MAR ATHANASIUS COLLEGE OF ENGINEERING

Government Aided, Autonomous Institution
Kothamangalam, Kerala, India

B.TECH ELECTRONICS AND COMMUNICATION ENGINEERING

CURRICULUM AND SCHEME

MAR ATHANASIUS COLLEGE OF ENGINEERING KOTHAMANGALAM
DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
UG CURRICULUM 2024

SEMESTER 1

SLOT	COURSE NO.	COURSES	L-T-P-S	HOURS	CREDIT
A	B24MA1T01	LINEAR ALGEBRA AND MULTI VARIABLE CALCULUS	3-1-0-3	4	4
B	B24ES1T01A	PROBLEM SOLVING AND PROGRAMMING TECHNIQUES	2-1-0-2	3	3
C	B24PH1T01A	ENGINEERING PHYSICS	2-1-0-2	3	3
D	B24CY1T01A	ENGINEERING CHEMISTRY	2-1-0-2	3	3
E	B24ES1T02	BASICS OF ELECTRICAL & ELECTRONICS ENGINEERING	2-2-0-2	4	4
F	B24ES1L02	BASIC ELECTRICAL AND ELECTRONICS WORKSHOP	0-0-2-2	2	1
G	B24ES1L01	PROGRAMMING LAB	0-0-3-3	3	2
H	B24PH1L01A	ENGINEERING PHYSICS LABORATORY	0-0-1-1	2	1
	B24CY1L01A	ENGINEERING CHEMISTRY LABORATORY	0-0-1-1		
I	B24MC1T01	LIFE SKILLS	1-0-1-2	2	P/F
J	B24MC1T02	DESIGN THINKING	1-1-0-1	2	P/F
K	B24MC1L03	YOGA AND SPORTS	0-0-2-2	2	-
			TOTAL	30	21

SEMESTER 2

SLOT	COURSE NO.	COURSES	L-T-P-S	HOURS	CREDIT
A	B24MA1T02	ORDINARY DIFFERENTIAL EQUATIONS AND TRANSFORMS	3-1-0-3	4	4
B	B24ES1T03A	COMPUTER AIDED ENGINEERING GRAPHICS	2-0-2-4	4	3
C	B24EC1T02	ELECTRICAL CIRCUIT THEORY	3-1-0-3	4	4
D	B24EC1T03	LOGIC CIRCUIT DESIGN	2-1-0-2	3	3
E	B24EC1T04	ANALOG CIRCUITS 1	3-1-0-3	4	4
G	B24EC1L01	BASIC ELECTRONICS LAB	0-0-3-3	3	2
H	B24EC1L02	SCIENTIFIC COMPUTING LAB	0-0-3-3	3	2
I	B24MC1T03	PROFESSIONAL COMMUNICATION & ETHICS	2-0-1-3	3	P/F
J	B24MC1L02	IDEA LAB	0-0-2-0	2	P/F
			TOTAL	30	22

SEMESTER 3					
SLOT	COURSE NO.	COURSES	L-T-P-S	HOURS	CREDIT
A	B24MA2T03A	COMPLEX VARIABLES AND APPLICATIONS OF PDE	3-1-0-3	4	4
B	B24EC2T01	NETWORK THEORY	3-1-0-3	4	4
C	B24EC2T02	COMPUTER ARCHITECTURE AND MICROCONTROLLERS	3-1-0-3	4	4
D	B24EC2T03	ANALOG CIRCUITS 2	2-1-0-2	3	3
E	B24HU2T01	BUSINESS ECONOMICS AND FINANCIAL MANAGEMENT	3-0-0-3	3	3
G	B24EC2L03	LOGIC CIRCUIT DESIGN LAB	0-0-3-3	3	2
H	B24EC2L04	ELECTRONIC CIRCUITS LAB	0-0-3-3	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		MINOR	3-1-0-3	4	
		TOTAL		32	22

SEMESTER 4					
SLOT	COURSE NO.	COURSES	L-T-P-S	HOURS	CREDIT
A	B24MA2T04A	STOCHASTIC PROCESSES AND NUMERICAL METHODS	3-1-0-3	4	4
B	B24EC2T04	SOLID STATE DEVICES	3-1-0-3	4	4
C	B24EC2T05	SIGNALS AND SYSTEMS	3-1-0-3	4	4
D	B24EC2T06	LINEAR INTEGRATED CIRCUITS	3-1-0-3	4	3
E	B24HU2T02	ENTREPRENEURSHIP AND MANAGEMENT SKILLS FOR ENGINEERS	2-1-0-2	3	3
F	B24EC2T07	FPGA BASED SYSTEM DESIGN	2-1-0-2	3	3
G	B24EC2L05	MICROCONTROLLER LAB	0-0-3-3	3	2
H	B24EC2L06	HDL LAB	0-0-3-3	3	2
M		MINOR	3-1-0-3	4	
N		HONORS	3-1-0-3	4	
			TOTAL	36	25

SEMESTER 5					
SLOT	COURSE NO.	COURSES	L-T-P-S	HOURS	CREDIT
A	B24EC3T01	DIGITAL SIGNAL PROCESSING	3-1-0-3	4	4
B	B24EC3T02	CONTROL SYSTEMS	3-1-0-3	4	4
C	B24EC3T03	ANALOG AND DIGITAL COMMUNICATION	3-1-0-3	4	4
D	B24EC3T04	VLSI DESIGN	3-1-0-3	4	4
E	B24EC3T05	EMBEDDED SYSTEMS	2-1-0-2	3	3
F	B24EC3P1X	PROGRAMME ELECTIVE I	2-1-0-2	3	3
G	B24EC3L07	LINEAR INTEGRATED CIRCUITS LAB	0-0-3-3	3	2
H	B24EC3L08	CONTROL SYSTEMS LAB	0-0-3-3	3	2
M		MINOR	3-1-0-3	4	
N		HONORS	3-1-0-3	4	
			TOTAL	36	26

SEMESTER 6					
SLOT	COURSE NO.	COURSES	L-T-P-S	HOURS	CREDIT
A	B24EC3T06	ELECTROMAGNETIC THEORY	3-1-0-3	4	4
B	B24EC3T07	MACHINE LEARNING	3-1-0-3	4	4
C	B24EC3T08	POWER ELECTRONICS	3-1-0-3	4	4
D	B24EC3T09	WIRELESS COMMUNICATION	3-1-0-3	4	4
E	B24EC3P2X	PROGRAMME ELECTIVE II	2-1-0-2	3	3
F	B24EC3G1X	OPEN ELECTIVE I	2-1-0-2	3	3
G	B24EC3L09	DIGITAL SIGNAL PROCESSING LAB	0-0-3-3	3	2
H	B24EC3L10	MINI PROJECT	0-0-3-3	3	2
M		MINOR	3-1-0-3	4	
N		HONORS	3-1-0-3	4	
			TOTAL	36	26

SEMESTER 7					
SLOT	COURSE NO.	COURSES	L-T-P-S	HOURS	CREDIT
A	B24EC4T01	INFORMATION THEORY AND CODING	2-1-0-2	3	3
B	B24EC4P3X	PROGRAMME ELECTIVE III	2-1-0-2	3	3
C	B24EC4P4X	PROGRAMME ELECTIVE IV	2-1-0-2	3	3
D	B24EC4G2X	OPEN ELECTIVE II	2-1-0-2	3	3
E	B24HU4T04	DISASTER MANAGEMENT AND INDUSTRIAL SAFETY	2-1-0-2	3	3
G	B24EC4L11	COMMUNICATION LAB	0-0-3-3	3	2
H	B24EC4L12	PROJECT PHASE I	0-0-6-6	6	3
J	B24EC4L13	SEMINAR	0-0-4-4	4	2
K	B24EC4T02	VIVA VOCE	0-0-0-0	-	1
M		MINOR	3-1-0-3	4	
N		HONORS	3-1-0-3	4	
			TOTAL	36	23

SEMESTER 8					
SLOT	COURSE NO.	COURSES	L-T-P-S	HOURS	CREDIT
A, B, C		INTERNSHIP & MOOC COURSES (3 NUMBERS)			9
OR					
A	B24EC4P5X	PROGRAMME ELECTIVE V	2-1-0-2	3	3
B	B24EC4P6X	PROGRAMME ELECTIVE VI	2-1-0-2	3	3
C	B24EC4G3X	OPEN ELECTIVE III	2-1-0-2	3	3
AND					
H	B24EC4L14	PROJECT PHASE 2	0-0-12-12	12	6
M		MINOR PROJECT	0-0-3-3	3	
N		HONORS PROJECT	0-0-6-6	6	
			TOTAL	30	15

PROGRAM ELECTIVE I	
B24EC3P11	SCIENTIFIC COMPUTING USING PYTHON
B24EC3P12	INSTRUMENTATION AND INDUSTRIAL AUTOMATION
B24EC3P13	OPTICAL FIBER COMMUNICATION
B24EC3P14	DIGITAL SYSTEM DESIGN
B24EC3P15	CHIP FABRICATION TECHNOLOGY
PROGRAM ELECTIVE II	
B24EC3P21	DATA STRUCTURES
B24EC3P22	MECHATRONICS
B24EC3P23	MODERN COMMUNICATION SYSTEMS
B24EC3P24	INTERNET OF THINGS
B24EC3P25	ARM SYSTEM ARCHITECTURE
PROGRAMME ELECTIVE III	
B24EC4P31	OBJECT ORIENTED PROGRAMMING IN JAVA
B24EC4P32	ROBOTICS
B24EC4P33	DIGITAL IMAGE PROCESSING
B24EC4P34	MIXED SIGNAL CIRCUIT DESIGN
B24EC4P35	RF CIRCUIT DESIGN

PROGRAMME ELECTIVE IV	
B24EC4P41	EMBEDDED NETWORKS
B24EC4P42	MICROWAVE AND ANTENNAS
B24EC4P43	SECURE COMMUNICATION
B24EC4P44	ANALOG CMOS DESIGN
B24EC4P45	OPTO-ELECTRONIC DEVICES
PROGRAMME ELECTIVE V	
B24EC4P51	REAL TIME OPERATING SYSTEMS
B24EC4P52	MEDICAL ELECTRONICS
B24EC4P53	RADIATION AND PROPAGATION
B24EC4P54	OPTIMIZATION TECHNIQUES
B24EC4P55	ERROR CONTROL CODES
PROGRAMME ELECTIVE VI	
B24EC4P61	DATA ANALYTICS
B24EC4P62	PATTERN RECOGNITION
B24EC4P63	LOW POWER VLSI
B24EC4P64	COMPUTER VISION
B24EC4P65	SATELLITE COMMUNICATION

OPEN ELECTIVE I	
B24EC3G11	RENEWABLE ENERGY SYSTEMS
B24EC3G12	SCIENTIFIC COMPUTING USING PYTHON
B24EC3G13	POWER ELECTRONICS
B24EC3G14	VLSI DESIGN
B24EC3G15	EMBEDDED SYSTEMS
OPEN ELECTIVE II	
B24EC4G21	INTERNET OF THINGS
B24EC4G22	BIOMEDICAL ENGINEERING
B24EC4G23	SECURE COMMUNICATION
B24EC4G24	ENTERTAINMENT ELECTRONICS
B24EC4G25	DIGITAL IMAGE PROCESSING
OPEN ELECTIVE III	
B24EC4G31	MACHINE LEARNING
B24EC4G32	ROBOTICS
B24EC4G33	REAL TIME OPERATING SYSTEMS
B24EC4G34	MECHATRONICS
B24EC4G35	ENTREPRENEURSHIP

SEMESTER	COURSES	L-T-P-S	HOURS	CREDIT
III	ELECTRONIC CIRCUITS	3-1-0-3	4	4
IV	MICROCONTROLLERS	3-1-0-3	4	4
V	EMBEDDED SYSTEM DESIGN	3-1-0-3	4	4
VI	VLSI CIRCUITS	3-1-0-3	4	4
VII	MINIPROJECT	0-0-3-3	3	3
VIII	MINIPROJECT	0-0-3-3	3	3
MINOR - BASKET 2				
SEMESTER	COURSES	L-T-P-S	HOURS	CREDIT
III	ANALOG COMMUNICATION	3-1-0-3	4	4
IV	DIGITAL COMMUNICATION	3-1-0-3	4	4
V	COMMUNICATION SYSTEMS	3-1-0-3	4	4
VI	DATA NETWORKS	3-1-0-3	4	4
VII	MINIPROJECT	0-0-3-3	3	3
VIII	MINIPROJECT	0-0-3-3	3	3
MINOR - BASKET 3				
SEMESTER	COURSES	L-T-P-S	HOURS	CREDIT
III	INTRODUCTION TO SIGNALS AND SYSTEMS	3-1-0-3	4	4
IV	INTRODUCTION TO DIGITAL SIGNAL PROCESSING	3-1-0-3	4	4
V	INTRODUCTION TO DIGITAL IMAGE PROCESSING	3-1-0-3	4	4
VI	INTRODUCTION TO COMPUTER VISION	3-1-0-3	4	4
VII	MINIPROJECT	0-0-3-3	3	3
VIII	MINIPROJECT	0-0-3-3	3	3

HONOURS - BASKET 1				
SEMESTER	COURSES	L-T-P-S	HOURS	CREDIT
IV	NANO ELECTRONICS	3-1-0-3	4	4
V	SYSTEM VERILOG FOR DESIGN AND VERIFICATION	3-1-0-3	4	4
VI	ELECTRONIC DESIGN AND AUTOMATION TOOLS	3-1-0-3	4	4
VII	RF MEMS	3-1-0-3	4	4
VIII	PROJECT	0-0-3-3	3	3
HONOURS - BASKET 2				
SEMESTER	COURSES	L-T-P-S	HOURS	CREDIT
IV	STOCHASTIC PROCESSES FOR COMMUNICATION	3-1-0-3	4	4
V	DETECTION AND ESTIMATION THEORY	3-1-0-3	4	4
VI	MIMO AND MULTIUSER COMMUNICATION SYSTEMS	3-1-0-3	4	4
VII	DESIGN AND ANALYSIS OF ANTENNAS	3-1-0-3	4	4
VIII	PROJECT	0-0-3-3	3	3
HONOURS - BASKET 3				
SEMESTER	COURSES	L-T-P-S	HOURS	CREDIT
IV	STOCHASTIC SIGNAL PROCESSING	3-1-0-3	4	4
V	COMPUTATIONAL TOOLS FOR SIGNAL PROCESSING	3-1-0-3	4	4
VI	DETECTION AND ESTIMATION THEORY	3-1-0-3	4	4
VII	MULTIRATE SIGNAL PROCESSING AND WAVELETS	3-1-0-3	4	4
VIII	PROJECT	0-0-3-3	3	3

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B.TECH ELECTRONICS AND COMMUNICATION ENGINEERING

SEMESTER 1

SYLLABUS

B24MA1T01	LINEAR ALGEBRA AND MULTIVARIABLE CALCULUS	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		3	1	0	3	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 multivariable 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	PO 12
CO 1	3	2	1	1	1					1		1
CO 2	3	2	1	1	1					1		1
CO 3	3	2	1	1	1					1		1
CO 4	3	2	1		1							1
CO 5	3	2	1	1	1					1		1

Assessment Pattern

Bloom's Category	Continuous Assessment		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	15 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, 10^{th} edition, 2015.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10^{th} edition, John Wiley & Sons, 2015.

