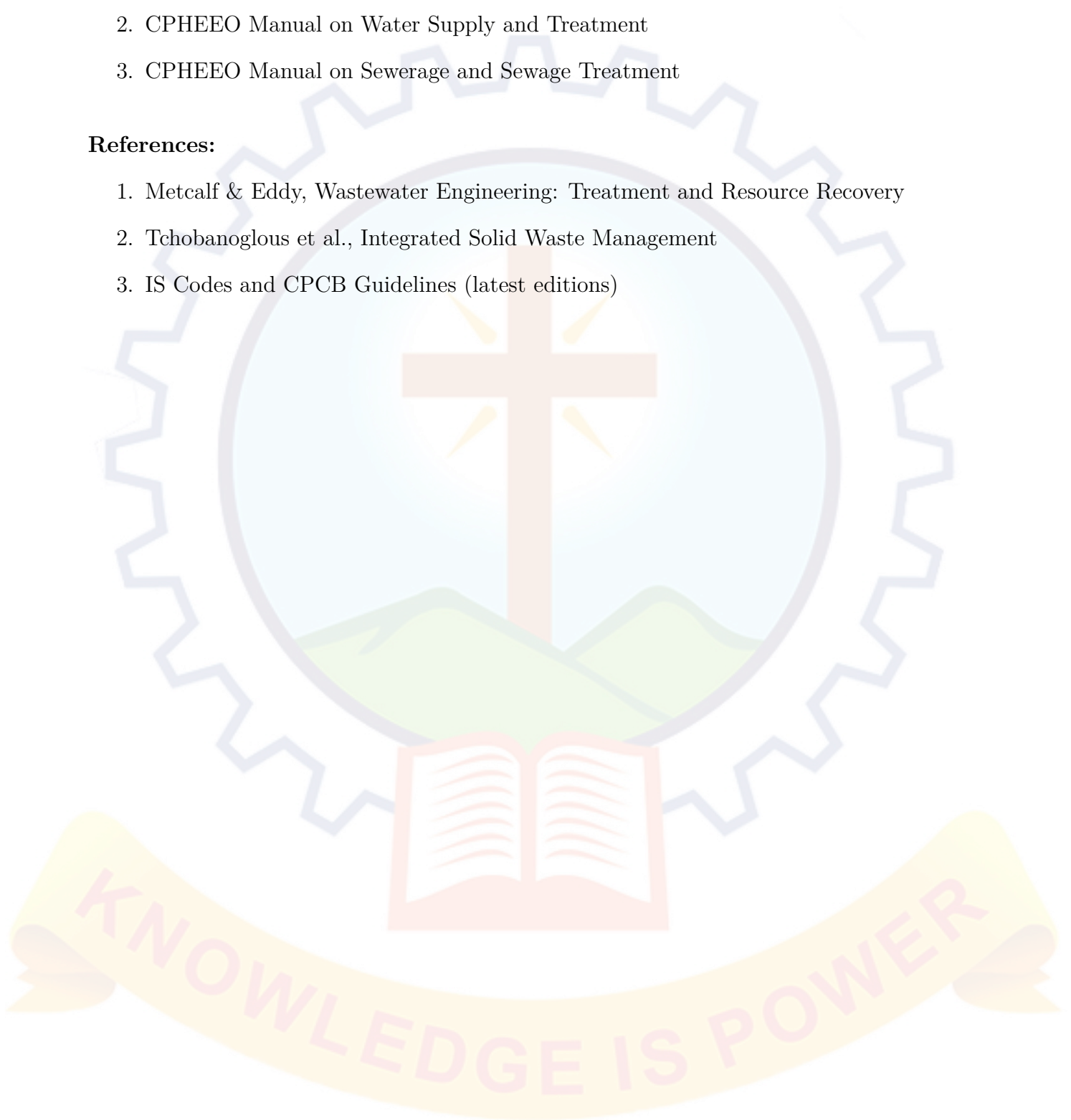
Design of environmental protection facilities: green belts, buffer zones, noise barriers – Stack height estimation (design concept) – Energy-efficient environmental facilities – Life cycle costing – Operation and maintenance aspects – Failure analysis and case studies of environmental facilities.

Text Books:

1. Peavy, H.S. & Row, K., Environmental Engineering, McGraw Hill
2. CPHEEO Manual on Water Supply and Treatment
3. CPHEEO Manual on Sewerage and Sewage Treatment

References:

1. Metcalf & Eddy, Wastewater Engineering: Treatment and Resource Recovery
2. Tchobanoglous et al., Integrated Solid Waste Management
3. IS Codes and CPCB Guidelines (latest editions)



COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	7 hours
1.1	Role and importance of environmental facilities – Integrated planning of water supply, wastewater, solid waste, and drainage systems	2
1.2	Design population and design period – Demand forecasting	2
1.3	Site selection and land requirement – Centralized and decentralized environmental facilities	2
1.4	Overview of relevant standards and guidelines: CPHEEO, NBC, IS codes, CPCB/SPCB norms.	1
2	Module 2	7 hours
2.1	Layout planning of water supply schemes – Design of intake structures .	2
2.2	Pumping stations – Clear water reservoirs and overhead tanks	1
2.3	Hydraulic considerations in distribution systems (pressure, zoning, continuity) – Design of rooftop and surface rainwater harvesting systems	2
2.4	Water supply design for institutional and campus-level facilities.	2
3	Module 3	8 hours
3.1	Design of sewer systems (alignment, slope, depth, self-cleansing velocity).	2
3.2	Design of on-site sanitation systems: septic tanks, soak pits, Imhoff tanks	3
3.3	Layout planning of sewage treatment plants – Sludge handling and drying beds	2
3.4	Decentralized wastewater treatment systems (DEWATS).	1

4	Module 4	7 hours
4.1	Design of solid waste storage, collection, and transfer systems .	2
4.2	Transfer station design – Composting yard and bio methana- tion plant design (basic) .	1
4.3	Sanitary landfill design including liner systems, leachate and gas management	2
4.4	Design of stormwater drainage systems and flood mitigation facilities.	2
5	Module 5	7 hours
5.1	Design of environmental protection facilities: green belts, buffer zones, noise barriers	3
5.2	Stack height estimation (design concept) – Energy-efficient environmental facilities	2
5.3	Life cycle costing – Operation and maintenance aspects	1
5.4	Failure analysis and case studies of environmental facilities.	1
Total		36 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Explain the role and importance of environmental facilities in urban infrastructure.
2. Describe the concept of design population and design period used in planning environmental facilities.
3. Explain the role of CPHEEO, NBC, and CPCB guidelines in environmental facility planning.

Course Outcome 2 (CO 2):

1. Explain the layout planning of a water supply system.
2. Describe the design considerations for overhead tanks and clear water reservoirs.
3. Explain the design principles of rooftop rainwater harvesting systems.

Course Outcome 3 (CO 3):

1. Explain the design considerations for sewer systems including slope and self-cleansing velocity.
2. Describe the design and functioning of septic tanks and soak pits.
3. Explain the concept and advantages of Decentralized Wastewater Treatment Systems (DEWATS).

Course Outcome 4 (CO 4):

1. Explain the components of a solid waste collection and transfer system.
2. Describe the design concept of sanitary landfills including liner systems and leachate management.
3. Explain the design considerations for stormwater drainage systems.

Course Outcome 5 (CO 5):

1. Explain the role of green belts and buffer zones in environmental protection.
2. Describe the concept of life cycle costing in environmental facilities.
3. Explain the importance of operation and maintenance of environmental facilities.

MODEL QUESTION PAPER

QP CODE:

Pages: 3

Reg.No.:

Name:

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

EIGHTH SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CE4P62

Course Name: DESIGN OF ENVIRONMENTAL FACILITIES

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. What are environmental facilities? Give two examples.
2. Define design population.
3. What is demand forecasting in water supply planning?
4. What is rainwater harvesting?
5. Define self-cleansing velocity in sewer design.
6. What is DEWATS?
7. What is a transfer station in solid waste management?
8. What is a sanitary landfill?
9. What are green belts?
10. What is life cycle costing?

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. a) Explain the role and importance of environmental facilities in urban planning. (8)
b) Discuss the concept of design population and design period in environmental infrastructure planning. (6)

OR

12. a) Explain integrated planning of water supply, wastewater, solid waste, and drainage systems. (7)
b) Discuss the importance of CPHEEO and NBC guidelines in environmental facility design. (7)

MODULE 2

13. a) Explain the layout planning and components of a water supply scheme. (8)
b) Discuss hydraulic considerations in water distribution systems. (6)

OR

14. a) Explain the design and working of overhead tanks and pumping stations. (7)
b) Discuss the design principles of rooftop rainwater harvesting systems. (7)

MODULE 3

15. a) Explain the design considerations of sewer systems including slope and depth. (8)
b) Discuss the design and working of septic tanks. (6)

OR

16. a) Explain the layout planning of sewage treatment plants. (7)
b) Discuss the concept and advantages of DEWATS systems. (7)

MODULE 4

17. a) Explain the design of solid waste collection and transfer systems. (8)
b) Discuss the design and components of sanitary landfills. (6)

OR

18. a) Explain composting yard and bio-methanation plant design concepts. (7)

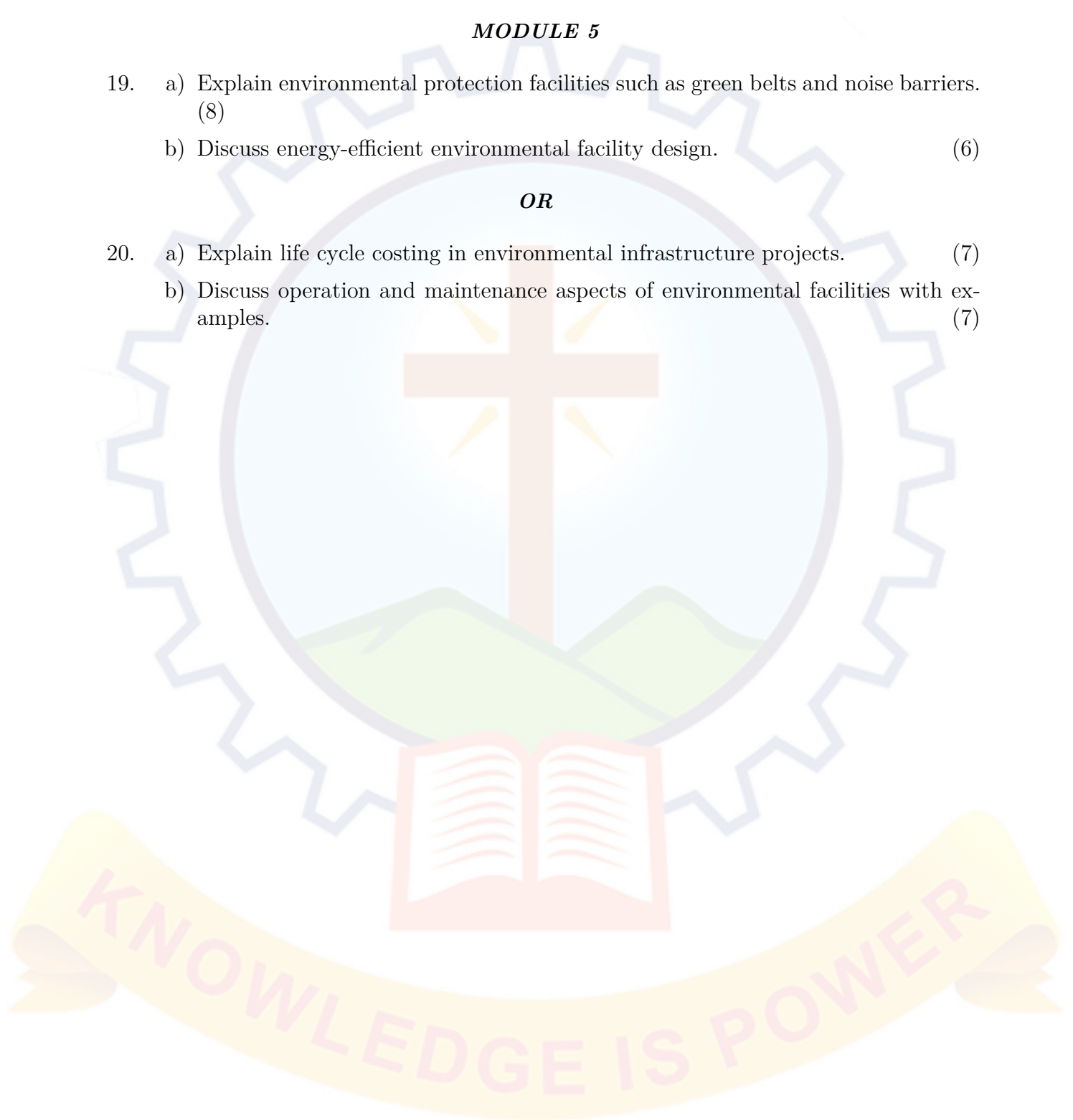
- b) Discuss the design considerations of stormwater drainage systems (7)

MODULE 5

19. a) Explain environmental protection facilities such as green belts and noise barriers. (8)
b) Discuss energy-efficient environmental facility design. (6)

OR

20. a) Explain life cycle costing in environmental infrastructure projects. (7)
b) Discuss operation and maintenance aspects of environmental facilities with examples. (7)



CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE4P63	APPLIED SOIL MECHANICS	2	1	0	4	3	2024

Preamble

This course focuses on the application of soil mechanics principles to real-world geotechnical and foundation engineering problems. It covers bearing capacity, settlement analysis, soil-structure interaction, seismic behavior of soils, liquefaction, and ground improvement techniques. Emphasis is placed on developing practical understanding and design-oriented thinking to address geotechnical challenges in civil engineering projects.