Reference Books

4. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9^{th} Edition, Pearson, Reprint,2002.

5. J. Stewart, Essential Calculus, Cengage, 2^{nd} edition, 2017.

6. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 43^{rd} Edition, 2015.

7. Peter O Neil, Advanced Engineering Mathematics, 7^{th} Edition, Thomson, 2007.

8. Veerarajan T. Engineering Mathematics for first year, Tata McGraw - Hill, 2008.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Topic	No of Lecture/Tutorial Hours
	Total	45 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 it's 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

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

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

1. Find the slope of the surface $z = x^2y + 5y^3$ in the x-direction at the point $(1, -2)$.
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 $x = \cos t$, $y = \sin t$, $z = t$.
3. Determine the dimension of rectangular box open at the top, having a volume 32 cubic ft and requiring the least amount of material for it's 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 ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

FIRST SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2024

Course Code: B24MA1T01

Course Name: 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 $x = rcos\theta$, $y = rsin\theta$, prove that

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

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 $\iint\limits_D (2x^2y + 9y^3)\, dx\, dy$ where D is the region bounded by $y = \frac{2}{3}x$ and $y = 2\sqrt{x}$.

(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 $\mathbf{F} = x^3y^2z\mathbf{i} + xyz^3\mathbf{j} + xyz^2\mathbf{k}$ 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 $\int_c F.dr$ 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

B24ES1T01A	PROBLEM SOLVING AND PROGRAMMING TECHNIQUES(A)	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		2	1	0	2	3	2024

Preamble

This course shall prepare Engineering Graduates to write versatile C programs for solving computational problems that they come across in their professional life. The subject covers the basics of C programming, array handling, string manipulations, function creation, structure and pointer operations and file processing. On completing this course a learner will be able to write efficient C programs to solve real world computational problems.

Prerequisites

Nil

Course Outcomes

After the completion of the course the student will be able to:

CO 1	Analyze a computational problem and try to solve it using algorithms, flowcharts and also develop C programs from them using Arithmetic, Logical, Relational and Bitwise operators. (Cognitive Knowledge Level: Understand)
CO 2	Develop C programs with branching and looping statements for processing arrays and matrices (Cognitive Knowledge Level: Apply)
CO 3	Divide a given computational problem into a number of modules and develop functions to find the solution to the computational problem and also create programs for string processing (Cognitive Knowledge Level: Apply)
CO 4	Develop C programs which use structures and pointers for data processing and parameter passing (Cognitive Knowledge Level: Apply)
CO 5	Develop C programs for file processing (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	PO 12
CO 1	3	3	3	3		1		1				1
CO 2	3	3	3	3		1		1				1
CO 3	3	3	3	3		1		1				1
CO 4	3	3	3	3		1		1				1
CO 5	3	3	3	3		1		1				1

Assessment Pattern

Bloom's Category	Continuous Assessment		End Semester Examination (% Marks)
	Test 1 (%Marks)	Test 2 (%Marks)	
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 15 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)

Problem solving:

Problem solving using Algorithms, Pseudocode and Flowcharts.

C fundamentals:

Character set, Constants, Identifiers, Keywords, Basic data types, Variables, Operators and its precedence, Bitwise operators, Expressions, Statements, Input and Output statements– Structure of a C program– simple programs.

MODULE 2 (9 hours)

Control statements:

If, if-else, nested if, switch , while, do-while, for, break continue, nested loops. Single dimensional arrays – defining an array, array initialization, accessing array elements, Enumerated data type, Two-dimensional arrays – defining a two-dimensional array – Programs for matrix processing - Programs for Sequential search, Bubble sort.

MODULE 3 (8 hours)

Strings:

Declaring a string variable, reading and displaying strings, string related library functions – Programs for string matching.

Functions:

Function definition, function call, function prototype, parameter passing – Recursion – Passing array to function. Macros: Defining and calling macros.

MODULE 4 (8 hours)

Structures:

Defining a structure variable, accessing members, array of structures, passing structure to function. Union, Pointers: declaration, operations on pointers, passing pointer to a function, accessing array elements using pointers, processing strings using pointers, pointer to pointer, array of pointers, pointer to function, pointer to structure, Dynamic memory allocation.

MODULE 5 (5 hours)

Files:

Different types of files in C – Opening Closing a file – Writing to and Reading from a file – Processing files – Library functions related to file – fseek(), ftell(), fread(), fwrite(). Storage Class associated with variables: automatic, static, external and register.

Text Books

1. Programming with C - Byron S. Gottfried, Tata McGraw Hill
2. Computer Programming in C - Kerninghan Ritchie, PHI

Reference Books

1. Programming in C - Stephen C. Kochan, CBS publishers.
2. Programming in C – E. Balaguruswamy , Mc Graw Hill.
3. Let us C – Yashwant Kanetkar, BPB.
4. A Book on C – Al Kelley and Ira Pohl, Addison-Wesley.
5. Mastering Turbo C - Stan Kelly Bootle, BPB Publications.
6. Pointers in C - Yashwant Kanetkar, BPB.
7. The Spirit of C- by Munish cooper, Jaico Books.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Topic	No of Lecture/Tutorial Hours
	Total Hours	36 Hours
	Module 1: C fundamentals	6
1.1	Problem solving using Algorithms, Pseudocode and Flowcharts.	1
1.2	C fundamentals: Character set, Constants, Identifiers.	1
1.3	Keywords, Basic data types, Variables.	1
1.4	Operators and its precedence, bitwise operators.	1
1.5	Expressions, Statements, Input and Output statements.	1
1.6	Structure of a C program– simple programs.	1

	Module 2: Control statements:	9
2.1	Control statements: if, if-else, nested if .	1
2.2	Switch, while loop, do-while loop.	1
2.3	For loop, break & continue statements, nested loops.	1
2.4	Single dimensional arrays – defining an array, array initialization, accessing array elements.	1
2.5	Two-dimensional arrays – defining a two-dimensional array.	1
2.6	Programs for matrix processing.	1
2.7	Programs for sequential search.	1
2.8	Bubble sort.	1
2.9	Enumerated data type.	1
	Module 3: Strings and Funtions	8
3.1	Strings: declaring a string variable, reading and displaying strings.	1
3.2	String related library functions.	1
3.3	Programs for string matching.	1
3.4	Functions: Function definition, Function call.	1
3.5	Function prototype, Parameter passing.	1
3.6	Recursion.	1
3.7	Passing array to function.	1
3.8	Macros: Defining and calling macros.	1
	Module 4: Structures	8
4.1	Structures: defining a structure variable, accessing members.	1
4.2	Array of structures, passing structure to function.	1
4.3	Union.	1
4.4	Pointers: declaration, operations on pointers, pointer to a function.	1
4.5	Accessing array elements using pointers, Processing strings using pointers.	1
4.6	Pointer to pointer, Array of pointers.	1
4.7	Pointer to function, Pointer to structure.	1
4.8	Dynamic memory allocation.	1
	Module 5:Files	5
5.1	Different types of files in C, Opening & Closing a file.	1
5.2	Writing to and Reading from a file, Processing file.	1
5.3	Library functions related to file – fseek(), ftell().	1
5.4	Library functions related to file – fread(), fwrite().	1
5.5	Storage Class associated with variables: automatic, static, external and register.	1

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Write an algorithm and pseudocode to check if a given number is an Armstrong number or not
2. Draw a flow chart to check if a given number is an Armstrong number or not.

Course Outcome 2 (CO 2):

1. Write a C program to find the smallest number, largest number and the number of occurrences from a set of numbers.
2. Write a C program to add two matrices.

Course Outcome 3 (CO 3):

1. Write a C program to find whether a string is present in another string.
2. Write functions to accept an N X N matrix and find the row sum and column sum of the matrix.

Course Outcome 4 (CO 4):

1. Write a C program to find the difference between two time intervals using structure.
2. Write a C program to check if a given string is palindrome using pointers.

Course Outcome 5 (CO 5):

1. Write a C program to count the number of lines in a file.
2. The name of some students and their marks in 5 subjects are given in a file. Write a C program to read the student details and calculate the total marks and write the name and total marks to another file.

MODEL QUESTION PAPER

QP CODE: **Pages: 2**

Reg.No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

First SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2024

Course Code: B24ES1T01A

Course Name: PROBLEM SOLVING AND PROGRAMMING TECHNIQUES

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Draw a flow chart to find the largest of three numbers.
2. Write a C program to convert Fahrenheit temperature to Celsius.
3. Differentiate between while loop and do-while loop.
4. Write a C program to find all the factors of a number.
5. Explain any 3 string handling functions using examples.
6. Differentiate between macros and functions.
7. What are the advantages of using structure in C language..
8. Explain pointer to a pointer with an example.
9. Write any three file handling functions in C.
10. What is a static variable? When should it be used?

PART B

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

11. Explain linear search with an example. Draw a flowchart and write pseudo code to perform linear search on an array of numbers. 14

OR

12. (a) Write a C program to find the area of a triangle given the length of three sides of the triangle. 7
    (b) Write a C program to find the Area and Circumference of a Circle given the radius of the circle. 7

13. (a) Write a C program to find the transpose of a matrix. 7
    (b) Write a C program to sort an array of numbers using bubble sort 7

OR

14. (a) Write a C program to find the sum of first and last digit of a number. 7
    (b) Write a C program to print all the prime numbers between 100 to 200. 7

15. (a) Explain any 4 string handling functions in C programming. 7
    (b) Write a C program to reverse a string without using string handling functions. 7

OR

16. (a) What is the purpose of function declaration and function definition and function call? With examples illustrate their syntax 7
    (b) What is recursion? Write a C program to display Fibonacci series using recursive function. 7

17. (a) Write a C program to: 7
       i. Create a structure with fields: Name, Address, Date of Birth.
       ii. Read the above details for five students from user and display the details.
    (b) Differentiate between array of pointers and pointer to an array.. 7

OR

18. (a) What are the different dynamic memory allocation functions available in C language. 7
    (b) Write a C program to reverse a string using pointers. 7

19. (a) What are different storage classes in C? Give examples for each. . 7
    (b) Explain any 5 file handling functions in C? 7

OR

20. (a) Write a C program to count number of lines in a text file. 7
    (b) Write a C program to read a text file and replace all vowels in the text file with character ‘x’ and write it to another file.. 7

B24PH1T01A	ENGINEERING PHYSICS (A)	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		2	1	0	2	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	Understand the principle and structure of lasers and the working of optical fibers. (Cognitive Knowledge Level: Apply)
CO 2	Analyze the behavior of matter in the atomic and subatomic level through the principles of quantum mechanics to perceive the microscopic processes in electronic devices. (Cognitive Knowledge Level: Apply)
CO 3	Quantitatively grasp fundamental semiconductor principles such as energy band theory, carrier statistics and transport phenomena and thus explain the structure and conduction in intrinsic semiconductors. (Cognitive Knowledge Level: Apply)
CO 4	IUnderstand the influence of doping on the energy structure, carrier statistics and transport phenomena and thus explain the structure and conduction in extrinsic semiconductors. (Cognitive Knowledge Level: Apply))
CO 5	WUnderstand the formation and structure of junctions and explain the working of solid state lighting devices. (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**	**PO 12**
CO 1	3	1	1	1			1					1
CO 2	3	2	1	1								1
CO 3	3	2	1	1								1
CO 4	3	2	1	1								1
CO 5	3	1	1				1					1

Assessment Pattern

Bloom's Category	Continuous Assessment		End Semester Examination (% Marks)
	Test 1 (%Marks)	Test 2 (%Marks)	
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	20 Marks
Continuous Assessment Test (2 numbers)	25 marks
Assignment/Quiz/Course Project	15 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)

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.

MODULE 2 (8 hours)

Quantum Mechanics:

Introduction - Concept of uncertainty and conjugate observables (qualitative), Uncertainty principle (statement only), Wave function, its properties and physical interpretation, Formulation of time dependent and time independent Schrodinger equations, Particle in a one dimensional box - Derivation of energy eigenvalues and normalized wave function.

MODULE 3 (8 hours)

Semiconductor Physics I :

Electrical Conduction in solids - Density of states function (no derivation), the Fermi-Dirac Probability function, Fermi energy and its physical significance, Charge carriers in semiconductors - Equilibrium distribution of electrons and holes, the n0 and p0 equations, Intrinsic carrier concentration ni, Intrinsic Fermi level position and its dependence on temperature.

MODULE 4 (7 hours)

Semiconductor Physics II :

Extrinsic semiconductors - P type semiconductor, N type semiconductor, Carrier concentration in N type semiconductor, Variation of fermi level with temperature, Variation of fermi level with donor concentration, Carrier concentration in P type semiconductor, Variation of fermi level with temperature, Variation of fermi level with acceptor concentration.

MODULE 5 (6 hours)

Semiconductor Devices:

Formation of PN junction, Energy band diagram of PN junction - Qualitative description of charge flow across a PN junction - Forward and reverse biased PN Junctions, Photonic devices (Qualitative treatment only) - Light Emitting Diode, Photo detectors (Junction and PIN photodiodes), Solar cells.

Text Books

1. 1. Aruldhas G., "Engineering Physics", PHI Pvt. Ltd., 2015.

2. 2. M.N. Avadhanulu, P.G. Kshirsagar, TVS Arun Murthy, "A Textbook of Engineering Physics", S.Chand & Co., Revised Edition, 2019.

3. Flask: 3. Donald A. Neamen, "Semiconductor Physics and Devices - Basic Principles", McGraw Hill, 4^{th} Edition, 2012.

Reference Books

4. Arthur Beiser, “Concepts of Modern Physics ”, Tata McGraw Hill Publications, 6^{th} Edition 2003.

5. D.K. Bhattacharya, Poonam Tandon, “Engineering Physics”, Oxford University Press, 2015.

6. Md.N.Khan & S.Panigrahi “Principles of Engineering Physics 1&2”, Cambridge University Press, 2016.

7. Aruldhas G., “Engineering Physics”, PHI Pvt. Ltd., 2015.

8. S.M. Sze, “Physics of Semiconductor Devices”, John Wiley & Sons, 1969.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Topic	No of Lecture/Tutorial Hours
	Total Hours	36 Hours
	Module 1: Laser and Fibre Optics	7
1.1	Optical processes - Absorption, Spontaneous emission and stimulated emission, - Einstein’s relations	2
1.2	Principle of laser - conditions for sustained lasing - components of laser - Population inversion - energy source - Pumping, Metastable states - active medium, optical resonator.	2
1.3	Construction and working of Ruby laser.	1
1.4	Optic fiber-Principle of propagation of light, Numerical aperture – Derivation	1
1.5	Applications of fibers - Intensity modulated sensors .	1
	Module 2: Quantum Mechanics	7
2.1	Introduction - Concept of uncertainty and conjugate observables (qualitative), Uncertainty principle (statement only),	1
2.2	Wave function, its properties and physical interpretation.	1
2.3	Formulation of time dependent and time independent Schrodinger equations, Particle in a one dimensional box - Derivation of energy eigenvalues and normalized wave function, Numerical Problems.	5
	Module 3: Semiconductor Physics I	8
3.1	Electrical Conduction in solids - Density of states function (no derivation), the Fermi-Dirac Probability function, Fermi energy and its physical significance	2

3.2	Charge carriers in semiconductors - Equilibrium distribution of electrons and holes, the n0 and p0 equations.	3
3.3	Intrinsic carrier concentration ni, Intrinsic Fermi level position and its dependence on temperature.	3
	Module 4: Semiconductor Physics II	8
4.1	Extrinsic semiconductors - P type semiconductor, N type semiconductor.	2
4.2	Carrier concentration in N type semiconductor, Variation of fermi level with temperature, Variation of fermi level with donor concentration	3
4.3	Carrier concentration in P type semiconductor, Variation of fermi level with temperature, Variation of fermi level with acceptor concentration	3
	Module 5: Semiconductor Devices	6
5.1	Formation of PN junction, Energy band diagram of PN junction - Qualitative description of charge flow across a PN junction - Forward and reverse biased PN Junctions, the ideal diode equation (no derivation).	3
5.2	Photonic devices (Qualitative treatment only) - Light Emitting Diode, Photo detectors (Junction and PIN photodiodes), Solar cells.	3

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

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

Course Outcome 2 (CO 2):

1. Describe the physical significance of wave function.
2. State HUP for position and momentum.
3. How does the size of a box affect the permitted energy levels of a particle?