Prerequisites: Soil Mechanics, Foundation Engineering

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Refresh core concepts needed for application (Cognitive Knowledge Level: Remember)
CO 2	Apply soil mechanics concepts directly to foundation problems. (Cognitive Knowledge Level: Apply)
CO 3	Attain conceptual clarity on how soil affects structural response. (Cognitive Knowledge Level: Understand)
CO 4	Geotechnical earthquake issues at conceptual level. (Cognitive Knowledge Level: Understand)
CO 5	Gain exposure to practical ground improvement and stability issues. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	2	2	2	-	-	-	-	-	-	-	-
CO 2	3	3	3	2	2	-	-	-	-	-	-
CO 3	2	3	3	2	-	-	-	-	-	-	-
CO 4	2	2	2	-	2	2	-	-	-	-	-
CO 5	2	2	2	2	-	-	-	-	-	-	-

Assessment Pattern

APPLIED SOIL MECHANICS			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	20	20	20
Understand	40	40	30
Apply	40	40	50
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance	: 10 marks
Continuous Assessment Test (2 numbers)	: 25 marks
Assignment/Quiz/Course Project	: 10 marks
Self Study	: 5 marks

End Semester Examination Pattern

There will be two parts; Part A and Part B. Part A contain 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question carries 14 marks and can have maximum 2 sub-divisions.

SYLLABUS

Module 1: Review of Fundamental Soil Mechanics: (7 Hours)

Essential Soil Behavior, Effective stress principle, Stress-strain behavior of soils, Shear strength parameters (c and ϕ)

Stress Distribution in Soil, Boussinesq theory (concept and applications), Stress influence factors, Practical stress estimation beneath footings

Module 2: Bearing Capacity and Settlement: (8 Hours)

Bearing Capacity of Shallow Foundations, Terzaghi bearing capacity theory, Effect of water table, Safe bearing capacity and allowable pressure

Settlement Analysis, Immediate settlement, Consolidation settlement, Differential settlement and structural implications

Application to Foundation Design, Bearing capacity vs settlement control, Practical design considerations

Module 3: Soil-Structure Interaction: (7 Hours)

Basic Concept of SSI, Relative stiffness of soil and structure, Contact pressure distribution, Flexible vs rigid foundation behavior

Dynamic Considerations (Introductory), Effect of soil flexibility on natural period, Basic seismic SSI concept

Module 4: Seismic and Liquefaction Aspects: (7 Hrs)

Soil Behavior During Earthquakes, Cyclic loading effects, Increase in pore water pressure

Liquefaction, Mechanism, Factors influencing liquefaction, Simplified evaluation concept (SPT-based idea only)

Foundation Considerations in Seismic Areas, Settlement during earthquakes, Basic design precautions

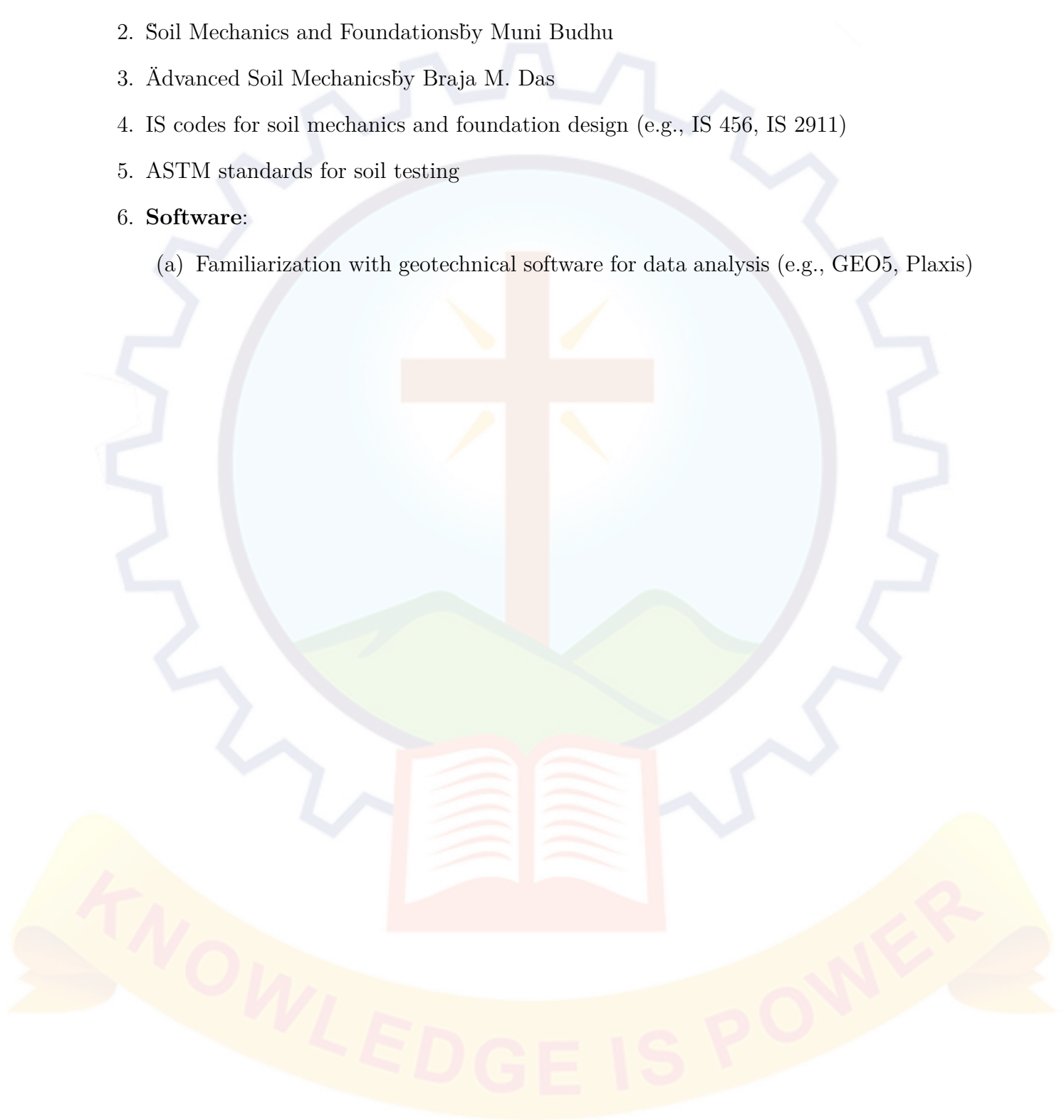
Module 5: Soil Improvement and Slope Stability: (7 Hrs)

Soil Improvement Techniques, Compaction, Chemical stabilization, Grouting, Stone columns (concept only)

Slope Stability (Basic Application Level), Types of slope failure, Factor of safety concept, Swedish slip circle method (concept only), Remedial measures.

Text Books:

1. Principles of Geotechnical Engineering by Braja M. Das
2. Soil Mechanics and Foundations by Muni Budhu
3. Advanced Soil Mechanics by Braja M. Das
4. IS codes for soil mechanics and foundation design (e.g., IS 456, IS 2911)
5. ASTM standards for soil testing
6. **Software:**
 - (a) Familiarization with geotechnical software for data analysis (e.g., GEO5, Plaxis)



COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
	MODULE 1	7
1.1	Essential Soil Behavior: Effective stress principle, Stress-strain behavior of soils, Shear strength parameters (c and ϕ)	3
1.2	Stress Distribution in Soil: Boussinesq theory (concept and applications), Stress influence factors, Practical stress estimation beneath footings	4
	MODULE 2	8
2.1	Bearing Capacity of Shallow Foundations: Terzaghi bearing capacity theory, Effect of water table, Safe bearing capacity and allowable pressure	2
2.2	Settlement Analysis: Immediate settlement, Consolidation settlement, Differential settlement and structural implications	3
2.3	Application to Foundation Design: Bearing capacity vs settlement control, Practical design considerations	3
	MODULE 3	7
3.1	Basic Concept of SSI: Relative stiffness of soil and structure, Contact pressure distribution, Flexible vs rigid foundation behavior	3
3.2	Dynamic Considerations (Introductory): Effect of soil flexibility on natural period, Basic seismic SSI concept	4
	MODULE 4	7
4.1	Soil Behavior During Earthquakes: Cyclic loading effects, Increase in pore water pressure	3
4.2	Liquefaction: Mechanism, Factors influencing liquefaction, Simplified evaluation concept (SPT-based idea only)	2
4.3	Foundation Considerations in Seismic Areas: Settlement during earthquakes, Basic design precautions	2

	MODULE 5	7
5.1	Soil Improvement Techniques: Compaction, Chemical stabilization, Grouting, Stone columns (concept only)	3
5.2	Slope Stability (Basic Application Level): Types of slope failure, Factor of safety concept, Swedish slip circle method (concept only), Remedial measures	4
Total		36 Hours



MODEL QUESTION PAPER

QP CODE:

Pages: 2

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

SEVENTH SEMESTER B. TECH. DEGREE EXAMINATION, YEAR

Course Code: B24CE4P63

APPLIED SOIL MECHANICS

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Define effective stress principle.
2. What are shear strength parameters?
3. State Boussinesq theory assumptions.
4. Define safe bearing capacity.
5. What is differential settlement?
6. Define soil-structure interaction (SSI).
7. What is meant by rigid foundation?
8. Define liquefaction.
9. What is factor of safety in slopes?
10. List any two soil improvement techniques.

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. (a) Explain effective stress principle and stress-strain behaviour of soils. (7 marks)

- (b) Using Boussinesq theory, determine vertical stress at a depth of 3 m due to a point load of 100 kN acting at ground surface. (7 marks)

OR

12. (a) Explain shear strength parameters (c and ϕ) and their significance. (7 marks)
(b) Calculate vertical stress beneath a footing using influence factor method (assume suitable data). (7 marks)

MODULE 2

13. (a) Derive Terzaghi's bearing capacity equation for strip footing. (6 marks)
(b) A footing of width 2 m rests on sand with: $\gamma = 18 \text{ kN/m}^3$, $\phi = 30^\circ$, Water table at ground level. Calculate ultimate and safe bearing capacity. (8 marks)

OR

14. (a) Explain types of settlement and their structural implications. (6 marks)
(b) A clay layer has: Thickness = 4 m, $C_c = 0.25$, $e = 0.8$, Initial stress = 100 kN/m², Final stress = 200 kN/m². Compute consolidation settlement. (8 marks)

MODULE 3

15. (a) Explain SSI and relative stiffness concept. (7 marks)
(b) Discuss contact pressure distribution for rigid and flexible foundations. (7 marks)

OR

16. (a) Explain effect of soil flexibility on natural period. (7 marks)
(b) Discuss basic seismic SSI concepts. (7 marks)

MODULE 4

17. (a) Explain soil behaviour under cyclic loading. (7 marks)
(b) Describe mechanism and factors influencing liquefaction. (7 marks)

OR

18. (a) Explain SPT-based simplified liquefaction evaluation. (7 marks)
(b) Discuss foundation design considerations in seismic areas. (7 marks)

MODULE 5

19. (a) Explain various soil improvement techniques. (7 marks)
(b) A slope has height 10 m and failure surface length 15 m. Cohesion $c = 20 \text{ kN/m}^2$, Unit weight $\gamma = 18 \text{ kN/m}^3$. Estimate factor of safety using simple approach. (7 marks)

OR

20. (a) Explain types of slope failure and remedial measures. (7 marks)
(b) Describe Swedish slip circle method (concept). (7 marks)

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE4P64	ADVANCED ANALYSIS AND DESIGN USING ETABS	2	1	0	4	3	2024

Preamble

This course introduces the modelling, analysis, and design of multi-storey reinforced concrete buildings using ETABS under gravity, wind, and seismic loads as per relevant IS codes. It covers response spectrum analysis, ductile detailing, design of RC shear walls, and shallow and deep foundations including pile caps, enabling students to develop practical software-oriented design skills for modern building systems.

Prerequisites: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Understand and apply the principles of modelling, loading, and analysis of multi-storey reinforced concrete buildings using ETABS, including gravity and wind load combinations as per relevant IS codes. (Cognitive Knowledge Level: Apply)
CO 2	Analyse multi-storey buildings under seismic loading and ductile detailing of beam-column joints and members as per IS 13920 provisions. (Cognitive Knowledge Level: Apply)
CO 3	Analysis and design of RC shear walls with necessary code checks and detailing provisions. (Cognitive Knowledge Level: Apply)
CO 4	Design the shallow foundation and understand the design principles of combined footing and raft foundation. (Cognitive Knowledge Level: Apply)
CO 5	Analysis and design of piles and pile caps. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	2	2	1	3	1		1	1		2
CO 2	3	3	1	2	3	2		1	1		2
CO 3	3	3	1	2	3	2		1	1		2
CO 4	3	2	2		2	2		1	1	1	2
CO 5	2	3	2		2	2		1	1	1	2

Assessment Pattern

ADVANCED ANALYSIS AND DESIGN USING ETABS			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember			
Understand	40	40	40
Apply	60	60	60
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course Project : 10 marks

Self Study : 5 marks

End Semester Examination Pattern

There will be two parts: Part A and Part B. Part A contain 10 questions, with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module, of which students should answer any one. Each question carries 14 marks and can have a maximum of 2 sub-divisions.