Course Outcome 3 (CO 3):

1. Determine the number of quantum states in silicon between $(E_V - kT)$ and E_V at T=300K.
2. Describe the concept of Fermi level and its physical significance..
3. Calculate the probability that an energy state above E_F is occupied by an electron. Let T= 300 K. Determine the probability that an energy level 3kT above the Fermi energy is occupied by an electron.

Course Outcome 4 (CO 4):

1. Describe the variation of Fermi level with temperature in an extrinsic semiconductor.
2. Determine the Fermi level and the max. doping concentration for which the Boltzmann approximation is still valid.
3. Sketch a graph of n_0 versus temperature for an n-type material.

Course Outcome 5 (CO 5):

1. Describe the formation of the depletion region.
2. Draw the I-V characteristics of a solar cell..
3. Describe the advantage of a PIN diode over a PN diode when used as a photo detector.

MODEL QUESTION PAPER

QP CODE: **Pages: 3**

Reg.No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

SECOND SEMESTER B.TECH DEGREE EXAMINATION, JUNE 2025

Course Code: B24PH1T01A

Course Name:ENGINEERING PHYSICS (A)

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Explain the term population inversion.
2. Describe the principle of operation of optic fibers.
3. State Heisenberg's Uncertainty principle for conjugate variables.
4. Write the time independent Schrodinger equation.
5. What is meant by Fermi level?.
6. Write the Fermi-Dirac distribution function..
7. What are the factors affecting the Fermi level in an extrinsic semiconductor?
8. Plot the variation in E_F against donor concentration in an n-type semiconductor.
9. Sketch the energy bands in an unbiased, reverse-biased and forward-biased PN junction.
10. What is meant by a space charge region?

PART B

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

1. (a) Define numerical aperture of an optic fiber and derive an expression for the NA of a step index fiber with a neat diagram.. 10

   (b) Calculate the numerical aperture and acceptance angle of a fiber with a core refractive index of 1.54 and a cladding refractive index of 1.50 when the fiber is inside water of refractive index 1.33. 4

OR

2. (a) Outline the construction and working of Ruby laser. 10

   (b) Calculate the N.A. of an optic fiber having core index of 1.54 and cladding index of 1.5 4

3. (a) Derive time dependent Schrodinger equation. 10

   (b) An electron is confined to a one dimensional potential box of length 2Å. Calculate the energies corresponding to the first and second quantum states in eV. 4

OR

4. (a) Derive the expression for the energy eigenvalues for a particle confined within a box of width L. 10

   (b) b. Find the de-Broglie wavelength of an electron whose kinetic energy is 15eV. 4

5. (a) Derive the equations for the thermal equilibrium concentrations of electrons and holes in terms of the Fermi energy 10

   (b) b. Calculate the density of states per unit volume with energies between 0 eV and 1 eV. 4

OR

6. (a) Derive the equation for the intrinsic carrier concentration. 10

   (b) b. Let T=300 K. Determine the probability that an energy level 3kT above the Fermi energy is occupied by an electron 4

7. (a) Derive the fundamental relationship $n_0 p_0 = n_i^2$. 10

   (b) Consider silicon at T=300 K and assume that $N_c = 2.8 \times 10^{19} cm^{-3}$ and $N_v = 1.04 \times 10^{19} cm^{-3}$. Assuming that the Fermi energy is 0.25 eV below the conduction band and that the bandgap energy of silicon is 1.12 eV, determine the type of silicon under consideration. 4

OR

8. (a) Derive the equations for n_0 and p_0 in terms of impurity doping concentrations.10

   (b) Silicon at T=300 K contains an acceptor impurity concentration of $N_a = 10^{16} cm^{-3}$. Determine the concentration of donor impurity atoms that must be added so that the silicon is n type and the Fermi level is 0.20 eV below the conduction-band edge. 4

9. (a) Describe the structure of energy bands in a PN junction under zero bias, forward bias and reverse bias and explain why conduction is possible only when it is forward-biased. 10

(b) b. Write the ideal diode equation and draw the corresponding I-V characteristics. 4

OR

10. (a) Explain the structure of an LED and explain the process of emission of light from the same with the help of the energy band diagram. 10

(b) b. Briefly describe the working of a PIN junction photodiode and explain its advantage over a PN junction photodiode. 4

B24CY1T01A	Engineering Chemistry (A)	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		2	1	0	2	3	2024

Preamble:

This basic science course will assist the students to acquire understanding in the concepts of chemistry for engineering applications and to familiarize the students with different application oriented topics like electrochemistry, nanomaterials, energy production, energy storage, OLED etc. Moreover, the students will be able to know analytical methods like various spectroscopic techniques, SEM etc. This will empower them to develop abilities and skills that are relevant to 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	Learn about the basics of energy harvesting methods and its application. Apply the knowledge of battery, hydrogen generation and fuel cells in engineering. (Cognitive Knowledge Level: Apply)
CO 5	Apply the knowledge of conducting polymers and advanced materials 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**	**PO 12**
CO 1	2	1	2	2	1	1	2					1
CO 2	1	2	2	1	2		2					1
CO 3	3	2	3	1	2	2	1					2
CO 4	3	2	3	2	3	3	3	1	1			2
CO 5	2	1	3	1	3	1	2	1				2

Assessment Pattern

Bloom's Category	Continuous Assessment		End Semester Examination (% Marks)
	Test 1 (% Marks)	Test 2 (% Marks)	
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	15 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)

Energy Storage and Harvesting Technologies

Cells and batteries – Primary and secondary cells – Na-ion battery and Li-ion battery - Construction, working, advantages and applications – Hydrogen generation – Electrolysis of water - Fuel cells – Introduction - Construction and advantages of H_2-O_2 fuel cell, Phosphoric acid fuel cell and Polymer Electrolyte Membrane Fuel Cell (PEMFC) - Supercapacitors - Classification - Construction and applications in hybrid vehicles.

MODULE 5 (7 hours)

Advanced Materials and Devices for Engineering Applications

Conducting polymers – Introduction - Classification - Intrinsically and extrinsically conducting polymers - Conduction mechanism – Band theory - Polyaniline and polypyrrole - Synthesis, properties and applications – Molecular devices based on conducting polymers – Diodes, Field Effect Transistor and Actuators - Introduction and applications - OLED – Construction, working and advantages - Smart materials - Thermo and light responsive materials - Introduction and examples - Sensors – Physical, chemical and biosensors – Introduction and applications.

Text Books

1. Jain and Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company, 17^{th} 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

8. T. Pradeep, "NANO: The Essentials: Understanding Nanoscience and Nanotechnology", McGraw-Hill, 2008.

9. B. Rogers, J. Adams, S. Pennathur, "Nanotechnology: Understanding Small Systems" , CRC Press, 2014.

10. Donald L. Pavia, "Introduction to Spectroscopy", Cengage Learning India Pvt. Ltd., 2015.

11. J. Goldstein, "Scanning Electron Microscopy and Microanalysis", Springer, 2012.

12. H. H. Willard, L. L. Merritt, "Instrumental Methods of Analysis", CBS Publishers, 7^{th} Edition, 2005.

13. Samuel Glasstone, "An Introduction to Electrochemistry", East-West Press Pvt. Ltd., 2006.

14. Pietro Pedeferri, "Corrosion Science and Engineering", Springer Link, 2018.

15. B. Sunden, "Hydrogen, Batteries and Fuel Cells", Elsevier Inc., 2019.

16. B. Sorensen and G. Spazzafumo, "Hydrogen and Fuel Cells - Emerging Technologies and Applications", Elsevier Ltd., 2018.

17. Raymond B. Seymour, Charles E. Carraher, "Polymer Chemistry: An Introduction", Marcel Dekker Inc; 4^{th} Revised Edition,1996.

18. J. Janata, "Principles of Chemical Sensors" Springer, New York, NY, 2009.

19. F-G. Banica, "Chemical Sensors and Biosensors: Fundamentals and Applications", John Wiley and Sons, 2012.

20. M. Schwartz, "Smart Materials", CRC Press, 2008.

21. Y. Zhao, T. Ikeda, "Smart Light-Responsive Materials", Wiley, 2009.

22. V. Khutoryanskiy, T. Georgiou, "Temperature-Responsive Polymers: Chemistry, Properties and Applications", Wiley, 2018.

23. P. W. Atkins, "Physical Chemistry", Oxford University Press, 10^{th} edn., 2014.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Topic	No of Lecture/Tutorial Hours
	Total Hours	36 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 (Energy Storage and Harvesting Technologies)	7
4.1	Cells and batteries – Primary and secondary cells – Na-ion battery and Li-ion battery - Construction, working, advantages and applications.	2
4.2	Hydrogen generation – Electrolysis of water - Fuel cells – Introduction - Construction and advantages of H_2-O_2 fuel cell, Phosphoric acid fuel cell and Polymer Electrolyte Membrane Fuel Cell (PEMFC).	3
4.3	Supercapacitors - Classification - Construction and applications in hybrid vehicles.	2
	Module 5 (Advanced Materials and Devices for Engineering Applications)	7
5.1	Conducting polymers – Introduction - Classification - Intrinsically and extrinsically conducting polymers - Conduction mechanism – Band theory - Polyaniline and polypyrrole - Synthesis, properties and applications.	3
5.2	Molecular devices based on conducting polymers – Diodes, Field Effect Transistors, and Actuators - Introduction and applications - OLED – Construction, working and advantages.	2
5.3	Smart materials - Thermo and light responsive materials - Introduction and examples - Sensors – Physical, chemical and biosensors – Introduction and applications.	2

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. What are carbon nanotubes? Give two applications.
2. Comment on the structure of graphene.
3. How nanomaterials are classified based on structural composition?

Course Outcome 2 (CO 2):

1. State Beer-Lambert's law.
2. Calculate and sketch the vibrational modes of CO_2.
3. What are the limitations of SEM?

Course Outcome 3 (CO 3):

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

Course Outcome 4 (CO 4):

1. Compare Na-ion and Li-ion batteries.
2. List the applications of PEM fuel cell.
3. Discuss the classification of supercapacitors.

Course Outcome 5 (CO 5):

1. Explain the preparation and properties of polypyrrole.
2. Discuss the working of OLED.
3. Compare physical and chemical sensors.

MODEL QUESTION PAPER

QP CODE: **Pages: 2**

Reg.No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

FIRST SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2024

Course Code: B24CY1T01A

Course Name: ENGINEERING CHEMISTRY (A)

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Discuss the properties and applications of quantum dots.
2. How carbon nanotubes are classified based on structure?
3. State Beer-Lambert's law.
4. List the important applications of IR spectroscopy.
5. Explain how galvanic series can be used in corrosion control?
6. What is calomel electrode? Give the reduction reaction.
7. How does a PEM fuel cell differ from the other types of fuel cells?
8. Distinguish between primary and secondary cells with examples.
9. Give example and explain the importance of light responsive smart materials.
10. What are biosensors? Give their applications.

PART B

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

11. (a) Explain two methods of chemical synthesis for nanomaterials. 8

(b) Discuss the classification of nanomaterials based on dimension. 6

OR

12. (a) What are nanoscale materials? Give the properties and applications of quantum dots and graphene. 9

(b) Explain the sputtering method for the synthesis of nanomaterials. 5

13. (a) Explain the principle, instrumentation and working of SEM. 8

(b) Calculate the force constant of HCl molecule, if it shows IR absorption at 2138 cm^{-1}. Given that atomic masses of hydrogen and chlorine are 1 u and 35 u respectively. 6

OR

14. (a) Illustrate the vibrational modes of CO_2 and H_2O. Justify its IR activity. 9

(b) Explain the various energy levels associated with a molecule. 5

15. (a) How electroless plating of copper is carried out? Give the procedure and reactions. 8

(b) Write the cell reactions and calculate the emf of the cell Cu/Cu^{2+} (1M) // Ag^{+} (0.01M) // Ag at 30^{o}C. Given E^0 Cu^{2+}/Cu = 0.34 V and E^0 $Ag^{+}/Ag = 0.8V$. 6

OR

16. (a) What is cathodic protection? Explain two methods. 9

(b) Write the Nernst equation for Daniel cell and explain the effect of temperature on emf. 5

17. (a) Discuss the construction, working and advantages of Li-ion battery. 9

(b) What is electrolysis of water? 5

OR

18. (a) With a neat diagram explain the construction and working of Hydrogen-Oxygen fuel cell. 8

(b) Explain the classification of supercapacitors. 6

19. (a) Discuss the construction and working of OLED with a diagram. 9

(b) Explain the synthesis, properties and applications of polyaniline. 5

OR

20. (a) Elaborate the classification and applications of conducting polymers. 8

(b) What are smart materials? Give examples for heat responsive materials. 6

B24ES1T02	BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		2	2	0	2	4	2024

Preamble

This course aims to provide fundamentals of circuit analysis, electrical components, machines, power systems, and safety practices. It also provide an overview of evolution of electronics, and introduce the working principle and examples of fundamental electronic devices and circuits.Course also aims to provide an introduction to digital electronics. 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:Understand)
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	identify the active and passive electronic component and their specifications (Cognitive Knowledge Level: Understand)
CO 5	Design and analyze Rectifiers and Voltage amplifiers (Cognitive Knowledge Level: Apply)
CO 6	Explain the elements of digital system abstractions such as digital representations of information, digital logic and Boolean algebra (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	PO 12
CO 1	3	3	2	1		1	1	1	1	1	1	1
CO 2	3	3	2	1		1	1	1	1	1	1	1
CO 3	3	2	2	1		1	1	1	1	1	1	1
CO 4	2	1	1									1
CO 5	2	1	1									1
CO 6	2	1	1									1

Assessment Pattern

	BASIC ELECTRICAL			**BASIC ELECTRONICS**		
Bloom's Category	**Continuous Assessment**		**End Semester Examination (% Marks)**	**Continuous Assessment**		**End Semester Examination (% Marks)**
	Test 1 (%Marks)	**Test 2 (%Marks)**		**Test 1 (%Marks)**	**Test 2 (%Marks)**	
Remember	15	15	15	15	15	30
Understand	20	20	20	25	25	50
Apply	15	15	15	10	10	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	15 marks

End Semester Examination Pattern

There will be two parts; Part I – Basic Electrical Engineering and Part II – Basic Electronics Engineering. Part I and PART II carries 50 marks each. For the end semester examination, part I contain 2 parts - Part A and Part B. Part A contain 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 to be answered. Each question carries 10 mark and can have maximum 2 subdivisions. The pattern for end semester examination for part II is same as that of part I.