SYLLABUS

Module 1: Introduction and Analysis of Multi-storey Building (7 hours)

Overview of ETABS for building analysis and design - Load definition and load combinations as per IS 456, IS 875 and IS 1893 - Definition and application of wind load parameters as per IS 875 (Part 3) – Types of building frame systems – introduction to special structural components of a building (slender column, corbel, flat slab)

Module 2: Seismic Analysis & Ductile Detailing (7 hours)

Seismic design parameters: Importance factor, seismic zone factor, soil type, response reduction factor - Concept and application of dynamic analysis in buildings - Response Spectrum Method - Selection and assignment of response spectrum functions - Ductile detailing of beam, column and beam-column joints for earthquake resistance as per IS 13920.

Module 3: Analysis and Design of Reinforced Concrete Shear Walls (7 Hours)

Behaviour and structural role of shear walls in buildings - Analysis of shear walls - Design of shear walls with and without boundary elements - Code checks for shear walls - Detailing of shear walls.

Module 4: Shallow Foundation (8 Hours)

Introduction to isolated footing, types of isolated footings, Load transfer mechanism from column to soil, Bearing capacity and settlement considerations, Structural design of isolated footing. Need for combined footing, Types: rectangular and trapezoidal combined footing, Load distribution and resultant location, Design principles, Reinforcement detailing. Concept and necessity of raft foundation, Types, Settlement considerations, Design concepts and reinforcement layout.

Module 5: Deep Foundation (7 Hours)

Structural action of pile and pile cap – Load transfer mechanism from column to piles – Behaviour of two-pile and three-pile pile cap systems – Modelling of piles and pile caps – loads and boundary conditions – Analysis and design of pile and pile cap.

Text Books:

1. Jain, A.K., Reinforced Concrete: Limit State Design, Nem Chand & Bros., New Delhi, 8th Edition, 2012.
2. Pillai, S. Unnikrishna and Menon, Devdas, Reinforced Concrete Design, Tata McGraw Hill Education, New Delhi, 4th Edition, 2021.
3. Agarwal, Pankaj and Shrikhande, Manish, Earthquake Resistant Design of Structures, PHI Learning Pvt. Ltd., New Delhi, 2nd Edition, 2024 (reprint).
4. Varghese, P.C., Foundation Engineering, PHI Learning Pvt. Ltd., New Delhi, 1st Edition, 2005.
5. Krishna Raju, N., Foundation Design Manual, CBS Publishers & Distributors, New Delhi, 1st Edition, 2010.

References:

1. CSI, ETABS Integrated Building Design Software – User Guide and Design Manual, Computers and Structures Inc., Berkeley, California, Latest Version (v22/v23, 2024–2025).
2. Chopra, Anil K., Dynamics of Structures: Theory and Applications to Earthquake Engineering, Pearson Education, 5th Edition, 2017.
3. Das, Braja M., Principles of Foundation Engineering, Cengage Learning, 10th Edition, 2023.
4. Duggal, S.K., Earthquake Resistant Design of Structures, Oxford University Press, New Delhi, 3rd Edition, 2019.
5. Varghese, P.C., Limit State Design of Reinforced Concrete, PHI Learning Pvt. Ltd., New Delhi, 2nd Edition, 2016.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	7 hours
1.1	Overview of ETABS for building analysis and design	1
1.1	Load definition and load combinations as per IS 456, IS 875 and IS 1893	2
1.3	Definition and application of wind load parameters as per IS 875 (Part 3)	1
1.4	Types of building frame systems	1
1.5	introduction to special structural components of a building (slender column, corbel, flat slab)	2
2	Module 2	7 hours
2.1	Seismic design parameters: Importance factor, seismic zone factor, soil type, response reduction factor	1
2.2	Concept and application of dynamic analysis in buildings	1
2.3	Response Spectrum Method - Selection and assignment of response spectrum functions	2
2.3	Ductile detailing of beam, column and beam-column joints for earthquake resistance as per IS 13920.	3
3	Module 3	7 hours
3.1	Behaviour and structural role of shear walls in buildings	1
3.2	Analysis of shear walls	1
3.3	Design of shear walls with and without boundary elements	3
3.4	Code checks for shear walls	1
3.5	Detailing of shear walls	1

4	Module 4	8 hours
4.1	Introduction to isolated footing, types of isolated footings	1
4.2	Load transfer mechanism from column to soil, Bearing capacity and settlement considerations	1
4.3	Structural design of isolated footing.	1
4.4	Need for combined footing, Types: rectangular and trapezoidal combined footing, Load distribution and resultant location	2
4.5	Design principles, Reinforcement detailing	1
4.6	Concept and necessity of raft foundation, Types, Settlement considerations	1
4.7	Design concepts and reinforcement layout.	1
5	Module 5	7 hours
5.1	Structural action of pile and pile cap – Load transfer mechanism from column to piles	1
5.2	Behaviour of two-pile and three-pile pile cap systems	1
5.3	Modelling of piles and pile caps – loads and boundary conditions	2
5.4	Analysis and design of pile	1
5.5	Analysis and design of pile cap	2
Total		36 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Explain the wind load parameters for a multi-storey RC building located at a place of basic wind speed of 39 m/s.
2. Discuss the effect of corbels in multi-storey buildings.
3. Explain the behavior of slender columns in multi-storey buildings.

Course Outcome 2 (CO 2):

1. Explain the response spectrum method for seismic analysis of RC buildings.
2. Determine the seismic design parameters for a building located in zone IV with medium soil and Importance Factor 1.2 using IS 1893 provisions.
3. Illustrate the ductile detailing requirements of beam-column joints for earthquake-resistant RC frames as per IS 13920.

Course Outcome 3 (CO 3):

1. Discuss the behaviour and structural role of shear walls in buildings.
2. Design a rectangular RC shear wall with boundary elements subjected to combined gravity and lateral loads.
3. Design a rectangular RC shear wall without boundary elements subjected to combined gravity and lateral loads.

Course Outcome 4 (CO 4):

1. Design an isolated footing for a column carrying axial load and moment, considering bearing capacity.
2. Explain the design concepts and reinforcement layout of raft foundation.
3. Discuss the design principles of trapezoidal combined footing when the property line restricts footing projection. .

Course Outcome 5 (CO 5):

1. Design a two-pile pile cap for a column load of 1200 kN and explain the load transfer mechanism.
2. Design a reinforced concrete bored cast-in-situ pile for a column load of 1000 kN using IS 2911 provisions. Assume suitable soil data and design the longitudinal and lateral reinforcement.
3. Design a pile cap for two 400 mm diameter piles spaced at 1.2 m c/c carrying a column load of 1200 kN. Use M25 concrete and Fe500 steel.

MODEL QUESTION PAPER

QP CODE:

Pages: 2

Reg.No.:

Name:

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

EIGHTH SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CE4P64

ADVANCED ANALYSIS AND DESIGN USING ETABS

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. List the steps involved in modelling a multi-storey RC building in ETABS.
2. Explain the significance of wind load parameters as per IS 875 (Part 3) in ETABS analysis.
3. Define importance factor and response reduction factor used in seismic design.
4. Explain the essential ductile detailing requirements for beam-column joints as per IS 13920.
5. What is the structural role of RC shear walls in high-rise buildings?
6. Differentiate between shear walls with and without boundary elements.
7. What are the factors affecting the selection of isolated footing?
8. State the necessity of raft foundation in building construction.
9. Explain the load transfer mechanism in pile foundations.
10. What is the structural action of a pile cap?

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. A 12-storey office building located in a region with basic wind speed 39 m/s is subjected to wind load. Determine the wind pressure at different storey levels as per IS 875 (Part 3) and explain how it is assigned in ETABS.

OR

12. Discuss the structural behaviour and modelling considerations of slender columns, corbels, and flat slabs in multi-storey buildings.

MODULE 2

13. Explain the response spectrum method for seismic analysis of a multi-storey building using ETABS, including the selection and assignment of spectrum functions.

OR

14. a) A building is located in Seismic Zone III on medium soil. Explain the procedure for determining seismic forces. (7)
b) Discuss the ductile detailing requirements for beams and columns as per IS 13920. (7)

MODULE 3

15. A reinforced concrete shear wall of length 3.5 m, thickness 200 mm, and storey height 3 m is subjected to an axial load of 800 kN and lateral shear of 180 kN. Design the shear wall without boundary elements and provide vertical and horizontal reinforcement detailing.

OR

16. A rectangular RC shear wall of length 4 m and thickness 250 mm in a 12-storey building is subjected to axial load 1200 kN and overturning moment 900 kNm due to seismic action. Design the wall with suitable boundary elements.

MODULE 4

17. Design an isolated footing for a 500 mm × 500 mm column carrying an axial load of 1200 kN. Assume SBC = 200 kN/m² and M25 concrete. Check for one-way shear, punching shear, and bending moment.

OR

18. Discuss design principles and reinforcement layout of combined footing and raft foundation.

MODULE 5

19. A column load of 1500 kN is supported by two piles of 400 mm diameter spaced at 1.2 m c/c. Design the pile cap, including bending, shear, and reinforcement detailing.

OR

20. Design a bored cast-in-situ pile of 500 mm diameter to carry an axial load of 1000 kN as per IS 2911.

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE4P65	URBAN TRANSPORTATION PLANNING	2	1	0	4	3	2024

Preamble

This course provides a comprehensive understanding of the principles and methodologies involved in urban transportation planning. The syllabus emphasizes the classical four-step travel demand modeling process, covering trip generation, trip distribution, mode choice, and route assignment in detail to equip students with the ability to analyze and predict travel patterns.

Prerequisites: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Explain urban transportation planning process, including problem definition, evaluation, and implementation strategies (Cognitive Level: Understand).
CO 2	Apply transportation survey techniques and trip generation methods for analyzing travel demand (Cognitive Level: Apply).
CO 3	Apply trip distribution using growth factor and gravity models(Cognitive Level: Apply).
CO 4	Apply mode choice behavior using modal split models and logit models
CO 5	Apply route assignment techniques for efficient traffic network analysis

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	2	2	1	1	1	1			1	1
CO 2	3	2	1	2	2	1				1	1
CO 3	3	3	2	2	2						1
CO 4	3	3	2	2	1	1					1
CO 5	3	3	3	2	2	1	1				1

Assessment Pattern

URBAN TRANSPORTATION PLANNING			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	25	25	25
Understand	25	25	25
Apply	50	50	50
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course Project : 10 marks

Self Study : 5 marks

End Semester Examination Pattern

There will be two parts: Part A and Part B. Part A contain 10 questions, with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module, of which students should answer any one. Each question carries 14 marks and can have a maximum of 2 sub-divisions.

SYLLABUS

Module 1: Introduction to Transportation Planning (7 hours)

Urban Transportation Planning: Definition and objectives, Role in urban development, Transport planning process – problem definition, solution generation, solution analysis, evaluation and choice, implementation, Sequence of activities in transport analysis, Goals, objectives and constraints in planning.

Module 2: Transportation Survey and Trip Generation (7 hours)

Transportation Survey: Definition of study area, zoning, types of movements, types of transportation surveys, Trip Generation Analysis: Regression Method, category analysis, Factors influencing trip generation.

Module 3: Trip Distribution Analysis (8 Hours)

Introduction to Trip Distribution, Factors affecting Trip Distribution, Desire lines and Trip Interchange Matrices, Growth Factor Methods: Uniform Growth Factor, Average Growth Factor and Fratar Method, Gravity Model- Concept and Formulation, Calibration of Friction Factor, Singly and Doubly Constrained Gravity Models

Module 4: Mode Choice Modelling (7 Hours)

Mode Choice Analysis: Factors influencing mode choice, modal split models – trip-end type and trip-interchange type, Aggregate and Disaggregate Models, utility functions, logit model and its applications.

Module 5: Route Assignment (7 Hours)

Route Assignment: Minimum path tree concept, assignment techniques – All-or-nothing assignment, multiple route assignment using BPR method, capacity restrained method - Detroit model.

Text Books:

1. Kadiyali L.R, Traffic Engineering and Transport Planning, 2013
2. Papacostas, C.S. and Prevedouros, P.D., Transportation Engineering and Planning, Prentice Hall, 2001.

3. Khisty, C.J. and Lall, B.K., Transportation Engineering: An Introduction, Prentice Hall, 2003.
4. Ortúzar, J. de D. and Willumsen, L.G., Modelling Transport, John Wiley & Sons, 2011.
5. Hutchinson, B.G., Principles of Urban Transport Systems Planning, McGraw-Hill, 1974.
6. Meyer, M.D. and Miller, E.J., Urban Transportation Planning: A Decision-Oriented Approach, McGraw-Hill, 2001.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	7 hours
1.1	Urban Transportation Planning: Definition, need and objectives, role in urban development	2
1.2	Transport Planning Process: Problem definition, solution generation and analysis, Evaluation and choice of alternatives, implementation strategies	3
1.3	Sequence of activities in transport analysis	1
1.4	Goals, objectives and constraints in transportation planning	1
2	Module 2	7 hours
2.1	Transportation Survey: Definition of study area and zoning concepts	1
2.2	Types of movements and types of transportation surveys	1
2.3	Trip Generation: Concepts and influencing factors	1
2.4	Trip Generation analysis - Regression Method, Category Analysis	4

3	Module 3	8 hours
3.1	Introduction to Trip Distribution, Factors Affecting Trip Distribution	1
3.2	Desire lines and trip interchange matrices	1
3.3	Growth factor methods: Uniform, Average Growth Factor Method methods, Fratar Method	2
3.4	Gravity model: Concept and formulation	1
3.5	Calibration of friction factor, Singly and doubly constrained gravity models	3
4	Module 4	7 hours
4.1	Modal split models: Trip-end type and Trip-interchange type, Aggregate and Disaggregate Models	2
4.2	Utility functions in mode choice modelling	2
4.3	Logit Model and applications	3
5	Module 5	7 hours
5.1	Route assignment: Minimum path tree concept	1
5.2	All-or-nothing assignment method	2
5.3	Multiple route assignment using BPR method	2
5.4	Capacity restrained method -Detroit model	2
Total		36 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Explain the stages of the urban transportation planning process and their significance in solving real-world traffic problems.
2. Discuss the role of goals, objectives, and constraints in developing effective urban transport solutions.

Course Outcome 2 (CO 2):

1. Explain different types of transportation surveys and their importance in travel demand analysis.
2. Apply trip generation techniques to estimate travel demand for a selected urban area.

Course Outcome 3 (CO 3):

1. Compare different growth factor methods (uniform, average, Fratar) used in trip distribution.
2. Apply the gravity model to estimate trip distribution between zones in an urban area.

Course Outcome 4 (CO 4):

1. Explain the factors influencing mode choice behavior in urban transportation systems.
2. Apply logit model concepts to analyze modal split for a given transportation scenario.

Course Outcome 5 (CO 5):

1. Explain different route assignment techniques such as all-or-nothing and capacity restrained methods
2. Apply route assignment methods to determine optimal traffic flow in a transportation network.

MODEL QUESTION PAPER

QP CODE:

Pages: 2

Reg.No.:

Name:

**MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM**

EIGHTH SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CE4P65

URBAN TRANSPORTATION PLANNING

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Define urban transportation planning and state its objectives
2. What is zoning? How is it used in transportation surveys?
3. List any three types of transportation surveys.
4. Define trip generation and mention its importance.
5. Explain the principle of the gravity model in trip distribution?
6. Define modal split in transportation planning
7. What is a utility function in mode choice modelling?
8. Explain utility function in mode choice modelling?
9. Explain all-or-nothing assignment?
10. Explain capacity restrained assignment method

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. a) Explain the stages involved in the urban transportation planning process. (7)
- b) Discuss the role of goals, objectives, and constraints in transport planning. (7)

OR

12. a) Describe the sequence of activities involved in transport analysis. (7)
- b) Explain problem definition and solution generation in transportation planning with examples. (7)

MODULE 2

13. a) Explain different types of transportation surveys and their applications. (7)
- b) Discuss trip production analysis and factors influencing trip generation. (7)

OR

14. a) Describe the concept of study area definition and zoning in transportation planning. (7)
- b) Explain category analysis and trip attraction modelling with suitable examples. (7)

MODULE 3

15. a) Explain the growth factor methods used in trip distribution (uniform, average, Fratar). (7)
- b) Describe the gravity model and its applications in transportation planning. (7)

OR

16. a) Compare growth factor methods and gravity models for trip distribution. (7)
- b) Explain singly and doubly constrained gravity models with examples. (7)

MODULE 4

17. a) Explain factors influencing mode choice behaviour (7)
- b) Distinguish between trip-end and trip-interchange modal split models. (7)

OR

18. a) Explain the concept of utility functions in mode choice modelling. (7)
- b) Describe the logit model and its applications in transportation planning. (7)

MODULE 5

19. a) Explain all-or-nothing assignment and its limitations. (7)
- b) Describe multiple route assignment using BPR method. (7)

OR

20. a) Explain capacity restrained assignment method and its significance. (7)
- b) Describe the Detroit model and its application in traffic assignment. (7)

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE4P66	ARCHITECTURAL MODELLING AND ADVANCED BIM	2	1	0	4	3	2024

Preamble

This course introduces advanced applications of Building Information Modeling (BIM) beyond basic 3D modelling. It covers architectural modelling, construction planning (4D), cost estimation (5D), sustainability analysis, and lifecycle management. The course also highlights the use of BIM in safety planning, lean construction, and digital twin technologies, enabling better coordination, planning, and decision-making throughout the project lifecycle.

Prerequisites: Introduction to BIM 2D Drafting and Architectural Modelling Fundamentals

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Apply parametric modelling concepts and advanced BIM tools to create coordinated 3D architectural models with appropriate constraints, families, and design options.(Cognitive Knowledge Level: Apply)
CO 2	Analyze construction activities and develop 4D BIM models by linking project schedules with BIM to visualize and optimize construction sequencing and site logistics. (Cognitive Knowledge Level: Analyze)
CO 3	Apply BIM tools to perform model-based quantity take-off and cost estimation for effective budget tracking and cost optimization.(Cognitive Knowledge Level : Apply)
CO 4	Analyze building performance using BIM-based sustainability assessments, energy analysis, and lifecycle management techniques. (Cognitive Knowledge Level: Apply)
CO 5	Evaluate the application of BIM in construction safety planning, lean project management, and digital twin technologies for improving project efficiency and decision-making. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	2	1		1	2	3	2	1	1	1
CO 2	2	2	3	1	2	2	2	1	1	1	2
CO 3	2	3	2	2	1	2	3	2		1	2
CO 4	2	2	2	1	1	2	3	2	1	1	2
CO 5	2	2	3	2	2	2	3	2	1	1	2

Assessment Pattern

ARCHITECTURAL MODELLING AND ADVANCED BIM			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	20	20	30
Understand	30	30	30
Apply	30	30	20
Analyse	20	20	20
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course Project : 10 marks

Self Study : 5 marks

End Semester Examination Pattern

There will be two parts: Part A and Part B. Part A contain 10 questions, with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module, of which students should answer any one. Each question carries 14 marks and can have a maximum of 2 sub-divisions.

SYLLABUS

Module 1: Advanced 3D Architectural Modelling (7 hours)

Parametric architectural modelling concepts, advanced families and components, constraints and relationships, massing to detailed model workflows, design options and phasing, clash awareness in architectural models, coordination with structural and MEP models.

Module 2: Construction Sequencing and Planning (7 hours)

Linking BIM models with project schedules, construction sequencing logic, visualization of construction phases, time-based simulation of activities, site layout and logistics planning using 4D BIM, schedule optimization and scenario analysis.

Module 3: Cost Estimation and Quantity Management (7 Hours)

Model-based quantity take-off, integration of cost databases with BIM, dynamic cost estimation, cost-time relationship analysis, budget tracking and control, value engineering and cost optimization using BIM.

Module 4: Sustainability and Lifecycle Management (7 Hours)

Energy and environmental performance analysis, daylighting and thermal simulations, sustainability assessment using BIM, BIM-enabled facility management, asset information modelling, lifecycle cost analysis and operational performance monitoring.

Module 5: Safety, Lean and Digital Twin Applications (8 Hours)

BIM for construction safety planning and risk visualization (8D), lean construction principles and productivity improvement through BIM (9D), digital twins and real-time data integration (10D), automation, AI and future trends in advanced BIM.

Text Books:

1. Eastman, C., Teicholz, P., Sacks, R., Liston, K., BIM Handbook: A Guide to Building Information Modeling, Wiley, 2018
2. Kymmell, Willem, Building Information Modeling: Planning and Managing Construction Projects, McGraw-Hill, 2008
3. Hardin, Brad & McCool, Dave, BIM and Construction Management, Wiley

References:

1. Smith, Dana K. & Tardif, Michael, Building Information Modeling: A Strategic Implementation Guide, Wiley
2. Crotty, Ray, The Impact of Building Information Modelling, Routledge
3. Azhar, Salman, Building Information Modeling for Sustainable Design, McGraw-Hill
4. Autodesk Official Learning Resources and Technical Documentation

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	7 hours
1.1	Parametric architectural modelling concepts, advanced families and components.	2
1.2	Constraints and relationships, massing to detailed model workflows	2
1.3	Design options and phasing, clash awareness in architectural models.	2
1.4	Coordination with structural and MEP models	1
2	Module 2	7 hours
2.1	Linking BIM models with project schedules, construction sequencing logic.	2
2.2	Visualization of construction phases.	1
2.3	Time-based simulation of activities	1
2.4	Site layout and logistics planning using 4D BIM	1
2.5	Schedule optimization and scenario analysis.	1
2.6	Role of COSTFORD, Nirmithi Kendra, Laurie Baker initiatives and Auroville Earth Institute.	1

3	Module 3	7 hours
3.1	Model-based quantity take-off, integration of cost databases with BIM.	2
3.2	Dynamic cost estimation, cost-time relationship analysis.	2
3.3	Budget tracking and control	1
3.4	Value engineering and cost optimization using BIM.	2
4	Module 4	7 hours
4.1	Energy and environmental performance analysis	2
4.2	Daylighting and thermal simulations, sustainability assessment using BIM	2
4.3	BIM-enabled facility management, asset information modelling	1
4.4	lifecycle cost analysis and operational performance monitoring.	2
5	Module 5	8 hours
5.1	BIM for construction safety planning and risk visualization (8D)	2
5.2	Lean construction principles and productivity improvement through BIM (9D)	2
5.3	Digital twins and real-time data integration (10D)	1
5.4	Automation, AI and future trends in advanced BIM	2
Total		36 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Explain the concept of parametric modelling and discuss how constraints and relationships improve design accuracy in BIM.
2. Describe the workflow from massing to detailed architectural modelling with a suitable example.
3. Discuss how the use of local and indigenous materials can reduce the embodied energy and carbon footprint of a building.

Course Outcome 2 (CO 2):

1. Explain how BIM models are linked with project schedules for construction sequencing.
2. Describe the role of 4D BIM in visualizing construction phases and improving project planning.
3. Discuss site layout and logistics planning using BIM and explain how scenario analysis helps in schedule optimization.

Course Outcome 3 (CO 3):

1. Explain model-based quantity take-off and its advantages over traditional methods.
2. Discuss how BIM integrates cost databases for dynamic cost estimation and budget control.
3. Analyze the relationship between cost and time in BIM and explain how value engineering can be achieved.

Course Outcome 4 (CO 4):

1. Explain how BIM is used for energy and environmental performance analysis in buildings.
2. Discuss the role of BIM in lifecycle cost analysis and facility management.
3. Describe how daylighting and thermal simulations contribute to sustainable building design.

Course Outcome 5 (CO 5):

1. Explain how BIM is used for construction safety planning and risk visualization (8D BIM).
2. Discuss the principles of lean construction and how BIM improves productivity.
3. Describe the concept of digital twins and explain their role in real-time project monitoring and future construction practices.

MODEL QUESTION PAPER

QP CODE:

Pages: 3

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

EIGHTH SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CE4P66

ARCHITECTURAL MODELLING AND ADVANCED BIM

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Define parametric modelling in BIM and explain its key advantages in architectural design.
2. Explain the concepts of design options and phasing in architectural modelling with their significance.
3. Explain the concept of 4D BIM and discuss its significance in construction planning.
4. Describe construction sequencing and explain its importance in effective project management.
5. Explain the concept of model-based quantity take-off and its role in BIM-based estimation.
6. Describe dynamic cost estimation in BIM and its importance in project budgeting.
7. Explain lifecycle cost analysis in BIM and its importance in long-term project evaluation.
8. Describe daylighting analysis and explain its importance in sustainable building design.
9. Explain the concept of 8D BIM in construction safety planning and risk visualization.
10. Describe the concept of digital twin and its relevance in the construction industry.