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)

Introduction to Electronics Components

Overview of the Evolution and Applications of Electronics. Familiarization of basic electronic components: Resistors, Capacitors, Inductors: Types, Specifications, Standard values, Color Coding.

Introduction to Semiconductor devices

Understanding PN Junction diode: Structure and Principle of Operation, V-I Characteristics, Diode Current equation (Simple problems), Special Diode: Zener Diode, Break down mechanisms, Bipolar junction Transistor: NPN and PNP Structure, Principle of operation of NPN Transistor

MODULE 5 (7 hours)

Introduction to Basic electronic circuits:

Rectifiers and power supplies: Block diagram description of a dc power supply, working of a full wave bridge rectifier, capacitor filter (no analysis), working of simple Zener voltage regulator, Input and Output Characteristics of Common Emitter Configuration, Amplifier: RC Coupled Amplifier using Voltage divider bias- Frequency Response-Bandwidth

MODULE 6 (7 hours)

Introduction to Digital Electronics

Number Systems: Decimal, Binary, Octal, and Hexadecimal number systems, Number Base Conversions, Binary Arithmetic: Addition, Subtraction, Multiplication, Logic gates, Universal Gates, Truth table, Realization of NOT gate using transistor

Text Books

1. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering," 3^{rd} Edition, Tata McGraw Hill."Electric Circuits & Networks", Pearson Education, 2009.

2. J. B. Gupta, "Theory and Performance of Electrical Machines" 15^{th} Edition, S. K. Katarina Sons.

3. M.K. Giridharan, Electrical System Design.

4. Chinmoy Saha, Arindham Halder and Debarati Ganguly, Basic Electronics - Principles and Applications, Cambridge University Press, 2018.

5. M.S.Sukhija and T.K.Nagsarkar, Basic Electrical and Electronics Engineering, Oxford University Press, 2012.

Reference Books

1. C. L. Wadhwa, “Basic Electrical Engineering,” 4^{th} 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,” 6^{th} Edition, S. Chand Co. PVT. LTD

4. S. K. Bhattacharya, “Basic Electrical and Electronics Engineering,” 2^{nd} Edition, Pearson Education.

5. D C Kulshreshtha, “Basic Electrical Engineering,” 2^{nd} Edition Tata McGraw Hill.

6. Del Toro V, “Electrical Engineering Fundamentals,” 2^{nd} Edition, New Delhi Prentice Hall of India.

7. Hughes, “Electrical and Electronic Technology”, 10^{th} Edition, Pearson Education.

8. R. K. Rajput, “Basic Electrical Engineering,” 2^{nd} Edition, Laxmi Publications PVT. LTD

9. Anant Agarwal, Jeffrey Lang, Foundations of Analog and Digital Electronic Circuits, Morgan Kaufmann Publishers, 2005.

10. Bernard Grob, Basic Electronics, McGraw Hil

COURSE CONTENTS AND LECTURE SCHEDULE

No	**Topic**	**No of Lecture/Tutorial Hours**
	Total Hours	45 Hours
	Module 1: DC Electric Circuits & Alternating Current Fundamentals:	7
1.1	DC Electric Circuits: Passive Components - R, L, and C, sources - current and voltage sources	1
1.2	Resistances in series and parallel, current and voltage division rule (Numerical problems).	1
1.3	Ohm’s Law, Kirchoff’s Laws (Numerical problems).	2

1.4	Alternating Current Fundamentals: Representation of sinusoidal waveforms - frequency, time period, average value, RMS value.	1
1.5	Phasor representation of R, RL, RC, RLC circuits - concept of impedance, power - active, reactive and apparent, power factor (Numerical problems).	2
	Module 2:DC Machine and Three-Phase AC Systems:	8 .
2.1	Electromagnetic Induction: Faraday's laws, Lenz's law, statically and dynamically induced EMF	1
2.2	DC Machines: Construction and working principle - DC Generator – Types-applications.	2
2.3	DC motor - Construction and working principle- Types-applications	1
2.4	Transformers (single phase only): Working principle.	1
2.5	Three-Phase AC Systems: Generation of three-phase voltages - phase sequence.	1
2.6	Y-Δ connection (balanced only), relation between line and phase quantities, three phase power.	2
	Module 3: Electrical wiring design & Electrical Installation in Buildings:	8
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
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
3.3	Electrical lay out (single line diagram) for low- class domestic installation. Electrical load calculation- connected load method (Numerical problems).	2
3.4	Electrical Installation in Buildings: Protection devices - MCB, MCCB, ELCB/RCCB and RCBO- Principle of operation, fuses-working and types	2
3.5	lectrical hazards and safety precautions-Earthing & need of earthing, types, Electrical Safety & Precautions	2
3.6	Average value, rms value, form and peak factors of trapezoidal and sinusoidal waveforms - Numerical problems.	2
3.7	Phasor representation of sinusoidal quantities - phase difference, addition and subtraction of sinusoids.	1
3.8	Symbolic Representation: cartesian, polar and exponential forms.	1
	Module 4: Introduction to Semiconductor devices	8
4.1	Overview of the Evolution and Applications of Electronics.	1
4.2	Familiarization of basic electronic components: Resistors, Capacitors, Inductors: Types, Specifications, Standard values, Color Coding.	3

4.3	Understanding PN Junction diode: Structure and Principle of Operation	1
4.4	V-I Characteristics, Diode Current equation (Simple problems	1
4.5	Special Diode: Zener Diode, Break down mechanisms	1
4.6	Bipolar junction Transistor : NPN and PNP Structure, Principle of operation of NPN Transistor	1
	Module 5: Introduction to Basic electronic circuits:	7
5.1	Rectifiers and power supplies: Block diagram description of a dc power supply, Working of a full wave bridge rectifier, capacitor filter (no analysis), working of simple Zener voltage regulator.	4
5.2	Input and Output Characteristics of Common Emitter Configuration	1
5.3	Amplifier: RC Coupled Amplifier using Voltage divider bias- Frequency response-Bandwidth .	2
	Module 6: Introduction to Digital Electronics:	7
6.1	Number Systems: Decimal ,Binary, Octal, and Hexadecimal number systems, Number Base Conversions	2
6.2	Binary Arithmetic : Addition, Subtraction, Multiplication	2
6.3	Logic gates, Universal Gates, Truth table .	2
6.4	Realization of NOT gate using transistor .	1

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 Kirchoff'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. Explain the significance of color coding in identifying the values of resistors.
2. Describe the structure of a PN junction diode and its principle of operation
3. Describe the structure of a PN junction diode and its principle of operation

Course Outcome 5 (CO 5):

1. What is the need of voltage divider biasing in an RC coupled amplifier?
2. Analyze the importance of selection of operating point in the context of a BJT amplifier.
3. Why is it required to have a voltage amplifier in a public address system?

Course Outcome 6 (CO 6):

1. Convert 203:5210 to binary and hexadecimal.
2. Implement an AND gate using NOR gate.
3. Define logic gates and explain their fundamental role in digital electronics.

MODEL QUESTION PAPER

QP CODE: **Pages: 3**

Reg.No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

FIRST SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2024

Course Code: : B24ES1T02

Course Name:BASICS OF ELECTRICAL ENGINEERING

Max. Marks: 100 Duration: 3 hours

PART 1:BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING

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.

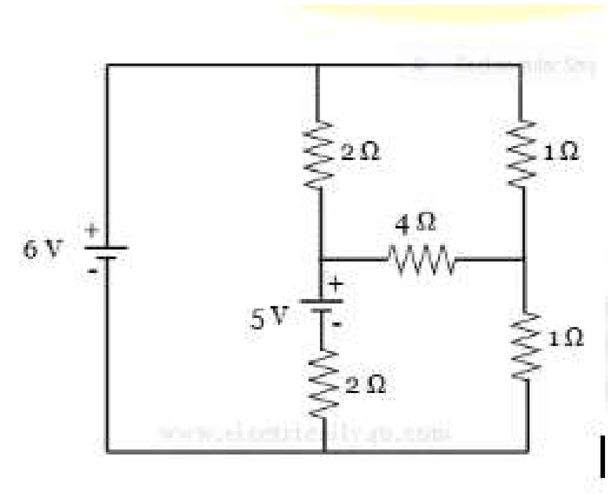
PART B

Answer any one full question . Each question carries 10 marks.

6. 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.

OR

7. For the circuit shown below, determine the current flows through all the resistors using Kirchoff's law. 10



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

OR

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

.

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

OR

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

PART 2:BASICS OF ELECTRONICS ENGINEERING

PART A

Answer all questions. Each question carries 4 marks.

1. (a) Identify the colour code for the given resistor values.
   i. $1\Omega + 5$
   ii. $3.3\text{k}\Omega + 1$
   (b) Identify the capacitor value with unit.

2. Explain the break down mechanisms of Zener diode

3. Briefly Discuss the block diagram of a DC power supply.
4. For a NPN transistor =0.98 and I_B=100 A . Find I_E and I_C
5. Which gates are called universal gates and why?

PART B

Answer any one full question . Each question carries 10 marks.

6. (a) Explain with necessary diagrams the principle of operation of NPN transistor 5

   (b) Write the diode current equation, If the reverse saturation current of Germanium diode at room temperature is 0.4 micro ampere. Determine the current flowing through the diode when 0.2V is applied at room temperature. 5

OR

7. (a) Plot and explain the V-I characteristics of a PN junction Diode 5

   (b) Describe the color coding of a resistor with suitable example. 5

8. With necessary diagrams explain the working of a full wave bridge rectifier 10

OR

9. Describe the input and output characteristics of Common emitter configuration. 10

10. Convert the following numbers to binary 10

    (a) $EE9_{16}$

    (b) $FD654 - 1_6$

    (c) 33_{10}

    (d) 17_{10}

    (e) 1142_8

OR

11. Draw the symbol and truth table of AND, OR, NAND, NOR and XOR 10

B24ES1L02	BASIC ELECTRICAL AND ELECTRONICS WORKSHOP	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		0	0	2	2	1	2024

Preamble

The course aims to impart fundamentals of electrical wiring, safety measures, and troubleshooting to students. The course will expose student to the concepts various wiring methods and distribution systems. It also gives the basic introduction of electronic hardware systems and provides hands-on training with familiarization, identification, testing, assembling, dismantling, fabrication and repairing such systems by making use of the various tools and instruments available in the Electronics Workshop.

Prerequisite

Nil

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. (Cognitive Knowledge Level: Apply)
CO 2	Understand the substation, distribution system, and safety measures against electrical shocks and select the fuse unit for a given electrical circuit.(Cognitive Knowledge Level – Understand)
CO 3	Estimate and develop the electric circuits for wiring domestic and industrial buildings. .(Cognitive Knowledge Level – Apply)
CO 4	Demonstrate proficiency in identifying various electronic components, including active, passive, electrical, electronic, and electromechanical components (Cognitive Knowledge Level-Understand)
CO 5	Develop and illustrate electronic circuit diagrams using recognized standards such as BIS/IEEE symbols and utilize Electronic Design Automation (EDA) tools for schematic capture and simulation. (Cognitive Knowledge Level-Apply)
CO 6	Design and fabricate electronic circuits on boards, trouble shooting of minor problems in electronic equipment and handling of test and measuring equipment (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	PO 12
CO 1	3	2	3	1		3	1	1	3	3	2	3
CO 2	3	2	3	1		3	1	1	3	3	2	3
CO 3	3	3	3	3		3	1	1	3	3	3	3
CO 4	3	1	1	1					1	1		2
CO 5	3	2	2	1	2				2	1		2
CO 6	3	2	2	1	2				2	1		1

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
Viva voce / test	30 marks

End Semester Examination Pattern

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

SYLLABUS

LIST OF EXPERIMENTS
PART I

ELECTRICAL

1	(a) Familiarization with electrical symbols, measuring instruments, lighting and wiring accessories, tools, and various wiring systems. (b) Familiarization with earthing in electrical installations ,precautions against electric shock phenomenon and safety procedures .
2	Realization of domestic wiring (a) Wiring of one lamp controlled by one switch and a 3-pin plug socket controlled independently. (b) Wiring of one lamp controlled by two switches (Staircase wiring).
3	(a) Realization of Industrial wiring - Wiring of three lamps controlled by three switches (Godown wiring). (b) Study of fuse, MCB, ELCB,RCCB 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.

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,5^{th} ed. Reem Publications, 2011.
4. A course in electrical installation estimating and costing, J Bh Gupta, 9^{th} editon , 2012

PART II
ELECTRONICS

1	Familiarization/Identification of electronic components with specification (Functionality, type, size, colour coding, package, symbol, cost etc. [Active, Passive, Electrical, Electronic, Electro-mechanical, Wires, Cables, Connectors, Fuses, Relays, Crystals, Displays, Heat sink etc.) .
2	Drawing of electronic circuit diagrams using BIS/IEEE symbols and introduction to EDA tools (such as Dia ,XCircuit, LT SPICE).
3	Familiarization/Application of testing instruments and commonly used tools. [Multimeter, Function generator, Power supply, DSO etc.] [Soldering iron, Desoldering pump, Pliers, Cutters, Wire strippers, Screw drivers, Tweezers etc.
4	Testing of electronic components [Resistor, Capacitor, Diode, Transistor and JFET using multimeter.
5	Inter-connection methods using Bread board and soldering practice. [Soldering - types - selection of materials and safety precautions, soldering practice in connectors and general purpose PCB] .
6	Design and fabrication of a single sided PCB for a simple circuit with manual etching (Ferric chloride) and drilling.
7	Assembling of electronic circuit/system on general purpose PCB or breadboard, test and show the functioning (Any Two circuits). (a) Fixed voltage power supply with transformer, rectifier diode, capacitor filter, Zener/IC regulator. (b) Astable Multivibrator using Transistor (c) Sine wave generation using IC 741 OP-AMP in IC base. (d) RC coupled amplifier with transistor BC107. .

Reference Books

1. ”Electronic Devices and Circuit Theory” by Robert L. Boylestad and Louis Nashelsky.
2. ”Fundamentals of Electric Circuits” by Charles K. Alexander and Matthew N.O. Sadiku .
3. ”The Soldering Handbook” by M.W. Schwartz.
4. “Electronic Devices Conventional current version”, by Floyd 9^{th} Edition.

B24ES1L01A	PROGRAMMING LAB(A)	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		0	0	3	3	2	2024

Preamble

The course aims to provide students with exposure to problem solving through C Programming. The students will have hands on experience in C programming, array handling, string manipulations, function creation, structure and pointer operations and file processing. After the lab sessions the student will be able to analyze complex problems and find solutions for real word problems.