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. a) Explain the concept of parametric architectural modelling with suitable examples from practice. (7)
b) Discuss the role of constraints and relationships in BIM and explain how they contribute to model accuracy. (7)

OR

12. a) Describe the workflow involved in developing a model from massing to detailed architectural components in BIM. (7)
b) Explain the importance of coordination and clash awareness among architectural, structural, and MEP models. (7)

MODULE 2

13. a) Explain the process of linking BIM models with project schedules for effective planning. (7)
b) Discuss construction sequencing logic and explain its benefits in project execution. (7)

OR

14. a) Describe the visualization of construction phases using 4D BIM and its advantages. (8)
b) (b) Explain the role of BIM in site layout and logistics planning for construction projects. (6)

MODULE 3

15. a) Explain the process of model-based quantity take-off and discuss its advantages over traditional methods. (7)
b) Describe the integration of cost databases with BIM and its role in cost estimation. (7)

OR

16. a) Explain the concept of cost-time relationship analysis in BIM and its importance in project management. (7)
b) Discuss the role of value engineering and cost optimization using BIM in construction projects. (7)

MODULE 4

17. a) Explain the methods used for energy and environmental performance analysis in BIM-based projects. (7)
b) Discuss the role of BIM in sustainability assessment and green building design. (7)

OR

18. a) Describe BIM-enabled facility management and its importance in building operations. (7)
b) Explain lifecycle cost analysis and operational performance monitoring using BIM. (7)

MODULE 5

19. a) Explain the application of BIM in construction safety planning and risk visualization. (7)
b) Discuss lean construction principles and explain how BIM improves productivity. (7)

OR

20. a) Explain the concept of digital twins and their role in real-time data integration in construction. (7)
b) Discuss the applications of automation and artificial intelligence in advanced BIM practices. (7)

KNOWLEDGE IS POWER

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE4G31	ENVIRONMENTAL HEALTH AND SAFETY	2	1	0	4	3	2024

Preamble

This course introduces the principles and practices of Environment, Health and Safety (EHS) management in workplaces. It covers occupational health and hygiene, workplace safety systems, hazard identification and risk management techniques, and relevant national and international regulations. The course also emphasizes environmental health and safety management systems, including ISO 45001, to promote safe working environments and sustainable industrial practices.

Prerequisites: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Explain the need for EHS systems and the regulatory framework governing workplace safety. (Understand)
CO 2	Describe occupational health hazards, exposure pathways, and control measures including personal protective equipment. (Understand)
CO 3	Apply workplace safety principles for safe design and operation of industrial facilities. (Apply)
CO 4	Apply hazard identification and risk management techniques for improving workplace safety. (Apply)
CO 5	Explain the concepts and elements of Environmental Health and Safety Management Systems including ISO 45001. (Understand)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	2	1				3	2	2			
CO 2	2	1				3	2	2		1	
CO 3	3	2	2	1	2	3	2	2		1	1
CO 4	2	3	2	2	2	3	2	2	1	1	1
CO 5	2	1				2	2	2	1	1	1

Assessment Pattern

ENVIRONMENTAL HEALTH AND SAFETY			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	40	40	40
Understand	40	40	40
Apply	20	20	20
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course Project : 10 marks

Self Study : 5 marks

End Semester Examination Pattern

There will be two parts: Part A and Part B. Part A contain 10 questions, with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module, of which students should answer any one. Each question carries 14 marks and can have a maximum of 2 sub-divisions.

SYLLABUS

Module 1: INTRODUCTION TO EHS (7 hours)

Need for developing Environment, Health and Safety systems in workplaces - International initiatives, National Policy and Legislations on EHS in India – Regulations and Codes of Practice - Role of trade union safety representatives – Ergonomics.

Module 2: OCCUPATIONAL HEALTH AND HYGIENE (7 hours)

Definition of occupational health and hygiene – Categories of health hazards – Exposure pathways and human responses – Exposure Assessment - occupational exposure limits Hierarchy of control measures – Role of personal protective equipment and the selection criteria

Module 3: WORKPLACE SAFETY AND SAFETY SYSTEMS (8 Hours)

Features of Satisfactory and Safe design of work premises – good housekeeping – lighting and color, Ventilation and Heat Control, Noise, Chemical and Radiation Safety – Electrical Safety – Fire Safety – Safety at Construction sites, Effluent Treatment Plant – Machine guarding – Process Safety, Working at different levels

Module 4: HAZARDS AND RISK MANAGEMENT (7 Hours)

Safety appraisal – Job Safety Analysis-Control techniques – plant safety inspection – Accident investigation – Analysis and Reporting – Hazard and Risk Management Techniques – Onsite and Offsite emergency Plans. Employee Participation - Education and Training - Case Studies

Module 5: ENVIRONMENTAL HEALTH AND SAFETY MANAGEMENT (7 Hours)

Concept of Environmental Health and Safety Management – Elements of Environmental Health and Safety Management Policy and implementation and review – ISO 45001- Structure and Clauses - Case Studies

Text Books:

1. The Beginner's Guide to the Environmental, Health and Safety Profession, Chance Roberts, Apr 10, 2022.
2. Environmental Safety and Health Regulations, Joel M. Haight, Feb 4, 2013.

3. Safety, Health and Environmental Auditing, Simon Watson Pain, May 31, 2023.

Reference Books:

1. Industrial Health and Safety Acts and Amendments, by Ministry of Labour and Employment, Government of India.
2. Fundamentals of Industrial Safety and Health by Dr.K.U.Mistry, Siddharth Prakashan, 2012.
3. The Facility Manager's Guide to Environmental Health and Safety by Brian Gallant, Government Inst Publ., 2007.
4. Effective Environmental, Health, and Safety Management Using the Team Approach by Bill Taylor, Culinary and Hospitality Industry Publications Services, 2005.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	7 hours
1.1	Need for developing Environment	1
1.2	Health and Safety systems in workplaces	1
1.3	International initiatives	1
1.4	National Policy and Legislations on EHS in India	1
1.5	Regulations and Codes of Practice	1
1.6	Role of trade union safety representatives -Ergonomics	2
2	Module 2	7 hours
2.1	Definition of occupational health and hygiene	1
2.2	Categories of health hazards	1
2.3	Exposure pathways and human responses	1
2.4	Exposure Assessment - occupational exposure limits Hierarchy of control measures	2

2.5	Role of personal protective equipment and the selection criteria	2
3	Module 3	8 hours
3.1	Features of Satisfactory and Safe design of work premises	1
3.2	Good housekeeping – lighting and color, Ventilation and Heat Control	1
3.3	Noise, Chemical and Radiation Safety	1
3.4	Electrical Safety – Fire Safety – Safety at Construction sites	2
3.5	Effluent Treatment Plant – Machine guarding - Process Safety	2
3.6	Working at different levels	1
4	Module 4	7 hours
4.1	Safety appraisal – Job Safety Analysis-Control techniques	1
4.2	Plant safety inspection – Accident investigation – Analysis and Reporting	2
4.3	Hazard and Risk Management Techniques – Onsite and Off-site emergency Plans	2
4.4	Employee Participation - Education and Training - Case Studies	2
5	Module 5	7 hours
5.1	Concept of Environmental Health and Safety Management	1
5.2	Elements of Environmental Health and Safety Management Policy and implementation and review	2
5.3	ISO 45001 - Structure and Clauses	2
5.4	Case Studies	2
Total		36 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Explain the need for developing Environment, Health and Safety (EHS) systems in workplaces.
2. Describe the major national policies and legislations related to EHS in India.
3. Explain the role of trade union safety representatives and ergonomics in workplace safety.

Course Outcome 2 (CO 2):

1. Define occupational health and hygiene and explain different categories of workplace health hazards.
2. Describe the exposure pathways and human responses to occupational hazards.
3. Explain the hierarchy of control measures and the role of personal protective equipment (PPE).

Course Outcome 3 (CO 3):

1. Explain the features of safe design of work premises including lighting, ventilation, and housekeeping.
2. Describe safety measures for electrical systems and fire protection in industries.
3. Explain safety considerations at construction sites and machine guarding techniques.

Course Outcome 4 (CO 4):

1. Explain the concept and procedure of Job Safety Analysis (JSA).
2. Describe the steps involved in accident investigation and reporting.
3. Explain hazard identification and risk management techniques used in industries.

Course Outcome 5 (CO 5):

1. Explain the concept and objectives of Environmental Health and Safety Management.
2. Describe the elements of an Environmental Health and Safety Management Policy.
3. Explain the structure and key clauses of ISO 45001.

MODEL QUESTION PAPER

QP CODE:

Pages: 2

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

EIGHTH SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CE4G31

ENVIRONMENTAL HEALTH AND SAFETY

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Define Environment, Health and Safety (EHS).
2. What is ergonomics?
3. Define occupational health.
4. What are occupational exposure limits?
5. What is machine guarding?
6. What is fire safety in workplaces?
7. Define Job Safety Analysis (JSA).
8. What is hazard identification?
9. What is Environmental Health and Safety Management?
10. What is ISO 45001?

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. a) Explain the need for Environment, Health and Safety systems in workplaces. (8)
- b) Discuss international initiatives and national legislations related to EHS in India.

OR

12. a) Explain the regulations and codes of practice for workplace safety. (7)
- b) Discuss the role of ergonomics and trade union safety representatives in occupational safety. (7)

MODULE 2

13. a) Explain occupational health and hygiene and different categories of workplace hazards. (8)
- b) Discuss exposure pathways and occupational exposure limits. (6)

OR

14. a) Explain the hierarchy of control measures for workplace hazards. (7)
- b) Discuss the importance and selection criteria of personal protective equipment (PPE). (7)

MODULE 3

15. a) Explain the features of safe design of work premises including ventilation, lighting, and housekeeping. (8)
- b) Discuss noise, chemical, and radiation safety measures in workplaces. (6)

OR

16. a) Explain electrical safety and fire safety practices in industrial environments. (7)
- b) Discuss safety measures at construction sites and machine guarding. (7)

MODULE 4

17. a) Explain Job Safety Analysis and safety appraisal techniques. (8)
- b) Discuss plant safety inspection and accident investigation procedures. (6)

OR

18. a) Explain hazard and risk management techniques used in industries. (7)
- b) Discuss onsite and offsite emergency plans and employee participation in safety management. (7)

MODULE 5

19. a) Explain the concept and elements of Environmental Health and Safety Management systems. (8)
- b) Discuss implementation and review of EHS policies in organizations. (6)

OR

20. a) Explain the structure and clauses of ISO 45001. (7)
- b) Discuss the importance of EHS management systems with suitable case studies. (7)

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE4G32	LAND USE AND TRANSPORT PLANNING	2	1	0	4	3	2024

Preamble

Land Use and Transport Planning examines the dynamic interrelationship between land-use patterns and transportation systems in the context of urbanization and sustainability. The course covers fundamentals of mobility, accessibility, integrated planning tools including GIS, and emerging sustainable strategies for efficient urban development.

Prerequisites: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Explain the fundamental relationship between land use, transportation systems, and urban form, including the concepts of mobility and accessibility. (Cognitive Level: Understand).
CO 2	Describe the interaction between transportation infrastructure and urban development patterns, including transit-oriented and mixed-use developments. (Cognitive Level: Understand).
CO 3	Differentiate various types of mobility patterns and transport modes, and describe their implications on urban travel behavior and sustainability. (Cognitive Level: Understand).
CO 4	Describe planning tools and techniques such as GIS, remote sensing, and accessibility analysis for integrated land use and mobility planning. (Cognitive Level: Understand).
CO 5	Describe sustainable and innovative mobility strategies, including policy frameworks, smart mobility interventions, and low-carbon urban transport solutions. (Cognitive Level: Understand).

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	2	1			1	2				
CO 2	2	3	2			2	3				
CO 3	2	3	2	1		2					1
CO 4	2	2	3	3	2						2
CO 5	1	1	2	2	3	3	2				

Assessment Pattern

LAND USE AND TRANSPORT PLANNING			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember	50	50	50
Understand	50	50	50
Apply			
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course Project : 10 marks

Self Study : 5 marks

End Semester Examination Pattern

There will be two parts: Part A and Part B. Part A contain 10 questions, with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module, of which students should answer any one. Each question carries 14 marks and can have a maximum of 2 sub-divisions.

SYLLABUS

Module 1: Fundamentals of Land Use and Transportation Systems (7 hours)

Introduction to Land Use and Transportation: Fundamentals of land use: types, zoning, urban form and structure. Interaction between transportation and land use, Impact of transportation on land value.

Module 2: Transportation and Urban Development (7 hours)

Transit-Oriented Development (TOD): Principles and examples, Mobility and accessibility concepts, Impact of transportation on development patterns, Land use intensity and transportation demand, Mixed-use development and walkability

Module 3: Mobility Patterns and Transport Planning (8 Hours)

Types of mobility: motorized, non-motorized, public, shared, Types of trips, Factors influencing mobility, Transport planning steps (Introduction) : Trip generation, Distribution, Mode choice, Route Assignment, Multi-modal transportation systems and integration

Module 4: Planning Tools and Techniques (7 Hours)

Surveys for mobility and land use data, Introduction to Geographic Information Systems (GIS), GIS, remote sensing and urban analytics in planning, Accessibility analysis using GIS tools, Travel diaries, GPS tracking, Role of simulation and digital twins in mobility planning.

Module 5: Innovations and Sustainable Practices in Land Use-Mobility Planning (7 Hours)

Urban mobility policies in India: NUTP, Metro Policy, Smart Cities Mission, Sustainable mobility strategies, Green infrastructure and low-carbon urban mobility, Smart mobility and digital interventions (ITS, Mobility-as-a-Service).

Text Books:

1. National Urban Transport Policy
2. Black, William R. Sustainable transportation: problems and solutions, The Guilford Press, 2010.

3. Edward, J.K., David, R.G., Stuart, F., Urban Land use Planning, 4th edition, Urbana, University of Illinois Press, 1995.
4. Hall, P., Cities of tomorrow: An intellectual history of urban planning and design in the twentieth century, Blackwell, London, 2001.
5. Preston, L. Schiller, Eric, C. Brunn and Jeffrey, R. Kenworthy. An Introduction to Sustainable Transportation: Policy, Planning and Implementation, Earthscan, 2010.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	7 hours
1.1	Fundamentals of land use: types, zoning, urban form and structure	2
1.2	Mobility and accessibility concepts	1
1.3	Interaction between transportation and land use	2
1.4	Urbanization trends and transportation demands	2
2	Module 2	7 hours
2.1	Transit-Oriented Development (TOD): Principles, 5 Ds, benefits and global examples	3
2.2	Impact of transportation on land value and development patterns.	2
2.3	Mixed-use development, walkability and metro influence zone case studies	2
3	Module 3	8 hours
3.1	Types of mobility: motorized, non-motorized, public, shared	2
3.2	Four Stage Travel Demand Model (Introduction only) - Trip Attraction, Trip Distribution, Modechoice, Route Assignment	3

3.3	Multi-modal systems, integration, first/last-mile connectivity and micro-mobility	3
4	Module 4	7 hours
4.1	Surveys for mobility and land use data	2
4.2	Introduction to GIS, remote sensing, Accessibility analysis using GIS tools	3
4.3	Travel diaries, GPS tracking, simulation and digital twins	2
5	Module 5	7 hours
5.1	Urban mobility policies in India: NUTP, Metro Policy, Smart Cities Mission	2
5.2	Sustainable mobility strategies, green infrastructure and low-carbon urban mobility	2
5.3	Smart mobility, digital interventions (ITS, MaaS), Role of AI and IoT, Case studies	3
Total		36 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Explain the relationship between land use and transportation systems with suitable examples.
2. Compare monocentric, polycentric, and dispersed urban forms in terms of transport implications.

Course Outcome 2 (CO 2):

1. Discuss the principles of Transit-Oriented Development (TOD) and its role in sustainable urban growth.
2. Examine the impact of transportation infrastructure on land value and urban development patterns.

Course Outcome 3 (CO 3):

1. Classify different types of mobility and explain their characteristics.
2. Describe the stages of the travel demand model and their relevance in transport planning.

Course Outcome 4 (CO 4):

1. Describe the role of GIS in transportation and land use planning.
2. Explain accessibility analysis using suitable measures.

Course Outcome 5 (CO 5):

1. Discuss major urban mobility policies in India and their objectives.
2. Explain the role of smart mobility solutions such as ITS and MaaS in urban transport systems.

MODEL QUESTION PAPER

QP CODE:

Pages: 2

Reg.No.:

Name:

**MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM**

EIGHTH SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CE4G32

LAND USE AND TRANSPORT PLANNING

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Define land use and list its major types
2. Differentiate mobility and accessibility with examples.
3. Define Transit-Oriented Development (TOD) and state its key principles.
4. Explain the impact of transportation in land value.
5. List the stages of the travel demand model.
6. Define micro-mobility and provide examples.
7. Define Geographic Information Systems (GIS) and mention two applications.
8. Describe the purpose of a travel diary in data collection.
9. List any two urban mobility policies in India.
10. Define Intelligent Transport Systems (ITS).

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. a) Explain the relationship between land use and transportation systems. (7)
b) Compare different urban forms and interpret their transport implications. (7)

OR

12. a) Explain mobility and accessibility concepts with examples. (7)
b) Discuss urbanization trends in India and their impact on transportation demand. (7)

MODULE 2

13. a) Discuss the principles and benefits of Transit-Oriented Development (TOD). (7)
b) Examine the impact of transportation infrastructure on land value and development patterns. (7)

OR

14. a) Explain mixed-use development and its role in promoting walkability. (7)
b) Illustrate metro influence zones with suitable examples. (7)

MODULE 3

15. a) Classify types of mobility and explain their characteristics. (7)
b) Describe the stages of the travel demand model. (7)

OR

16. a) Discuss multi-modal transportation systems and integration strategies. (7)
b) Explain first-mile and last-mile connectivity issues and solutions. (7)

MODULE 4

17. a) Explain the importance of transport surveys in data collection. (7)
b) Describe the applications of GIS in planning. (7)

OR

18. a) Explain different accessibility measures used in planning. (7)
b) Discuss travel diaries and GPS tracking in mobility studies. (7)

MODULE 5

19. a) Discuss major urban mobility policies in India. (7)
b) Explain sustainable mobility strategies in urban areas. (7)

OR

20. a) Explain the role of ITS and MaaS in smart mobility. (7)
b) Discuss the application of digital technologies in transportation systems. (7)

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE4G33	CONDITION ASSESSMENT OF STRUCTURES	2	1	0	4	3	2024

Preamble

This course introduces the principles and practices involved in assessing the condition of existing structures. It covers causes of deterioration, inspection techniques, non-destructive testing, damage evaluation, and reporting methods to ensure structural safety, serviceability, and durability. By the end of the course, students will be equipped with the knowledge to assess the safety, durability, and resilience of existing structures.

Prerequisites: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Gain insights into the need, scope, and stages of condition assessment of structures. (Cognitive Knowledge Level: Understand)
CO 2	Identify and classify common structural defects through visual inspection. (Cognitive Knowledge Level: Apply)
CO 3	Select and interpret appropriate non-destructive testing methods for structures. (Cognitive Knowledge Level: Apply)
CO 4	Evaluate the basic structural condition and causes of deterioration. (Cognitive Knowledge Level: Analyse)
CO 5	Prepare a basic condition assessment report with findings and recommendations. (Cognitive Knowledge Level: Analyse)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	1				1					2
CO 2	2	3		2							1
CO 3	2	2		3	3						1
CO 4	2	3	1	3		1					1
CO 5	2	2	2	2			1		3		1

Assessment Pattern

CONDITION ASSESSMENT OF STRUCTURES			
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%)
	Test 1 (%)	Test 2 (%)	
Remember			
Understand	40	30	30
Apply	60	40	40
Analyse	30	30	30
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3 hours

Continuous Internal Evaluation Pattern

Attendance : 10 marks

Continuous Assessment Test (2 numbers) : 25 marks

Assignment/Quiz/Course Project : 10 marks

Self Study : 5 marks

End Semester Examination Pattern

There will be two parts: Part A and Part B. Part A contain 10 questions, with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module, of which students should answer any one. Each question carries 14 marks and can have a maximum of 2 sub-divisions.

SYLLABUS

Module 1: Introduction to Structural Condition Assessment (6 hours)

Introduction and need for condition assessment; Types of structures: RCC, steel, masonry, bridges; Causes of structural distress and deterioration; Concepts of safety, serviceability, and durability; Stages of condition assessment: preliminary and detailed inspection; Overview of relevant Indian Standards.

Module 2: Visual Inspection and Damage Identification (7 hours)

Objectives and planning of structural inspection; Visual inspection methods and tools; Identification of common defects: cracks (types, causes, patterns), spalling, corrosion, honey-combing, excessive deflection and settlement; Documentation of damage using sketches, photographs, and checklists; Preparation of basic inspection reports.

Module 3: Non-Destructive Testing of Structures (8 Hours)

Introduction to non-destructive testing (NDT); Advantages and limitations of NDT; Rebound Hammer Test, Ultrasonic Pulse Velocity (UPV) Test, Half-cell potential test, Cover meter test; Introduction to minor destructive tests – core cutting (concept only); Basic interpretation of test results.

Module 4: Deterioration Mechanisms and Structural Health Monitoring (7 Hours)

Corrosion of reinforcement, carbonation, sulphate attack.
Introduction to Structural Health Monitoring (SHM); Simple monitoring techniques such as crack gauges and settlement markers.

Module 5: Condition Rating, Reporting, and Case Studies (8 Hours)

Condition grading and rating of structures; Decision-making: repair, rehabilitation, or demolition; Overview of repair and rehabilitation methods; Preparation of simple condition assessment reports; Case studies on existing buildings and bridges; Professional ethics and responsibilities in assessment practice.

Text Books:

1. V. Ramachandran; A.C. Raghuram; R.V. Krishnan; S.K. Bhaumik, "Failure Analysis of Engineering Structures: Methodology and Case Histories", 2005, ASM International.
2. Maierhofer, Christiane & Reinhardt, H.-W & Dobmann, Gerd. (2010), "Non-Destructive

Evaluation of Reinforced Concrete Structures: Non-Destructive Testing Methods”, Woodhead publishing.

3. Malcolm Holland, ”Practical Guide to Diagnosing Structural Movement in Buildings”, Second edition, Wiley Blackwell.
4. Luca Bertolini, ”Corrosion of Steel in Concrete: Prevention, Diagnosis, Repair”,2003, Wiley.
5. Myer Kutz, ”Handbook of Environmental Degradation of Materials”,2005, First edition.
6. Ronald Hamburger and Andrew Whittaker, ”Case Studies in Structural Engineering for Architects”

References:

1. N.J. Delatte, ”Beyond Failure: Forensic Case Studies for Civil Engineers”, ASCE, 2009Talreja, R. & Natarajan, C., Assessment of Existing Structures, Narosa Publishing House.
2. IS 456: 2000 – Plain and Reinforced Concrete – Code of Practice.
3. IS 13311 (Part 1 & 2): 1992 – Non-Destructive Testing of Concrete.
4. IS 15988: 2013 – Seismic Evaluation and Strengthening of Existing RC Buildings.
5. IS 16401: 2015 – Structural Health Monitoring of Civil Engineering Structures.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	Module 1	6 hours
1.1	Introduction and need for condition assessment	1
1.2	Types of structures	1
1.3	Causes of deterioration	1
1.4	Safety, serviceability, durability concepts	2
1.5	Stages of assessment and IS codes	1
2	Module 2	7 hours
2.1	Objectives and planning of structural inspection	1
2.2	Visual inspection methods	2
2.3	Identification of defects	2
2.4	Documentation techniques	1
2.5	Inspection report preparation	1
3	Module 3	8 hours
3.1	Introduction to NDT, its advantages and limitations	2
3.2	Rebound hammer test	1
3.3	UPV test	1
3.4	Half-cell potential test	2
3.5	Core cutting and interpretation of test results	2
4	Module 4	7 hours
4.1	Corrosion mechanisms	2

4.2	Carbonation and sulphate attack	2
4.3	Introduction to SHM	1
4.4	Monitoring techniques	2
5	Module 5	8 hours
5.1	Condition rating methods	2
5.2	Decision-making: repair, rehabilitation, or demolition	1
5.3	Repair techniques overview	1
5.4	Case studies on existing buildings and bridges	3
5.5	Professional ethics and responsibilities in assessment practice	1
Total		36 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. What is meant by condition assessment of structures? Explain its importance in civil engineering practice.
2. List and explain the different stages involved in the condition assessment of an existing structure.
3. Why is condition assessment necessary before deciding repair or rehabilitation of a structure?

Course Outcome 2 (CO 2):

1. Identify the common types of cracks observed in RCC structures and state their possible causes.
2. During visual inspection, how would you distinguish between structural and non-structural cracks?
3. List common defects observed in concrete structures and explain any two with neat sketches.

Course Outcome 3 (CO 3):

1. Explain the principle and procedure of the Rebound Hammer Test and state its limitations.
2. Describe the Ultrasonic Pulse Velocity (UPV) test and explain how it is used to assess concrete quality.
3. Which NDT methods are suitable for assessing corrosion in RCC structures?

Course Outcome 4 (CO 4):

1. Explain the mechanisms of corrosion of reinforcement in concrete structures.
2. How does carbonation affect the durability of RCC structures?
3. Discuss the causes and effects of sulphate attack on concrete structures.

Course Outcome 5 (CO 5):

1. What are the essential components of a condition assessment report for an existing building?
2. Prepare a sample condition assessment report outline for a residential RCC building.
3. Based on inspection and test results, how would you recommend repair, rehabilitation, or demolition of a structure?

MODEL QUESTION PAPER

QP CODE:

Pages: 2

Reg.No.:

Name:

MAR ATHANASIOUS COLLEGE OF ENGINEERING (AUTONOMOUS),
KOTHAMANGALAM

EIGHTH SEMESTER B TECH DEGREE EXAMINATION, YEAR

Course Code: B24CE4G33

CONDITION ASSESSMENT OF STRUCTURES

Max. Marks: 100

Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Define condition assessment of structures and state its objectives.
2. List any three causes of deterioration in reinforced concrete structures.
3. What is visual inspection? Mention any two tools used for it.
4. Differentiate between structural cracks and non-structural cracks.
5. What is Non-Destructive Testing (NDT)? State its advantages.
6. State the principle of the Rebound Hammer Test.
7. What is the use of Ultrasonic Pulse Velocity (UPV) test ?
8. Define carbonation of concrete.
9. What is condition rating of structures?
10. List any three components of a condition assessment report.

PART B

Answer any one question from each module. Each question carries 14 marks

MODULE 1

11. Explain the need and importance of condition assessment of existing structures. Discuss the various causes of structural distress and deterioration in RCC, steel, and masonry structures.

OR

12. Describe the stages involved in condition assessment of structures. Explain the concepts of safety, serviceability, and durability with reference to relevant Indian Standards.

MODULE 2

13. Describe the procedure for planning and conducting a visual inspection of a structure. How are defects identified and documented during inspection?