Prerequisite

Nil

Course Outcomes

After the completion of the course the student will be able to

CO 1	C programs with branching and looping statements for processing arrays and matrices. (Cognitive Knowledge Level: Apply)
CO 2	Divide a given computational problem into a number of modules and develop functions to find the solutions to the computational problem and also create programs for string processing (Cognitive Knowledge Level: Apply)
CO 3	Construct C programs for searching and sorting (Cognitive Knowledge Level: Apply)
CO 4	Develop C programs which use structures and pointers for data processing and parameter passing (Cognitive Knowledge Level: Apply)
CO 5	Develop C programs for file processing (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	PO 12
CO 1	3	3	3	3		1		1				1
CO 2	3	3	3	3		1		1				1
CO 3	3	3	3	3		1		1				1
CO 4	3	3	3	3		1		1				1
CO 5	3	3	3	3		1		1				1

Mark Distribution

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

Continuous Internal Evaluation Pattern

Attendance	15 marks
Class Work/ Assessment Viva-Voce	15 marks
Viva-Voce/ Test	20 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

1	Familiarization of Linux Commands.
2	Familiarization of IO console. a) Write a C program to display the Personal details. b) Write a C program to Add two numbers c) Write a C program to evaluate the arithmetic expression using command line arguments
3	Familiarization of Operators. a) Write a C program to evaluate bitwise operations on given numbers. b) Write a C program to swap two numbers using XOR operation. c) Write a C program to find the largest of three numbers using conditional operator.
4	Write a C program for the salary increment of an employee (eg: if the given salary is > 50000, 20 % increment)

5	Write a menu driven program to perform the Calculator operations, namely addition, subtraction, multiplication, division and square of a number.
6	Write a C program to check the given number is Armstrong or not and find the reverse of the number
7	Write a C program to find the sum of first N natural numbers using array.
8	Write a C program a) To read an array of size n and display in reverse order. b) Display the sum and average of the array elements.
9	Write a C program to read an array of size n and display the prime numbers in the array.
10	Write a C program to read n integers, store them in an array and search for an element in the array using Linear Search.
11	Write a C program to read n integers, store them in an array and sort the elements using Bubble Sort.
12	Write a C program to read a string (word), store it in an array and check whether it is a palindrome word or not.
13	Write a C program to read two strings (each one ending with a $ symbol), store them in arrays and concatenate them without using library functions.
14	Write a C program to read a string (ending with a $ symbol), store it in an array and count the number of vowels, consonants and spaces in it.
15	Write a C program to read a string (word), store it in an array and obtain its reverse by using a user defined function.
16	Write a menu driven program for performing matrix addition, multiplication and finding the transpose. Use functions to a) Read a matrix. b) Find the sum of two matrices. c) Find the product of two matrices d) Find the transpose of a matrix and e) Display a matrix.
17	Find the factorial of a given Natural Number n using recursive and non-recursive functions.
18	Write a C Program to find the largest of three numbers using Macros.
19	Using structure, read and print data of n employees (Name, Employee Id and Salary).
20	Write a C program to declare a union containing 5 string variables (Name, House Name, City Name, State and Pin code) each with a length of C_SIZE (user defined constant).Then, read and display the address of a person using a variable of the union.
21	Write a C program to read the student details using structure and display the information through the user defined function.

22	Do the following using pointers a) add two numbers. b) swap two numbers using a user defined function.
23	Read and display the elements of an array using pointers, Compute the sum of the elements stored in the array using pointers and user defined function.
24	Define a structure for student with fields roll no, name and age. Create a pointer to this structure, assign values to the fields, and print the values using pointer.
25	Write a C program to concatenate two strings using pointers.
26	Create a file and perform the following a) Write data to the file. b) Read the data in a given file & display the file content on console . c) append new data and display on console
27	Open a text file and count the number of characters, words and lines in it; and store the result in another file.
28	Find the substring from the given text file and replace it with another string.

Reference Books

1. Programming in C - Stephen C. Kochan, CBS publishers.
2. Programming in C – E. Balaguruswamy , Mc Graw Hill.
3. Let us C – Yashwant Kanetkar, BPB.
4. A Book on C – Al Kelley and Ira Pohl, Addison-Wesley.
5. Mastering Turbo C - Stan Kelly Bootle, BPB Publications.
6. Pointers in C - Yashwant Kanetkar, BPB.
7. SThe Spirit of C- by Munish cooper, Jaico Books.

B24PH1L01A & B24CY1L01A	ENGINEERING PHYSICS LAB (A) & ENGINEERING CHEMISTRY LAB (A)	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		0	0	2	2	1	2024

PART I
ENGINEERING PHYSICS LAB (A)

Preamble

This course is designed to complement and enhance the students' understanding of fundamental principles in physics through hands-on experimentation and practical application. The primary aim of this laboratory course is to provide students with an experience that bridges the gap between theoretical concepts and real-world challenges. By actively engaging in experiments, students will develop crucial skills in observation, measurement, analysis, problem-solving and team work. These skills are essential in preparing students to tackle complex engineering problems in their future career.

Prerequisite

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	Develop technical skills associated with the usage of modern scientific tools. (Cognitive Knowledge Level: Apply)
CO 5	Develop basic communication skills through working in groups in performing the laboratory experiments and interpreting the results. (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	PO 12
CO 1	3	1			1			1	2			1
CO 2	3	1			1			1	2	1		1
CO 3	3	1			1			1	2	1		1
CO 4	3	1			2			1	3			1
CO 5	3	1			1			3	3			1

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
50	35	15	30 minutes

Continuous Internal Evaluation Pattern

Attendance	10 marks
Class Work/ Assessment Viva-Voce	25 marks
End semester examination (Internally by the college)/ Test	15 marks

End Semester Examination Pattern

The college will internally conduct an end semester examination in the form of a 30 minutes written objective examination.

SYLLABUS

LIST OF EXPERIMENTS

1	WDSO-Measurement of frequency and amplitude of wave forms.
2	Optic Fiber -Measurement of Splice Loss.
3	Junction Diode - Measurement of E_R.
4	Photoelectric cell - Calculation of Planck's constant.
5	Optic Fiber - Measurement of Numerical Aperture.
6	I-V characteristics of solar cells.
7	Optic Fiber - Measurement of Bending Loss.
8	LED Characteristics.

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.

PART II
ENGINEERING CHEMISTRY LAB (A)

Preamble

The aim of this course is to develop a scientific approach and to bridge the gap between theoretical chemistry and the applications of chemistry in the field of engineering. This course is designed to familiarize the students with experimental skills through hands-on training, and the students will demonstrate an understanding of the practical applications of these skills while carrying out the research projects in their respective branch of engineering.

Prerequisite

Nil

Course Outcomes

After the completion of the course the student will be able to

CO 1	Understand and practice fundamental techniques in chemistry to generate experimental skills. (Cognitive Knowledge Level: Apply)
CO 2	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 3	Acquire the ability to understand different methods of chemical synthesis and instrumental techniques to solve various engineering problems. (Cognitive Knowledge Level: Apply)
CO 4	Function as a team member, communicate effectively and engage in further learning while carrying out the experiment. (Cognitive Knowledge Level: Apply)
CO 5	Understand the importance of chemistry in the curriculum and how it addresses the social, economical and environmental 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	PO 12
CO 1	2		1	1	1							2
CO 2	2	2	2	2	1							2
CO 3	2	2	2	1	2							2
CO 4	2								3	3	2	3
CO 5	2	1				2	3					3

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
50	35	15	30 minutes

Continuous Internal Evaluation Pattern

Attendance	10 marks
Class Work/ Assessment Viva-Voce	25 marks
End semester examination (Internally by the college)/ Test	15 marks

End Semester Examination Pattern

The college will internally conduct an end semester examination in the form of a 30 minutes written objective examination.

SYLLABUS

LIST OF EXPERIMENTS
(MINIMUM FOUR EXPERIMENTS ARE MANDATORY)

1	Determination of molar absorptivity of a compound.
2	Potentiometric redox titration.
3	Verification of Nernst equation using Daniel cell.
4	Determination of wavelength of absorption maximum and colorimetric estimation of Fe^{3+} ions in the solution.

5	Electroplating with copper.
6	Synthesis of iron oxide nanoparticles.
7	Estimation of sodium ions by flame photometry.
8	Synthesis of conducting polyaniline from aniline.

Reference Books

1. G. Svehla, B. Sivasankar, “Vogel’s Qualitative Inorganic Analysis”, Pearson, 2012.

2. R. K. Mohapatra, “Engineering Chemistry with Laboratory Experiments”, PHI Learning, 2017.

3. Muhammed Arif, “Engineering Chemistry Lab Manual”, Owl publishers, 2019.

4. Roy K. Varghese, “Engineering Chemistry Laboratory Manual”, Crown plus Publishers, 2019.

5. Soney C. George, Rino Laly Jose, “Lab Manual of Engineering Chemistry”, S. Chand Company Pvt Ltd., New Delhi, 2019.

6. S. M. Ashraf, “A Laboratory Manual of Polymers” I. K. International Publishing House Pvt. Ltd., 2008

7. Ulrich Schubert, Nicola Hüsing, “Material Synthesis: A Practical Guide”, Springer Vienna, 2008.

8. Anu Tresa Sunny, Prajitha Velayudhan, Sabu Thomas, “Colloidal metal Oxide Nanoparticles: Synthesis, Characterization and Applications”, Elsevier Science, 2019.

B24MC1T01	LIFE SKILLS	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		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	PO 12
CO 1			1			2			2			3
CO 2						3	1	2	2	2		2
CO 3									3			2
CO 4		1	1								3	

Assessment Pattern

Bloom's Category	**Continuous Assessment**	**End Semester Examination (% Marks)**
	Test (%Marks)	
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
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. Ace of Soft Skills: Attitude, Communication and Etiquette for Success, Pearson Education; 1 edition, 2013
12. Prasanna Chandra, "Fundamentals of Financial Management", McGraw Hill Education (India) Private Ltd,2020
13. Edward de Bono, "Lateral Thinking"
14. Howard Gardener, "Multiple Intelligences"

COURSE CONTENTS AND LECTURE SCHEDULE

No	**Topic**	**No of Lecture/Tutorial Hours**
	Total Hours	24 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

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, DECEMBER 2024

Course Code: B24MC1T01

Course Name: 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?

B24MC1T02	DESIGN THINKING	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		1	1	0	1	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**	**PO 12**
CO 1	2	1	2	1			1	1	1		1	3
CO 2	2	2	2	1			1	1	1	1	1	3
CO 3	2	2	2	1			1	1	1	1	1	2
CO 4	2	2	2	1			1	1	1		2	2

Assessment Pattern Assessment Pattern

Bloom's Category	Continuous Assessment		End Semester Examination (% Marks)
	Test (%Marks)	Case Study Presentation (Marks) (%Marks)	
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
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 " 2^{nd} Edition, McGraw Hill, 2006.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Topic	No of Lecture/Tutorial Hours
	Total Hours	24 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 Desing thinking	1
4.3	Design thinking case studies detailing the various aspects	5

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 ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

FIRST SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2024

Course Code: B24MC1T02

Course Name: DESIGN THINKING

Max. Marks: 50 Duration: 2 hours

PART A

Answer all questions. Each question carries 5 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. Identifyl 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

B24MC1L01	YOGA AND SPORTS	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		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	PO 12
CO 1								2	3	2		2
CO 2								3	3	2		2
CO 3						2		3	3	3		2
CO 4								3	3	2		2

Mark Distribution

Total Marks	CIE Marks
50	50

Continuous Internal Evaluation Pattern

Attendance 10 marks
Regular assessment 40 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, Pavan Muktasana, Ardha Chakrasana, Bhujangasana, Sharasana.Obesity: Procedure, Benefits and contraindications for Vajrasana, Hastasana, Trikonasana, Ardh Matsyendrasana.Back pain: Tadasana, Ardh 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

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

COURSE CONTENTS AND LECTURE SCHEDULE

No	Topic	No of Lecture/Tutorial Hours
	Total Hours	24 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, Pavan Muktasana, Ardha Chakrasana, Bhujangasana, Sharasana.	1
1.3	Obesity: Procedure, Benefits and contraindications for Vajrasana, Hastasana, Trikonasana, Ardh Matsyendrasana.	1

1.4	Back pain: Tadasana, Ardh 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 co ordinative 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

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):

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):

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 ATHANASIUS COLLEGE OF ENGINEERING

Government Aided, Autonomous Institution

Kothamangalam, Kerala, India

B.TECH ELECTRONICS AND COMMUNICATION ENGINEERING

SEMESTER 2

SYLLABUS

B24MA1T02	ORDINARY DIFFERENTIAL EQUATIONS AND TRANSFORMS	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		3	1	0	3	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	PO 12
CO 1	3	2	1		1							1
CO 2	3	2	1		1							1
CO 3	3	2	1		1							1
CO 4	3	2	1		1							1
CO 5	3	2	1		1							1

Assessment Pattern

Bloom's Category	Continuous Assessment		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	15 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 (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},$sinax$, $cosax$ 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, 10^{th} edition, 2015.
2. Erwin Kreyszig, “Advanced Engineering Mathematics”, 10^{th} edition, John Wiley& Sons, 2016.

Reference Books

3. J. Stewart, “Essential Calculus”, Cengage,2^{nd} edition, 2017.
4. G.B. Thomas and R.L. Finney, “Calculus and Analytic geometry”, 9^{th} Edition, Pearson, Reprint,2002.
5. Peter O Neil, “Advanced Engineering Mathematics”, 7^{th} Edition, Thomson, 2007.
6. Louis C Barret, C Ray Wylie, “Advanced Engineering Mathematics”, Tata McGraw Hill, 6^{th} 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	Topic	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 $x^2y^{''} - 3xy^{'} + 4y = 0$ given that $y(1) = \pi, y^{'}(1) = 4\pi$
3. By the method of undetermined coefficients, solve $y^{''} - 2y^{'} + y = e^x cos2x$

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 $1 + \frac{1}{3^2} + \frac{1}{5^2} + \cdots = \frac{\pi^2}{8}$.

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 the Laplace Transform of:
   (i) $e^{-t}\sin^2 t$
   (ii) $\delta(t-a)$
3. Solve the differential equation $y'' + 4y = f(t)$, with initial conditions $y(0) = 1$ and $y'(0) = 0$, 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 ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

SECOND SEMESTER B.TECH DEGREE EXAMINATION, JUNE 2025

Course Code: B24MA1T02

Course Name: 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, lnx 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 $y'' + 4y = tan2x$. 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

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) $\sum_{k=1}^{\infty} (\frac{4k-5}{2k+1})^k$

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 $1 - \frac{1}{2^2} + \frac{1}{3^2} - \frac{1}{4^2} + \cdots = \frac{\pi^2}{12}$. 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 $f(x) = \begin{cases} sinx & , 0 \leq x \leq \pi \\ 0 & , x > \pi \end{cases}$ 7

OR

18. (a) Using Fourier integral representation show that $\int_0^{\infty} \frac{coswx}{1+w^2} dw = \frac{\pi}{2} e^{-x}, x > 0$. 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) $tsin2t$

    (ii) $e^{-t}sin3tcos2t$ 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

B24ES1T03A	COMPUTER AIDED ENGINEERING GRAPHICS	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		2	0	2	4	3	2024

Preamble

This course aims to equip students with the skills for precise technical communication using global standards. Through this course, students learn to proficiently use CAD software and interpret engineering drawings accurately. Emphasis is placed on conveying design intent and specifications effectively. By mastering these skills, students develop a critical eye for detail and enhance their ability to communicate complex engineering concepts visually. Ultimately, the course prepares students to excel in the global engineering landscape by fostering proficiency in graphical communication and CAD expertise.