OR

14. Explain different types of cracks in concrete structures, their causes, and patterns. Illustrate how inspection tools and techniques are used to identify such defects.

MODULE 3

15. Explain the principles, procedure, and applications of the Rebound Hammer Test and Ultrasonic Pulse Velocity (UPV) Test. How are the results interpreted?

OR

16. Discuss various non-destructive testing methods used in structural assessment. Explain the significance of the half-cell potential test and core cutting in evaluating structural condition.

MODULE 4

17. Describe the mechanisms of deterioration in reinforced concrete structures due to corrosion, carbonation, and sulphate attack.

OR

18. Analyse the effectiveness of health monitoring techniques such as crack gauges and settlement markers in assessing structural performance.

MODULE 5

19. Explain the procedure for condition rating of structures. How does condition assessment help in decision-making for repair, rehabilitation, or demolition?

OR

20. Evaluate the importance of case studies and professional ethics in structural assessment practice.

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CE4L14	PROJECT PHASE II	0	0	12	3	6	2024

Preamble

The course 'Project Work Phase II' evokes innovation and invention skills in students. It offers an opportunity to synthesize and apply learned knowledge and analytical skills toward developing a functional prototype, simulation, or technology solution. Projects should align with thrust areas of the engineering stream or be interdisciplinary, prioritizing societal problems, sustainable development (aligned with UN SDGs such as SDG 7: Affordable & Clean Energy, SDG 9: Industry/Innovation/Infrastructure, SDG 13: Climate Action), and indigenous technologies.

Course Objectives

- To apply engineering knowledge in practical problem-solving and implementation.
- To foster innovation in design, development, and testing of sustainable engineering solutions.
- To develop teamwork, project management, and effective communication skills.

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Model, analyze, and solve real-world engineering problems by applying cross-domain knowledge. (Apply)
CO 2	Develop, test, and validate sustainable products/processes/technologies aligned with relevant UN SDGs. (Apply)
CO 3	Function effectively in teams, manage tasks/resources, and adhere to ethical/professional norms. (Apply)
CO 4	Identify research/technology gaps and propose innovative solutions with implementation evidence. (Analyze)
CO 5	Organize and communicate technical findings effectively through reports, presentations, and publications. (Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	3	2	2	2	2	1	1	1	1	2
CO 2	2	2	3	1	1	3	2	1	1	1	2
CO 3					2	1	2	3	2	3	2
CO 4	2	3	3	2	2	2	1	1		2	2
CO 5					2	1	1	1	3	2	2

Abstract POs defined by National Board of Accreditation (new Tier-1, GAPC v4.0 aligned with Washington Accord)

PO#	Broad PO
PO1	Engineering Knowledge
PO2	Problem Analysis
PO3	Design/Development of Solutions
PO4	Conduct Investigations of Complex Problems
PO5	Engineering Tool Usage
PO6	The Engineer and The World (society, sustainability/SDGs, legal/ethical considerations)
PO7	Ethics (including inclusivity, diversity, and professional responsibility)
PO8	Individual and Collaborative Team Work
PO9	Communication
PO10	Project Management and Finance
PO11	Life-Long Learning

PROJECT PHASE II Targets

- In-depth study and refinement of the topic based on Phase-I report.
- Review and finalization of problem approach/methodology.
- Detailed action plan with timelines, resource allocation, and teamwork.
- Comprehensive analysis, modeling, simulation, design, experimentation, prototype development, testing, and validation.
- Final product/process development, results analysis, conclusions, future directions (with SDG alignment where applicable).

- Preparation of conference/journal paper (if feasible).
- Presentation in university/state/national/international project expos.
- IPR filing (patent/publication) if applicable.
- Standard-format report preparation for departmental assessment.
- Final presentation and viva-voce with external expert.

Evaluation Guidelines & Rubrics

Total: 150 marks (Minimum to pass: 75 marks).

Component	Marks
Project progress evaluation by guide	30
Two interim evaluations by Evaluation Committee	50
Final evaluation by Final Evaluation Committee	40
Quality of the report evaluated by committee	25
Paper publication / acceptance in conference or indexed journal	5
Total	150

Paper publication / acceptance (5 marks): Awarded only if at least one paper (authored by the student team) is **published or accepted** in:

- A recognized national/international conference, or
- An indexed journal.
- Proof required: acceptance letter / publication link / DOI / conference proceedings page

Evaluation committee: HoD/senior faculty, Project coordinator, supervisor. Final committee: Project coordinator, industry/research/academic external expert, senior faculty from sister department.

Evaluation by the Guide (30 Marks)

- **Project Scheduling & Work Distribution (5):** Detailed timelines, WBS, balanced allocation.
- **Literature Survey (4):** Outstanding depth/breadth (updated from Phase-I).
- **Student's Diary/Daily Log (7):** Regular signed records of progress, observations, sketches, reflections; promotes documentation and reasoning.
- **Individual Contribution (9):** Evidence of meaningful, equitable input per student.
- **Project Completion/Demonstration (5):** Functional prototype/demo to guide; objectives met, results verified.

Rubrics for evaluation by the Guide

Aspect / Parameter	Marks	Poor (0-1 for 5-mark items; 0-2 for 7-9 mark items)	Fair (2 for 5-mark; 3-4 for 7-9 mark)	Very Good (3-4 for 5-mark; 5-7 for 7-9 mark)	Outstanding (5 for 5-mark; 8-9 for 7-9 mark; full for others)
Project Scheduling & Distribution of Work [CO3, CO4 / PO8, PO10]	5	No meaningful scheduling or WBS; tasks unclear, unbalanced, or not assigned; no evidence of planning.	Basic scheduling exists but incomplete; distribution skewed or vague; partial follow-up from Phase I.	Detailed scheduling with timelines and WBS; distribution mostly balanced; plan followed reasonably.	Excellent comprehensive scheduling, clear timelines, equitable WBS; strong documentation/ tools used.
Literature Survey [CO1, CO5 / PO1, PO2]	4	Minimal or superficial survey; lacks depth, relevance, or updates; no critical analysis/ gap identification.	Basic survey with some sources; limited depth; partial updates but inadequate analysis.	Comprehensive survey; clear organization, relevant updates; some gap analysis evident.	In-depth, critical survey; broad/relevant sources; excellent synthesis and alignment with SDG needs.
Student's Diary / Daily Log [CO4, CO5 / PO9, PO11]	7	Incomplete/ irregular entries; little/ no detail, sketches, or reflections; no evidence of documentation habit.	Entries sporadic; basic observations but limited depth/ reflection; inconsistent signatures.	Regular entries with good detail on progress, observations, and sketches; shows developing thought process.	Exemplary records: detailed and reflective with sketches; consistent signatures; fosters lifelong learning habits.
Individual Contribution [CO3 / PO8]	9	Minimal/no meaningful participation; contributions superficial or absent across stages.	Some contribution but uneven/ limited; certain members dominate or under-contribute.	Good individual input evident in most stages; contributions mostly equitable and documented.	Outstanding equitable, substantial contributions; clear leadership/ impact; well-evidenced via logs and demos.
Completion of the Project [CO1, CO2, CO5 / PO1-PO6]	5	No functional demonstration; objectives not met; results unverifiable or absent.	Partial demonstration; some objectives met but significant gaps; results limited/ incomplete.	Good demonstration; most objectives achieved; results verifiable with minor issues.	Full functional prototype/ simulation; all objectives met; results validated with evidence of innovation.

Rubrics for Interim Evaluation – 1 (25 Marks)

Sl. No.	Parameters	Marks	Poor (0–1)	Fair (2–3)	Very Good (4)	Outstanding (5)
2-a	Novelty of idea & Implementation scope [CO5] (Group)	5	No useful societal/SDG-relevant requirement addressed; lacks originality; routine implementation without fresh features.	Some aspects implementable; limited originality; minimal improvements over Phase-I.	Good implementable scope with evidence of originality; fresh specifications/features; independent learning/ingenuity shown.	Highly novel/original idea (unreported); ingenious, SDG - aligned implementation; fully implementable/publishable quality.
2-b	Effectiveness of task distribution [CO3/PO8] (Group)	5	No distribution; members unclear on roles.	Allocated but ineffective/skewed; some members underutilized.	Good allocation via discussions/journal; mostly equitable/followed.	Excellent equitable distribution per capabilities; well-documented (journal/brainstorming); all actively contribute.
2-c	Adherence to project schedule [CO4/PO10] (Group)	5	Minimal planning; no adherence to Phase-I plan; unclear resources/budget; no journal.	Some progress over Phase-I; vague resources/budget; partial schedules.	Good planning/follow-up; resources listed; plan mostly followed; journal updated somewhat.	Detailed planning/tools (e.g., revision control); resource procurement on track; journal comprehensive; strong team interaction.
2-d	Interim Results & Progress [CO1/CO5] (Group)	5	No meaningful progress/results from Phase-I continuation.	Few results; limited analysis/inferences.	Several results achieved; issues identified with partial solutions.	Significant progress; clear inferences; SDG/societal impact evident.
2-e	Presentation & Documentation [CO5/PO9] (Group/Individual)	5	Poor clarity/organization; no understanding shown.	Needs major improvement in structure/delivery.	Adequate content/delivery.	Professional, confident, well-structured presentation.

Rubrics for Interim Evaluation – 2 (25 Marks)

Sl. No.	Parameters	Marks	Poor (0–3)	Fair (4–6)	Very Good (7–9)	Outstanding (10)
2-f	Application of Engineering knowledge [CO1/PO1–PO5] (Individual)	10	No evidence of knowledge application in implementation.	Basic application; inadequate for methodology.	Reasonable application in design/testing.	Excellent, adaptive use of knowledge for robust solutions.
2-g	Involvement of individual members [CO3/PO8] (Individual)	5	Minimal/ no participation.	Superficial/ limited contribution.	Good involvement in core activities.	Leadership/ substantial technical impact.
2-h	Results and inferences [CO5/PO2–PO4] (Group)	5	No outcomes achieved; no analysis.	Few outcomes; superficial inferences.	Many outcomes; analysis/issues addressed.	Comprehensive outcomes; deep inferences; SDG-aligned suggestions.
2-i	Documentation and presentation [CO5/PO9] (Individual/ Group)	5	Poor individual understanding/ delivery.	Needs improvement overall.	Satisfactory performance.	Professional, clear, confident delivery.

Rubrics for Final Evaluation (40 Marks)

Sl. No.	Parameters	Marks	Poor (0–3)	Fair (4–6)	Very Good (7–9)	Outstanding (10)
2-j	Engineering knowledge application [CO1/ PO1-PO5] (Group)	10	No effective application in final design/ execution.	Partial application; gaps in methodology.	Good application; minor improvements needed.	Outstanding integration for effective, validated solutions.
2-k	Relevance to societal/ industrial/ SDG needs [CO2/PO3/PO6] (Group)	5	No clear relevance.	Some relevance; limited translation to specs.	Strong relevance; problem solved with societal/ SDG considerations.	Exceptional impact; outstanding contribution to sustainable/ societal challenges.
2-l	Innovation/ Novelty/ Creativity [CO5/PO3] (Group)	5	Routine; no originality.	Limited freshness.	Good ingenuity; implementable with improvements.	Highly novel/ ingenious; publishable/ IPR potential.
2-m	Quality of results/ conclusions/ solutions [CO1/ CO5/ PO2/ PO4] (Group)	10	None achieved; no valid conclusions.	Few achieved; limited analysis.	Many achieved; good inferences/ suggestions.	Most achieved; extensive validation; clear future directions/ SDG alignment.
2-n	Presentation/ Communication [CO5/PO9] (Group/ Individual)	10	Poor organization/ delivery.	Needs improvement.	Good flow/ professionalism.	Exceptional clarity/ confidence; engaging technical communication.

Rubrics for Report Evaluation (25 Marks)

Sl. No.	Parameters	Marks	Poor (0–9)	Fair (10–15)	Very Good (16–22)	Outstanding (23–25)
2-o	Report [CO5/ PO9]	25	Shallow/non - standard; poor organization; inadequate references; inconsistent/unprofessional.	Partial standard format; language/references need improvement; some inconsistencies.	Systematic/standard format; good organization; consistent formatting; most references cited properly.	Exceptionally organized/professional; all references/diagrams/tables correctly cited/captioned; clear, readable, high - quality language; publication - ready quality.

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CEM8x	MINOR PROJECT	0	0	3	12	6	2024

Preamble

The course aims to

- Assess students' ability to transform theoretical knowledge into a functional working model.
- Enable experience in organizing and implementing small-scale projects.
- Facilitate design and development of a moderately complex project (hardware or hardware-software combination) with practical, sustainable applications.

Course Plan

In groups of up to 4 students, design and develop a moderately complex system that addresses a real-world need or application (a functional working prototype/model is required). The project must meaningfully incorporate fundamental product design principles, including innovation, reliability, and aesthetics/ergonomics.

Students (in consultation with faculty/advisor):

- Identify topic of interest.
- Conduct literature review and gather information.
- State objectives and develop methodology.
- Perform design/fabrication/coding/programming.
- Demonstrate novelty/results/outputs (with SDG alignment where applicable).