Prerequisites

Nil

Course Outcomes

After the completion of the course the student will be able to:

CO 1	Draw the projection of points and lines located in different quadrants. (Cognitive Knowledge Level: Analyse)
CO 2	Prepare multi view orthographic projections of objects by visualizing them in different positions. (Cognitive Knowledge Level: Apply)
CO 3	Draw sectional views and develop surfaces of a given object. (Cognitive Knowledge Level: Apply)
CO 4	Familiarize the tools and features of CAD software (Cognitive Knowledge Level: Understand)
CO 5	Prepare pictorial drawings using the principle of isometric projections and convert 3D views to orthographic views using CAD Software (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	PO 12
CO 1	3	2	2	2				1		1		1
CO 2	3	2	2	2				1		1		1
CO 3	3	2	2	2				1		2		1
CO 4	3	1	1	1	2			1		2		1
CO 5	3	2	2	2	2			1		2		1

Assessment Pattern

Bloom's Category	**Continuous Assessment**		**End Semester Examination (% Marks)**
	Test 1 (%Marks)	**Test 2 (%Marks)**	
Remember			
Understand	40	40	30
Apply	30	30	40
Analyse	30	30	30
Evaluate			
Create			

Mark Distribution

Total Marks	**CIE Marks**	**ESE Marks**	**ESE Duration**
150	100	50	2 hours

Continuous Internal Evaluation Pattern

Attendance	20 marks
Continuous Assessment Test (2 numbers)	40 marks
Assignment/Class work	40 marks

Continuous Assessment Test 1 will have 20 marks and will be from Part A. Test 2 will be from Part B and will also carry 20 marks. Regarding Assignments/Class work, 15 marks will be awarded for Part A and the remaining 25 marks should be based on class works/assignments from Part B (minimum 5 exercises).

End Semester Examination Pattern

ESE will have questions only from Part A and with a duration of 2-hours. The exam will be for 50 marks and will have to be drawn on A4 size answer booklets. The question paper shall contain two parts; Part I contains three questions, one question each from the three modules, each carrying 12 marks. Part II contains two questions (from any of the three modules) carrying 14 marks each. The student has to answer all the three questions from Part I and any one question from Part II.

SYLLABUS

PART A

MODULE 1 (11 hours)

Introduction:

Relevance of technical drawing in engineering field. Types of lines, Dimensioning, BIS code of practice for technical drawing.

Orthographic projection of Points and Lines:

Projection of points in different quadrants, Projection of straight lines inclined to one plane and inclined to both planes. Trace of line. Inclination of lines with reference planes True length of line inclined to both the reference planes.

MODULE 2 (10 hours)

Orthographic projection of Solids:

Projection of Simple solids such as Triangular, Rectangle, Square, Pentagonal and Hexagonal Prisms, Pyramids, Cone and Cylinder. Projection of solids in simple position. Projection of solids with axis inclined to one of the reference planes and both reference planes.

MODULE 3 (10 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 the Prisms, Pyramids, Cone, Cylinder cut by different section planes.

PART B

MODULE 4 (6 hours)

Introduction to Computer Aided Drawing:

Role of CAD in design and development of new products, Advantages of CAD- Create a new drawing, Set model environment i.e., units, limits etc., Set interface settings e.g., snap, grid, ortho, Create and save an AutoCAD drawing template, Use zooming tools, Drawing commands as line, spline, circle, arc, rectangle, polygon, ellipse, Hatch a closed entity to represent sections, Erase & oops, Copy and Move objects, Rotate, Scale, Stretch Extend & Offset, Mirror and array, Apply Chamfers and Fillets, Edit polylines and spline, decurve, fit, thickness join & explode, Trim, break, explode, Create layers and assign properties as line weights, line types, colour, Modify status: On, Off, Freeze, Thaw, Lock, Unlock, Set layer current, Modify layer attributes, Text and Dimensions, Plotting, Extrusion.

MODULE 5 (8 hours) Isometric Projection using CAD:

Isometric View and Projections of Prisms, Pyramids, Cone, Cylinder, Frustum of Pyramid, Frustum of Cone.

Conversion of Pictorial Views using CAD:

Creating two-dimensional drawing from pictorial 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. K.N. Anilkumar, Engineering Graphics, Adhyuth Narayan Publishers.
4. P. I. Varghese, Engineering Graphics, Tata McGraw Hill Education.

Reference Books

1. Agrawal, B. and Agrawal, C.M., Engineering Drawing, Tata McGraw Hill Publishers.
2. Duff, J.M. and Ross, W.A., Engineering Design and Visualisation, Cengage Learning.
3. Kulkarni, D.M., Rastogi, A.P. and Sarkar, A.K., Engineering Graphics with AutoCAD, PHI.
4. Luzaddff, W.J. and Duff, J.M., Fundamentals of Engineering Drawing, PHI.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Topic	No of Lecture/Tutorial Hours
	Total Hours	45 Hours
	Module 1: Introduction and Orthographic projection of Points and Lines	11
1.1	Relevance of technical drawing in Engineering field. Types of lines, Dimensioning, BIS code of practice for technical drawing.	1
1.2	Concept of principle planes of projection, different quadrants, locating points on different quadrants	2
1.3	Projection of lines, inclined to one plane and Lines inclined to both planes.	4
1.4	Problems on lines using trapezoid method .	2
1.5	Line rotation method of solving, problems on line rotation method.	2
	Module 2: Orthographic projection of Solids	10
2.1	Introduction of different solids, Simple position plan and elevation of solids.	3
2.2	Problems on views of solids inclined to one plane.	2
2.3	Problems on views of solids inclined to both planes.	3
2.4	Practice problems on solids inclined to both planes.	2
	Module 3: Sections of solids and development of surfaces	10
3.1	Introduction to section planes. Principle of locating cutting points and finding true shape.	2
3.2	Problems on sections of different solids and Problems when the true shape is given.	3
3.3	Principle and development of simple solids.	2
3.4	Development of solids and sectioned solids.	3
	Module 4: Introduction to Computer Aided Drawing	6
4.1	Role of CAD in design and development of new products, Advantages of CAD	1
4.2	AutoCAD Fundamentals: Open, (and close) AutoCAD application, Create a new drawing, Set model environment ie units, limits etc, Set interface settings eg snap, grid, ortho, Create and save an AutoCAD drawing template.	1

4.3	Use zooming tools, Drawing commands as line, spline, circle, arc, rectangle, polygon, ellipse, Hatch a closed entity to represent sections, Erase & oops, Copy and Move objects, Rotate, Scale, Stretch Extend & Offset, Mirror and array, Apply Chamfers and Fillets, Edit polylines and spline, decurve, fit, thickness join & explode .	2
4.4	Trim, break, explode, Create layers and assign properties as line weights, line types, colour, Modify status: On, Off, Freeze, Thaw, Lock, Unlock, Set layer current, Modify layer attributes, Text and Dimensions, Plotting, Extrusion. .	2
	Module 5: Isometric Projection using CAD	8
5.1	Isometric View and Projections of Prisms, Pyramids, Cone, Cylinder.	3
5.2	Isometric View and Projections of Frustum of Pyramid, Frustum of Cone..	2
5.3	Creating two-dimensional drawing from pictorial views..	3

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 location and inclination of cutting plane given 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 the given figure including dimensions using 2D software.

Course Outcome 5 (CO 5):

1. Draw Isometric views/projections of solids/combination of solidsusing modelling software.
2. Create 2D model using modelling software from the given 3D figure orfrom real 3D objects.

MODEL QUESTION PAPER

QP CODE: **Pages: 1**

Reg.No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

SECOND SEMESTER B.TECH DEGREE EXAMINATION, JUNE 2025

Course Code: B24ES1T03A

Course Name: COMPUTER AIDED ENGINEERING GRAPHICS

Max. Marks: 50 Duration: 2 hours

Instructions: Retain construction lines.Show necessary dimensions.

PART I

Answer all questions. Each question carries 12 marks.

1. The end point A of a line is 20mm above HP and 10mm in front of VP. The other end of the line is 50mm above HP and 15mm behind VP. The distance between the end projectors is 70mm. Draw the projections of the line. Find the true length and true inclinations of the line with the principal planes.
2. A pentagonal pyramid of base side 25mm and height 40mm, is resting on the ground on one of its triangular faces. The base edge of that face is inclined 30^0 to VP. Draw the projections of the solid.
3. Draw the development of a pentagonal pyramid of base side 30mm and height 50mm. A string is wound from a corner of the base round the pyramid and back to the same point through the shortest distance. Show the position of the string in the elevation and plan.

PART II

Answer any one full question. Each question carries 14 marks.

4. A triangular prism of base side 40mm and height 70mm is resting with its base on the ground and having an edge of the base perpendicular to VP. Section the solid such that the true shape of the section is a trapezium of parallel sides 30mm and 10mm. Draw the projections showing the true shape. Find the inclination of the cutting plane with the ground plane.
5. A hexagonal prism of base edge 25 mm and height 60 mm is resting on one of its base edges on HP. Draw its projection if the rectangular face carrying that base edge is inclined 35^0 to HP and the base edge at which it is resting is inclined 40^0 to VP.

B24EC1T02	ELECTRICAL CIRCUIT THEORY	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		3	1	0	3	4	2024

Preamble

This course aims to equip the students with an understanding of basic circuit elements and enables the student to analyze electrical circuits.

Prerequisites

Nil

Course Outcomes

After the completion of the course the student will be able to:

CO 1	Apply fundamental concepts and circuit laws to solve simple DC electric circuits [Understand , Apply]
CO 2	Develop and solve DC circuits using circuit analysis and network theorems [Apply, Analyze]
CO 3	Apply the fundamental laws of electrical engineering to solve simple ac circuits [Apply, Analyze]
CO 4	Analyze the complex impedance components and solve the ac circuits [Apply, Analyze]
CO 5	Examine the magnetic circuits and its working [Understand, Apply, 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	PO 12
CO 1	3	2	3	2		1						3
CO 2	3	2	3	2		1						3
CO 3	3	2	3	2		1						3
CO 4	3	2	3	2		1						3
CO 5	3	2	3	2		1						3

Assessment Pattern

Bloom's Category	Continuous Assessment		End Semester Examination (% Marks)
	Test 1 (%Marks)	Test 2 (%Marks)	
Remember			
Understand	30	30	30
Apply	20	20	20
Analyse	50	50	50
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/Class work	15 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 (7 hours)

Fundamental Concepts of Circuit Elements and Circuit variables: Charge, current, voltage, electromotive force and power. Resistors, Capacitors Inductors- terminal V-I relations.
Voltage and Current sources : Real and Ideal independent voltage and current sources, V-I relations, voltage and current division, source transformation, Star-Delta Transformation.

MODULE 2 (9 hours)

Voltage and Current Laws : Equivalent R,L,C in series and parallel combination, Kirchoff's Voltage Law, Kirchoff's Current Law, Mesh Analysis, Nodal Analysis, Thevinin's theorem and Norton's theorem.

MODULE 3 (10 hours)

Alternating current fundamentals : Generation of Alternating voltages-waveforms, Frequency, Period, RMS and average values, peak factor and form factor of periodic waveforms and composite waveforms, Numerical problems, Phasor Concepts, Complex representation (polar and rectangular forms) of sinusoidal voltages and currents, phasor diagrams, Average Power, Power factor.

MODULE 4 (9 hours)

Complex impedance: series and parallel impedances and admittances, Phasor analysis of series RL, RC, RLC circuits, active, reactive and apparent power, Simple numerical problems.
Basic Circuit Laws applied on AC circuits: Kirchhoff's current and voltage laws, mesh analysis and node analysis. Power and power factor – solution of RLC series and parallel circuits.

MODULE 5 (10 hours)

Magnetic Circuits : Magneto motive force, flux, reluctance, permeability -comparison of electric and magnetic circuits, analysis of series magnetic circuits, Parallel magnetic circuits, numerical problems, self and mutual inductance – coupling coefficient. Transformer – principle of operation – EMF equation, losses and efficiency, Three phase system – generation of three phase voltage – star and delta system and its relation between line and phase voltages and currents – phasor representation of three phase system - balanced delta connected system.

Text Books

1. Engineering circuit analysis (Seventh Edition) by William H. Hayt, Jr., Jack E. Kemmerly, Steven M. Durbin.

2. Charles K Alexander and Mathew N O Sadiku,Fundamentals of Electric Circuits, Tata McGraw-Hill, 3rd Ed, 2009.

Reference Books

1. Kothari and Nagrath, Basic Electrical Engineering, Tata McGraw Hill, 2nd Edition, 2006.

2. Basic Electrical Engineering, SK Sahadev, Khanna Book Publishing .

COURSE CONTENTS AND LECTURE SCHEDULE

No	Topic	No of Lecture/Tutorial Hours
	Module 1	**7**
1.1	Fundamental Concepts of Circuit Elements and Circuit variables: Charge, current, voltage, electromotive force and power.	1
1.2	Resistors, Capacitors Inductors- terminal V-I relations.	1
1.3	Voltage and Current sources - Real and Ideal independent voltage and current sources, V-I relations	1
1.4	voltage and current division, source transformation	2
1.5	Star-Delta Transformation.	2
	Module 2	**9**
2.1	Equivalent R,L,C in series and parallel combination	2
2.2	Kirchoff's Voltage Law, Kirchoff's Current Law, Mesh Analysis	2
2.3	Nodal Analysis	2
2.4	Thevinin's theorem	2
2.5	Norton's theorem	1
	Module 3	**10**
3.1	Generation of Alternating voltages-waveforms, Frequency, Period, RMS and average values	2
3.2	Peak factor and form factor of periodic waveforms and composite waveforms	2
3.3	Numerical problems, Phasor Concepts	2
3.4	Complex representation (polar and rectangular forms) of sinusoidal voltages and currents phasor diagrams, Average Power, Power factor	4
	Module 4	**9**
4.1	Series and parallel impedances and admittances	1
4.2	Phasor analysis of series RL, RC, RLC circuits, active, reactive and apparent power, Simple numerical problems	4
4.3	Basic Circuit Laws applied on AC circuits: Kirchhoff's current and voltage laws, mesh analysis and node analysis	3
4.4	Power and power factor – solution of RLC series and parallel circuits.	1
	Module 5	**10**
5.1	Magnetic Circuits: Magneto motive force, flux, reluctance, permeability	1
5.2	Comparison of electric and magnetic circuits, analysis of series magnetic circuits, Parallel magnetic circuits, numerical problems	2
5.3	self and mutual inductance – coupling coefficient	2

5.4	Transformer – principle of operation – EMF equation, losses and efficiency	2
5.5	Three phase system – generation of three phase voltage – star and delta system and its relation between line and phase voltages and currents – phasor representation of three phase system - balanced delta connected system	3
	Total Hours	**45 Hours**

CO ASSESSMENT QUESTIONS

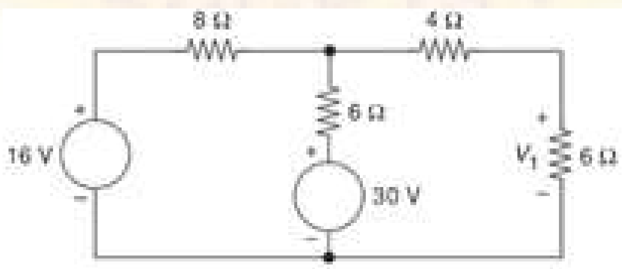
Course Outcome 1 (CO 1):

1. A capacitor is fabricated from two thin aluminum discs with 1 cm diameter separated by 150 m, with air in between. Calculate its capacitance. What voltage should be applied across this capacitor to store 1 mJ of energy?