Progress evaluated via minimum two reviews by committee (constituted by HoD). Submit project report at semester end. Demonstrate product against full specifications. Weightage given to innovative concepts, reliability, aesthetics/ergonomics, and societal/SDG relevance.

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Apply acquired knowledge in the selected technology area for project development and implementation. (Apply)
CO 2	Identify, discuss, and justify technical/design aspects of the project systematically. (Analyze)
CO 3	Reproduce, improve, and refine technical aspects for engineering projects. (Apply)
CO 4	Collaborate effectively as a team in technical project development. (Apply)
CO 5	Communicate and report project activities/findings effectively (written/oral). (Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	3	3	2	2	3	1	1	1	1	2
CO 2	3	3	3	2	1	3	1	1	1	2	2
CO 3	3	3	3	2	2	3	1	1	1	1	2
CO 4						1	2	3	2	3	2
CO 5					1	1	1	2	3	2	2

Evaluation Guidelines Total: 150 marks (CIE 75 + ESE 75). Minimum pass as per university norms.

Split-up of CIE (75 Marks)

- Attendance : 10 Marks
- Marks awarded based on guide's evaluation : 15 Marks
- Project Report : 10 Marks
- Evaluation by Committee : 40 Marks

(Committee: 3 members – HoD/senior faculty, Academic coordinator/program coordinator, project guide/coordinator.)

Split-up of ESE (75 Marks)(1-hour duration)

- Level of completion : 10 Marks
- Demonstration of functionality/specifications : 25 Marks

- Project Report : 10 Marks
- Viva-voce : 20 Marks
- Presentation : 10 Marks

Enhanced Rubrics for All Evaluation Components

1. Guide's Evaluation (CIE – 15 Marks) Holistic assessment by guide (regular monitoring, involvement, progress).

Parameters	Marks Allocation (out of 15)	Poor (0–3)	Fair (4–7)	Good (8–11)	Very Good (12–14)	Outstanding (15)
Project Planning, Scheduling & Task Distribution [CO4/ PO8, PO10]	4	No plan/WBS; unbalanced/unclear roles.	Basic plan; skewed distribution.	Reasonable plan/timelines; mostly balanced.	Detailed WBS/timelines; equitable distribution documented.	Comprehensive planning; excellent equitable allocation; strong team coordination.
Technical Progress & Implementation [CO1, CO3 / PO1-PO5]	5	Minimal progress; major gaps in design/fabrication.	Partial implementation; basic functionality.	Good progress; most objectives met partially.	Strong implementation; refined technical aspects.	Excellent execution; innovative/refined design with SDG relevance.
Individual & Team Involvement [CO4 / PO8]	3	Low/ no participation by some members.	Uneven contribution.	Good involvement; fair equity.	Consistent active participation.	Outstanding collaboration; leadership evident.
Documentation & Regular Reviews [CO5 / PO9, PO11]	3	Poor/irregular records; no updates.	Basic records; inconsistent.	Good records; regular updates.	Detailed logs/reviews.	Exemplary documentation; reflective & timely.

2. Evaluation by Committee (CIE – 40 Marks)

Panel assessment (reviews, interim progress, knowledge, involvement).

Parameters	Marks (out of 40)	Poor (0–10)	Fair (11–20)	Good (21–28)	Very Good (29–35)	Outstanding (36–40)
Technical Depth & Justification [CO1-CO3 / PO1-PO4]	15	Superficial; no justifica- tion/ gaps.	Basic explanation; limited depth.	Reasonable justification; some analysis.	Strong technical discussion/ systematic approach.	Excellent depth; critical analysis; innovative/ SDG - aligned.
Innovation & Practical Relevance [CO1, CO3 / PO3, PO6]	10	No novelty; routine.	Limited innovation.	Some novelty/ practical aspects.	Good innovation; practical/ SDG relevance.	Highly innovative; strong societal/ SDG impact.
Team Work & Involvement [CO4 / PO8]	8	Poor col- laboration.	Uneven in- volvement.	Good team effort.	Strong col- laboration.	Exemplary teamwork/ leadership.
Communication & Presenta- tion Readiness [CO5 / PO9]	7	Poor clarity.	Needs im- provement.	Adequate.	Clear & structured.	Professional & confident.

3. ESE Components – Enhanced Rubrics (75 Marks Total)

- **Level of Completion (10 Marks)** [CO1-CO3]
 - Poor (0-2): Incomplete; major unfinished parts.
 - Fair (3-5): Partially complete; significant gaps.
 - Good (6-7): Mostly complete; minor issues.
 - Very Good (8): Fully complete with good quality.
 - Outstanding (9-10): Exceptionally complete; exceeds expectations (innovative/SDG features).
- **Demonstration of Functionality/Specifications (25 Marks)** [CO1, CO3 / PO3]
 - Poor (0-6): Non-functional; fails specs.
 - Fair (7-12): Basic functionality; many failures.
 - Good (13-18): Functional; meets most specs with issues.
 - Very Good (19-22): Reliable demo; meets all key specs.
 - Outstanding (23-25): Flawless; innovative features; reliable/SDG-aligned performance.

- **Project Report (10 Marks – CIE + ESE combined consideration)** [CO5 / PO9]
 - Poor (0-2): Poor organization; incomplete/missing sections.
 - Fair (3-5): Basic format; language/references weak.
 - Good (6-7): Systematic; mostly consistent.
 - Very Good (8): Well-organized; good references.
 - Outstanding (9-10): Professional; excellent structure/readability; proper citations/SDG discussion.
- **Viva-voce (20 Marks)** [CO2, CO5 / PO2, PO9]
 - Poor (0-5): Unable to explain basics; no understanding.
 - Fair (6-10): Limited answers; frequent prompting.
 - Good (11-14): Answers most questions reasonably.
 - Very Good (15-17): Confident; good depth/explanation.
 - Outstanding (18-20): Excellent articulation; integrates concepts; handles challenges fluently.
- **Presentation (10 Marks)** [CO5 / PO9]
 - Poor (0-2): Poor delivery/structure.
 - Fair (3-5): Needs major improvement.
 - Good (6-7): Clear & logical.
 - Very Good (8): Professional flow.
 - Outstanding (9-10): Engaging, confident; excellent visuals/technical clarity.

CODE	COURSE NAME	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
B24CEH8x	HONOURS PROJECT	0	0	6	9	6	2024

Preamble

The Honours Project aims to assess and develop advanced capabilities in B.Tech Honours students by transforming deep theoretical knowledge into an innovative, functional system, model, prototype, process, software solution, or technology intervention with research depth and practical/societal impact. It enables hands-on experience in organizing, implementing, and leading moderately complex to advanced projects (hardware, software, simulation-based, experimental, process-oriented, or hybrid) relevant to the student's core engineering branch or interdisciplinary areas. Emphasis is placed on product/process design concepts, novelty, reliability, aesthetics/ergonomics/user-centric design (where applicable), sustainability (aligned with UN SDGs such as SDG 9: Industry, Innovation and Infrastructure, SDG 13: Climate Action, SDG 7: Affordable and Clean Energy, SDG 6: Clean Water and Sanitation, SDG 11: Sustainable Cities and Communities, or other relevant goals), and potential for publication, patent/IPR, or technology transfer. Students (individual or in groups of 2–4) consult faculty/guides to identify advanced, relevant topics, conduct a thorough literature review and gap analysis, define clear objectives and methodology, implement/develop/validate the solution through modeling, simulation, experimentation, prototyping, or deployment, analyze results rigorously, and demonstrate outcomes with evidence of innovation and real-world applicability.

Course Plan

- Identify advanced core engineering branch topic in consultation with faculty/advisor.
- Conduct in-depth literature review and gap analysis.
- State objectives, develop systematic methodology (with SDG alignment where relevant).
- Design/fabricate/develop hardware/software/codes, implement, test, refine.
- Demonstrate novelty, functionality, reliability, aesthetics/ergonomics through results/outputs.
- Progress evaluated via minimum two reviews by committee.
- Submit comprehensive project report; demonstrate full design specifications.
- Explore conference/journal publication or IPR filing.

Course Outcomes: After the completion of the course, the student will be able to:

CO 1	Apply and extend acquired knowledge in selected core engineering branch /technology area for advanced Honours project development. (Apply)
CO 2	Identify, discuss, justify, and systematically approach technical/design aspects of innovative projects with SDG/societal relevance. (Analyze)
CO 3	Reproduce, improve, refine, and validate technical solutions for complex engineering projects. (Apply/Analyze)
CO 4	Collaborate effectively as a team in development and management of advanced technical projects. (Apply)
CO 5	Communicate and report project activities, findings, and innovations effectively (written/oral). (Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	3	3	3	2	2	3	1	1	1	1	2
CO 2	3	3	3	3	2	3	2	1	1	2	2
CO 3	3	3	3	2	2	3	1		1	1	2
CO 4					1	1	2	3	2	3	2
CO 5					1		1	1	3	2	2

Evaluation Scheme (Maintained as per attached document) **Total: 150 marks** (CIE 75 + ESE 75; ESE duration 1 hour). Evaluation by 3-member committee (HoD/senior faculty, academic/program coordinator, project guide/coordinator). Committee assesses completion, functionality/specs demonstration, presentation, viva, knowledge, involvement.

Split-up of CIE (75 Marks)

- Attendance : 10
- Marks awarded based on guide's evaluation : 15
- Project Report : 10
- Evaluation by Committee : 40

Split-up of ESE (75 Marks)

- Level of completion : 10

- Demonstration of functionality : 25
- Project Report : 10
- Viva-voce : 20
- Presentation : 10

Enhanced Rubrics (Progressive levels tied to COs/POs/SDGs; evidence-based for fairness)

1. Guide's Evaluation (CIE – 15 Marks) Holistic assessment via regular monitoring, logs, contribution, progress.

Aspect	Marks Allocation	Poor (0–3)	Fair (4–7)	Good (8–11)	Very Good (12–14)	Outstanding (15)
Progress Scheduling / Task Distribution [CO4 / PO8, PO10]	~4	No plan/ adherence; unbalanced roles.	Basic plan; skewed/ ineffective.	Reasonable scheduling; mostly balanced.	Detailed WBS/ timelines; equitable.	Exemplary tools/ planning; full SDG - aligned engagement.
Innovation / Literature / SDG Relevance [CO2, CO3 / PO2, PO3, PO6]	~5	Superficial; no novelty/ SDG link.	Limited depth/ gaps.	Good review; some innovation.	Strong analysis; SDG - integrated novelty.	Outstanding research; creative/ sustainable impact.
Individual/ Team Contribution & Diary/Log [CO4, CO5 / PO8, PO11]	~6	Minimal participation/ no records.	Limited/ superficial.	Good input; regular logs.	Substantial/ reflective.	Leadership impact; exemplary documentation.

2. Evaluation by Committee (CIE – 40 Marks) Based on interim reviews (progress, demo, knowledge, involvement).

Parameters	Marks	Poor (0–8)	Fair (9–16)	Good (17–24)	Very Good (25–32)	Outstanding (33–40)
Technical Depth / Justification / SDG Alignment [CO1–CO3 / PO1–PO6]	15	Major gaps; no justification/ SDG.	Basic; limited analysis.	Reasonable; some justification.	Strong/ systematic/ SDG - linked.	Exceptional depth; innovative/ refined/ SDG-impact.
Teamwork / Involvement [CO4 / PO8]	10	Uneven/ no collaboration.	Limited equity.	Good teamwork.	Effective/ collaborative.	Outstanding leadership/ equity.
Interim Progress / Functionality [CO3 / PO3, PO5]	15	No demo/ progress.	Partial/ unreliable.	Good interim results.	Advanced/ reliable.	Highly innovative/ validation/ SDG relevance.

3. ESE – Level of Completion (10 Marks)

- Poor (0–2): Incomplete/no model.
- Fair (3–4): Basic; major gaps.
- Good (5–6): Most features done.
- Very Good (7–8): Near-full; minor issues.
- Outstanding (9–10): Fully advanced; exceeds specs/SDG innovation.

4. ESE – Demonstration of Functionality (25 Marks)

- Poor (0–5): Non-functional.
- Fair (6–10): Partial/unreliable.
- Good (11–15): Functional basics.
- Very Good (16–20): Reliable/meets most specs.
- Outstanding (21–25): Fully functional; innovative/reliable/SDG-aligned.

5. ESE – Project Report (10 Marks) (CIE+ESE combined)

- Poor (0–2): Poor/no references.

- Fair (3–4): Basic/inconsistent.
- Good (5–6): Systematic/good refs.
- Very Good (7–8): Professional/SDG discussion.
- Outstanding (9–10): Exemplary/publishable.

6. ESE – Viva-voce (20 Marks)

- Poor (0–4): No understanding.
- Fair (5–8): Basic/prompting needed.
- Good (9–12): Good grasp/explanation.
- Very Good (13–16): Strong; handles questions.
- Outstanding (17–20): Deep insight/integration/SDGs confidently.

7. ESE – Presentation (10 Marks)

- Poor (0–2): Unclear/poor delivery.
- Fair (3–4): Needs improvement.
- Good (5–6): Clear/structured.
- Very Good (7–8): Professional/confident.
- Outstanding (9–10): Engaging/excellent visuals/communication.