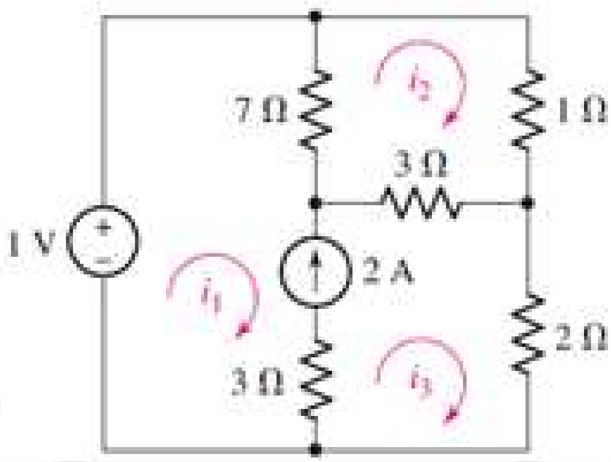
2. Employing resistance combination and current division as appropriate, determine values for i_1,i_2,and v_3 in the circuit.

Course Outcome 2 (CO 2):

1. Find the voltage V_1 across the 6ohm resistance using (i) nodal method, and (ii) mesh method of circuit analysis.



2. Determine values for the three mesh currents

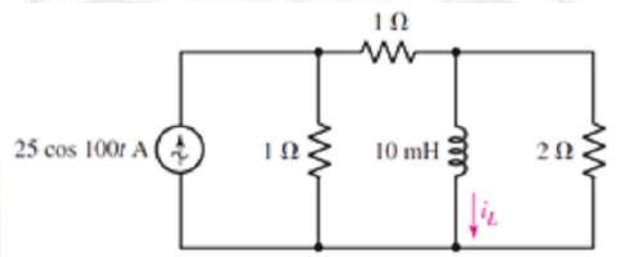


Course Outcome 3 (CO 3):

1. Find the average and rms value of a saw tooth waveform of period T seconds.
2. A coil connected to 100 V DC supply draws 10 and the same coil when connected to 100 V, AC voltage of frequency 50 Hz draws 5 A. Calculate the parameters of the coil and power factor.

Course Outcome 4 (CO 4):

1. A coil resistance 10 and inductance 0.14 H is connected in series with a capacitor of 150 F across a 200 V, 50 Hz supply. Calculate (i) inductive reactance, (ii) capacitive reactance, (iii) impedance, (iv) current, and (v) voltage across coil and capacitor.
2. Calculate the power dissipated in the 2 ohm resistor assuming there are no transients present. Express your answer in terms of a single sinusoidal function.



Course Outcome 5 (CO 5):

1. The design requirements of an 11000/415 V, 50 Hz single-phase core type transformer are approximate emf/turn 15 V, maximum flux density 1.5 T. Find suitable number of primary and secondary turns and net cross-sectional area of core.
2. A 230/110 V single-phase transformer has a core loss of 100 W. If the input under no-load condition is 400 VA, find core loss current, magnetizing current, and no-load power factor angle.

MODEL QUESTION PAPER

QP CODE: **Pages: 5**

Reg.No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

SECOND SEMESTER B TECH DEGREE EXAMINATION, DECEMBER 2024

Course Code: B24EC1T02

Course Name: ELECTRICAL CIRCUIT THEORY

Max. Marks: 100 Duration: 3 hours

PART A

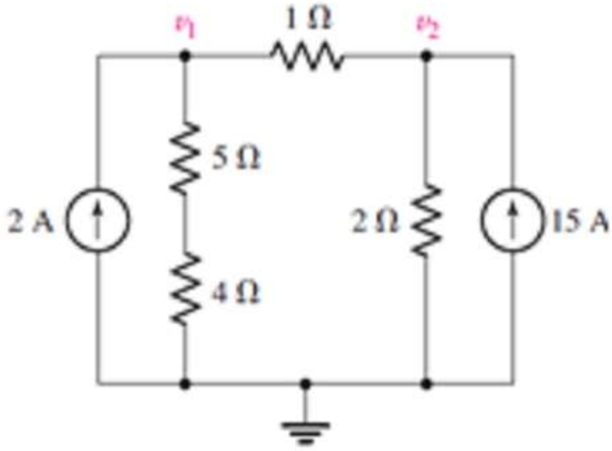
Answer all questions. Each question carries 4 marks

1. A battery is measured to have an open-terminal voltage of 14.2 V. When this voltage is connected to a 100 ohm load, the voltage measured between the terminals of the battery drops to 6.8 V. Determine the internal resistance of the battery.

2. A voltage source of V volts is connected to a current source of I amperes as shown. Find the power absorbed by the voltage source if V = -6V and I = 4 A.

3. Show how to combine four 100 ohm resistors to obtain an equivalent resistance of 60 ohm.

4. Find v_1 and v_2 using nodal analysis.

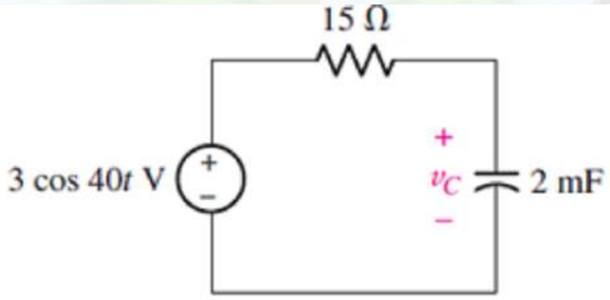


5. Our houses are supplied with alternating voltage whose instantaneous value is given by the equation $V = 325sin(\omega t)$, but we always say that AC voltage at home is 230 V. How do you explain this difference?

6. Distinguish between form factor and peak factor.

7. Define true power, apparent power, and reactive power and draw the power triangle.

8. Obtain an expression for v_c , in terms of a single sinusoidal function. You may assume all transients have died out long before t = 0.



9. A balanced three-phase system with a line voltage of 300 V is supplying a balanced Y-connected load with 1200 W a leading PF of 0.8. Find the line current.

10. The emf per turn for a single-phase 2310/220 V, 50 Hz transformer is approximately 13 volt. Calculate the number of primary and secondary turns.

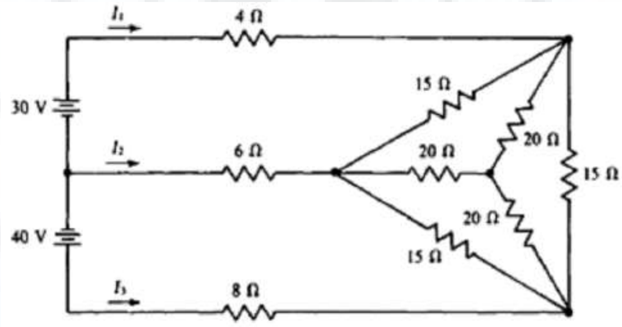
PART B

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

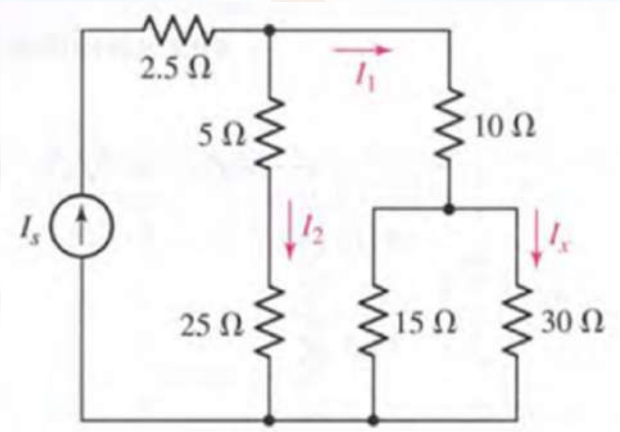
Module I

11. a) Find the power delivered by the 2A source to the rest of the circuit. (7 Marks)

b) Find the currents I_1, I_2, I_3 (7 Marks)

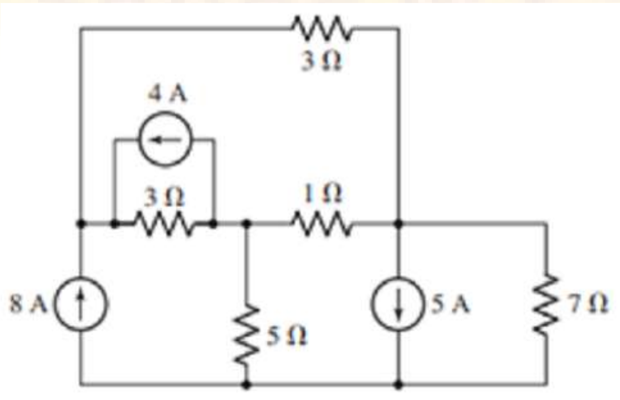


12. For the given circuit, find (i) I_x if I_1 is $12mA$ (ii) I_1 if I_x is $12mA$ (iii) I_x if I_2 is $15mA$ (iv) I_x if I_s is $60mA$ (14 Marks)

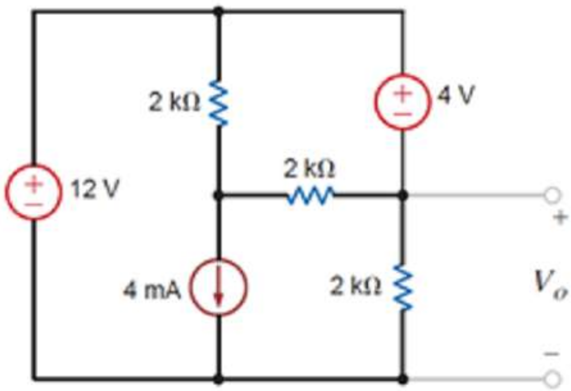


Module II

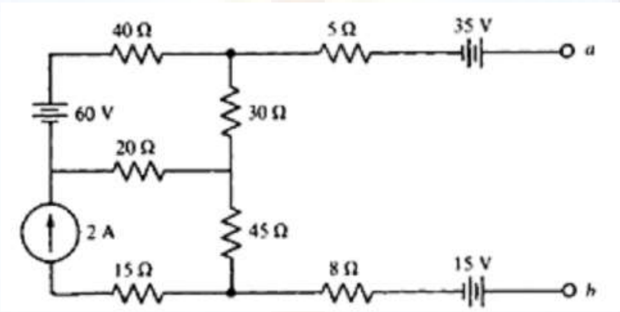
13. a) Determine the voltage across the 5 ohm resistor in the circuit and also calculate the power dissipated by the 7 ohm resistor. (8 Marks)



b) Find V_o using nodal analysis (6 Marks)



14. Determine the Thevenin and Norton equivalent circuit across the terminals a-b
. (14 Marks)



Module III

15. a) Three sinusoidal voltages acting in series are given by $v_1 = 10sin(440t)$, $v_2 = 10\sqrt{2}sin(440t - 45^0)$, $v_3 = 20cos(440t)$.Find an expression for the resultant voltage, and then find its frequency and rms value.
. (7 Marks)

b) Calculate the average value and rms value of a periodic current wave having values for equal time interval changing suddenly from one value to next: 0, 30, 45, 70, 90, 70, 45, 30, 0, -30, -45, -70, etc. in ampere. What would be the average and the rms value of a sine wave having the same peak value? (7 Marks)

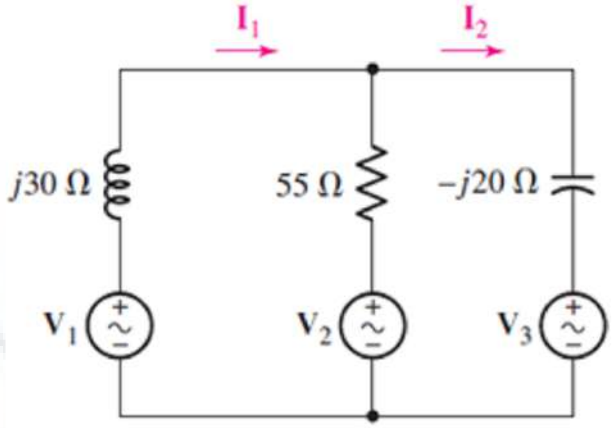
16. a) Find the rms value, average value, and form factor of the voltage waveform.
. (7 Marks)

b) Two AC voltages $v_1(t) = 30sin(314t + 45°)$ and $v_2(t) = 60sin(314t + 60°)$ are kept in series. Find the resultant voltage $v(t)$ and express in the form $v(t) = V_m sin(314t \pm \phi)$ (7 Marks)

Module IV

17. a) A coil having a resistance of 12 ohms and an inductance of 0.1 H is connected across a 100 V, 50 Hz supply. Calculate the (i) reactance and impedance of the coil, (ii) current, (iii) phase difference between the current and the applied voltage, and (iv) power factor. Draw also the phasor diagram showing voltage and current. (8 Marks)

b) Find I_1 and I_2 given $V_1 = 10\angle - 80°V$, $V_2 = 4\angle - 0°V$ and $V_3 = 2\angle - 23°V$. (6 Marks)

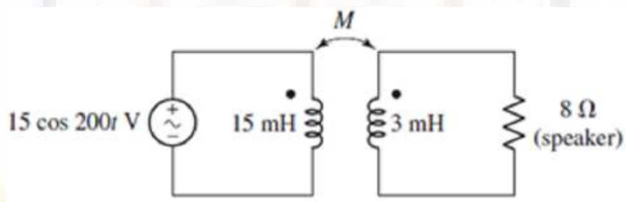


18. An inductive coil takes 10 A and dissipates 1,000 W when connected to a 250 V, 25 Hz supply. Calculate the (i) impedance, (ii) effective resistance, (iii) reactance, (iv) value of the capacitance required to be connected in series with coil to make the power factor of the circuit unity, and (vi) current taken by the coil after connecting capacitor. Further, draw the phasor diagram of the two cases. (14 Marks)

Module V

19. a) Three 100 ohm resistors are connected first in star and then in delta across 415 V, three-phase supply. Calculate the line and phase currents in each case and also the power taken from the source. (7 Marks)

    b) For the below circuit, determine for what value of M results in 1 W of average power being delivered to the speaker? (7 Marks)



20. a) A three-phase, 400 V supply is connected to a three-phase star-connected balanced load. The line current is 20 A and the power consumed by the load is 12 kW. Calculate the impedance of the load, phase current, and power factor. (7 Marks)

    b) Estimate the number of AT necessary to produce a flux of 1,00,000 lines round an iron ring of $6cm^2$ cross section and 20 cm mean diameter having an air gap 2 mm wide across it. The permeability of the iron may be taken as 1,200. Neglect the leakage flux outside the 2 mm air gap. (7 Marks)

B24EC1T03	Logic Circuit Design	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		2	1	0	2	3	2024

Preamble:

The objective of the course is to 1) familiarize students with the basic concepts of Boolean algebra and digital systems 2) enable students to design simple combinational and sequential logic circuits 3) familiarize the representation of Binary and BCD (Binary Coded Decimal) numbers which in turn are helpful in understanding organization & design of a computer system.

Prerequisites:

NIL

Course Outcomes:

After the completion of the course the student will be able to:

CO 1	Compare various positional number systems and binary codes (Cognitive Knowledge Level : Understand)
CO 2	Simplify a given Boolean Function and design a combinational circuit to implement the simplified function using logic gates (Cognitive Knowledge Level : Understand)
CO 3	Learn to analyze and understand the behavior of combinational digital circuits (Cognitive Knowledge Level : Apply)
CO 4	Design a sequential logic circuit using the basic building blocks like flip-flops (Cognitive Knowledge Level : Apply)
CO 5	Compare different logic families with respect to efficiency and performance (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**	**PO 12**
CO 1	3	3										1
CO 2	3	3	3	2								1
CO 3	3	3	3	2								1
CO 4	3	3	3	2								1
CO 5	3	3	3	2								1

Assessment Pattern

Bloom's Category	Continuous Assessment		End Semester Examination (% Marks)
	Test 1 (% Marks)	Test 2 (% Marks)	
Remember	10	10	10
Understand	20	20	30
Apply	20	20	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	15 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 (7 hours)

Number Systems

Decimal, Binary, Octal and Hexadecimal Number Systems- Number Base Conversions. Addition, Subtraction, Multiplication and Division of binary numbers. Addition and subtraction of BCD, Octal and Hexadecimal numbers. Representation of negative numbers- Complements, Subtraction with complements. Binary coded decimal codes; Gray codes; Excess 3 code. Alphanumeric codes: ASCII.

MODULE 2 (8 hours)

Boolean Algebra and Karnaugh Maps

Postulates of Boolean Algebra. Basic theorems and Properties of Boolean Algebra. Minimization of Boolean expressions, Sum of Products (SOP), Product of Sums (POS) - Canonical and Standard forms. Simplification of Boolean Functions- Using Karnaugh- Map Method (upto five variables), Don't care conditions, Product of sums simplification, Tabulation Method.

MODULE 3 (8 hours)

Combinational Circuits

Combinatorial Logic Systems - Binary adders and subtractors-Half adder, Full adder, Half Subtractor, Full Subtractor, Binary Parallel adder, Carry look ahead adder, BCD adder, Comparators – one bit and two bit, Multiplexers-Implementation of combinational circuits using Multiplexers, Demultiplexers, Encoder, Decoder, Code converter-Binary to Gray, BCD to Excess 3.

MODULE 4 (7 hours)

Sequential Circuits

Building blocks like S-R, JK and Master-Slave JK FF, Edge triggered FF, Conversion of Flipflops, Excitation table and characteristic equation. Shift registers-SIPO, SISO, PISO, PIPO. Shift Registers with parallel Load/Shift, Ring counter and Johnsons counter. Asynchronous and Synchronous counter design, Mod N counter, Up- down counter, BCD counter.

MODULE 5 (6 hours)

TTL and CMOS

TTL, ECL, CMOS - Electrical characteristics of logic gates – logic levels and noise margins, fan-out, propagation delay, transition time, power consumption and power-delay product. TTL inverter - circuit description and operation; CMOS inverter - circuit description and operation; Structure and operations of TTL and CMOS gates; NAND in TTL, NAND and NOR in CMOS.

Text Books

1. M. Morris Mano, Digital Logic and Computer Design, 4/e, Pearson Education, 2013
2. Thomas L Floyd, Digital Fundamentals, 10/e, Pearson Education, 2009.
3. D.V. Hall, "Digital Circuits and Systems", Tata McGraw Hill, 1989
4. R.P. Jain, "Modern digital Electronics", Tata McGraw Hill, 4th edition, 2009

Reference Books

5. M. Morris Mano, Michael D Ciletti , Digital Design With An Introduction to the Verilog HDL, 5/e, Pearson Education, 2013.

6. Donald D Givone, Digital Principles and Design, Tata McGraw Hill, 2003.

7. W.H. Gothmann, "Digital Electronics – An introduction to theory and practice", PHI, 2nd edition ,2006

8. Wakerly J.F., "Digital Design: Principles and Practices," Pearson India, 4th 2008

9. A. Ananthakumar, "Fundamentals of Digital Circuits", Prentice Hall, 2nd edition, 2016

10. Fletcher, William I., An Engineering Approach to Digital Design, 1st Edition, Prentice Hall India, 1980

COURSE CONTENTS AND LECTURE SCHEDULE

No	Topic	No of Lecture/Tutorial Hours
	Total Hours	36 Hours
	Module 1 (Number Systems)	7 hours
1.1	Decimal, Binary, Octal and Hexadecimal Number Systems- Number Base Conversions.	2 hour
1.2	Addition, Subtraction, Multiplication and Division of binary numbers.	1 hours
1.3	Addition and subtraction of BCD, Octal and Hexadecimal numbers.	1 hours
1.4	Representation of negative numbers- Complements, Subtraction with complements.	2 hours
1.5	Binary coded decimal codes; Gray codes; Excess 3 code. Alphanumeric codes: ASCII.	1 hours
	Module 2 (Boolean Algebra and Karnaugh Maps)	8 hours
2.1	Postulates of Boolean Algebra. Basic theorems and Properties of Boolean Algebra. .	2 hours
2.2	Minimization of Boolean expressions, Sum of Products (SOP), Product of Sums (POS) - Canonical and Standard forms.	2 hours
2.3	Simplification of Boolean Functions- Using Karnaugh- Map Method (upto five variables), Don't care conditions	2 hour
2.4	Product of sums simplification, Tabulation Method.	2 hours
	Module 3 (Combinational Circuits)	8 hours

3.1	Combinatorial Logic Systems - Binary adders and subtractors -Half adder, Full adder, Half Subtractor, Full Subtractor	2 hours
3.2	Binary Parallel adder, Carry look ahead adder, BCD adder	2 hours
3.3	Comparators – one bit and two bit, Multiplexers-Implementation of combinational circuits using Multiplexers	2 hours
3.4	Demultiplexers, Encoder, Decoder, Code converter-Binary to Gray, BCD to Excess 3.	2 hours
	Module 4 (Sequential Circuits)	7 hours
4.1	Building blocks like S-R, JK and Master-Slave JK FF, Edge triggered FF, Conversion of Flipflops, Excitation table and characteristic equation.	3 hours
4.2	Shift registers-SIPO, SISO, PISO, PIPO., Shift Registers with parallel Load/Shift, Ring counter and Johnsons counter.	2 hours
4.3	Asynchronous and Synchronous counter design	2 hours
4.4	Mod N counter, Up- down counter, BCD counter	2 hours
	Module 5 (TTL and CMOS)	6 hours
5.1	TTL, ECL, CMOS - Electrical characteristics of logic gates – logic levels and noise margins, fan-out, propagation delay, transition time, power consumption and power-delay product.	2 hours
5.2	TTL inverter - circuit description and operation; CMOS inverter - circuit description and operation;	2 hours
5.3	Structure and operations of TTL and CMOS gates; NAND in TTL, NAND and NOR in CMOS.	2 hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Perform the mentioned base conversions for the following numbers. (i) (563.8125)10 to binary (ii) (78.89)10 to octal (iii) (EC.4)16 to decimal
2. Perform the following operations (i)E8AE16-C86516 (ii) A4758-86348

Course Outcome 2 (CO 2):

1. Simplify the function F(A,B,C,D)=Σ(0,1,2,8,12,13,14)+d(3,5,10,15) using Karnaugh map.
2. Express F=(XY+Z)(Y+XZ) in both canonical forms.

Course Outcome 3 (CO 3):

1. Design a BCD to Excess-3 Code Convertor.
2. Implement the following using an 8x1 multiplexer F(A, B, C, D) = Σ m (0, 1, 3, 5, 6, 7, 8, 9, 11, 13, 14)

Course Outcome 4 (CO 4):

1. Design a 4-bit binary asynchronous counter using JK flipflops. Give the state diagram and logic diagram.
2. With a circuit diagram, explain the working of master-slave JK flip-flop.

Course Outcome 5 (CO 5):

1. 1. Define the terms noise margin, propagation delay and power dissipation of logic families. Compare TTL and CMOS logic families showing the values of above-mentioned terms.
2. Draw the circuit and explain the operation of a TTL NAND gate.

MODEL QUESTION PAPER

QP CODE: **Pages: 2**

Reg.No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

SECOND SEMESTER B.TECH DEGREE EXAMINATION, MAY2025

Course Code: B24EC1T03

Course Name: LOGIC CIRCUIT DESIGN

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Convert the hexadecimal number 2FC3 into binary and decimal.
2. The 2's complement representation of a binary number is 10101100. (i) Determine its decimal value. (ii) Represent it in 1's complement form.
3. Find the dual and complement of the boolean function F = AB'+ B(A + B').
4. Prove that x(x+y) = x using Boolean algebra postulates and rules.
5. Realize a one-bit comparator.
6. Explain the working of a decoder.
7. What is race around condition?
8. Write the excitation table and characteristic equation of SR flip-flop.
9. Define fan-in and fan-out of logic circuits.
10. Draw the circuit of a CMOS inverter and explain its working.

PART B

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

1. (a) Perform the subtraction 43.5 – 67.25 using 1) 2's complement 2)1's complement 8

   (b) Convert the following numbers to the base indicated:

   i. (1234)8 to base 10.
   ii. (23.875)10 to base 2.
   iii. (EC.5)H to base 8 6

OR

2. (a) Solve the following binary arithmetic. 1) 36.25 - 98.625 (using 1's complement) 2) 53.5 – 29.25 (using 2's complement) 8

   (b) Perform the following operations (i) (520)8 + (488)8 (ii) (520)H − (488)H 6

3. (a) Minimize the following using K Map

   i. f = Σm (1, 3, 4, 6, 8, 9, 11, 13, 15) + Σd(0,2,14)
   ii. f = ΠM (0,2,8,9,12,13,15)
   iii. f = Σm (0,4,5,6,8,9,10,11,16,20,22,24,25,26,27)

   12

   (b) State and prove De Morgan's theorem. 2

OR

4. (a) Simplify the following Boolean function, f(A,B,C,D)= m(2,6,8,9,10,11,14,15) using Quine-McCluskey tabular method. 10

   (b) Prove that ABC + A'+AB'C = A' + C 4

5. (a) Design a 4-bit BCD adder and draw the block diagram. 8

   (b) Implement full adder using 8:1 Multiplexer. 6

OR

6. (a) Design a 4 bit Binary to Gray code converter. 10

   (b) Implement half adder using decoder. 4

7. (a) Design a Mode 14 Synchronous UP counter using JKFlip-flop 10

   (b) Explain the working of a 4 bit PISO register. 4

OR

8. (a) Design a Mod 7 Asynchronous UP counter with timing diagram 6

   (b) Design Mod 8 Synchronous UP/DOWN counter using T Flip-flop. 8

9. (a) Explain in detail about TTL with open collector output configuration 7

   (b) Draw an ECL basic gate and explain. 7

OR

10. (a) Describe the working of a 3 bit TTL NAND gate in totem pole configuration. 8

    (b) Compare the characteristics features of TTL and ECL digital logic families. 6

B24EC1T04	ANALOG CIRCUITS 1	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		3	1	0	3	4	2024

Preamble

This course aims to equip

1. The students with an understanding of fundamental theory of electronic circuits using diodes and transistors.
2. Familiarization of data sheets, design of discrete electronic circuits and analyze the circuit performance.
3. Familiarize different circuit realization and application using diodes, BJT and FET transistors.

Prerequisites

Nil

Course Outcomes

After the completion of the course the student will be able to

CO 1	Understand the different diodes, diode circuits and applications
CO 2	To study regulated power supplies
CO 3	Design transistor modelling and design amplifiers
CO 4	Understand feedback in BJT amplifiers and improvement in performance
CO 5	Study and analyse different sinusoidal oscillators

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	PO 12
CO 1	2	3	2									2
CO 2	3	3	2									2
CO 3	3	3	2									2
CO 4	3	3	2									2
CO 5	3	3	2									2

Assessment Pattern

Bloom's Category	Continuous Assessment		End Semester Examination (% Marks)
	Test 1 (%Marks)	Test 2 (%Marks)	
Remember	15	15	30
Understand	25	25	50
Apply	10	10	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 15 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
Diode basics: Semiconductor diode, Biasing, Diode current equation, Characteristics, Static and Dynamic resistance, Diode equivalent circuit.
Wave shaping circuits: Sinusoidal and non-sinusoidal wave shapes, Principle and working of RC differentiating and integrating circuits, Clipping circuits - Positive, negative and biased clipper. Clamping circuits - Positive, negative and biased clamper.

MODULE 2
Regulated power supplies: Half wave and Full wave rectifiers: Centre tapped transformer and bridge circuits and waveforms. PIV of the diode, simple zener voltage regulator, series and shunt voltage regulator, 3 pin regulators-78XX and 79XX, block diagram and working of SMPS.

MODULE 3
Bipolar Junction Transistors (BJTs Basic construction and operation, Transistor configurations- Common Base, Common Emitter and Common Collector, Transistor currents and relation of and , Transistor amplifying action, detailed study of common emitter characteristics, Input- Output characteristics.
BJT amplifiers: DC biasing of BJT: Operating (Q) point, Load line analysis, Fixed Bias circuit, Emitter biased circuit, Voltage divider biased circuit. Bias stabilisation, Stability factor.

MODULE 4
Feedback Amplifiers: Feedback connection types, Effect of Gain and bandwidth with feedback, hybrid Π and T models of BJT, Zi, Zo, Av, Ai of different feedback amplifiers.

MODULE 5
Oscillators: Classification, criterion for oscillation, RC phase shift oscillator, Wien bridge oscillator, Derivation of gain and frequency of oscillations. Tuned Oscillator circuits: Basics of resonant circuit oscillator, Colpitts and Hartley oscillators, Crystal oscillators: Series and parallel resonance of quartz crystal.

Text Books

1. Robert Boylestad, Electronic Devices and Circuit Theory, Prentice Hall 7th Edition or latest

2. Thomas L Floyd, Electronic Devices, Pearson Education 7th Edition or latest .

Reference Books

1. Integrated Electronics , Millman and Halkias, Mc Graw Hill Publications

2. Razavi B., “Fundamentals of Microelectronics”, Wiley, 2015

3. Neamen D., “Electronic Circuits, Analysis and Design”, 3/e, TMH, 2007

COURSE CONTENTS AND LECTURE SCHEDULE

No	Topic	No of Lecture/Tutorial Hours
1	Semiconductor diode, Biasing, Diode current equation	**1**
	Characteristics, Static and Dynamic resistance, Diode equivalent circuit1	**1**
	Sinusoidal and non-sinusoidal wave shapes.	**1**
	Principle and working of RC differentiating and integrating circuits.	**2**
	Clipping circuits - Positive, negative and biased clipper.2	**2**
	Clamping circuits - Positive, negative and biased clamper.	**2**
2	Half wave and Full wave rectifiers: Centre tapped transformer and bridge circuits and waveforms. PIV of the diode.	**3**
	Simple zener voltage regulator, series and shunt voltage regulator.	**3**
	3 pin regulators-78XX and 79XX, block diagram and working of SMPS.	**3**
3	Basic construction and operation	**1**
	Transistor configurations- Common Base, Common Emitter and Common Collector	**1**
	Transistor currents and relation of α and β Transistor amplifying action.	**2**
	Detailed study of common emitter characteristics, Input-Output characteristics.	**1**

	DC biasing of BJT: Operating (Q) point, Load line analysis,2.	**2**
	Fixed Bias circuit, Emitter biased circuit, Voltage divider biased circuit.	**1**
	Bias stabilisation, Stability factor.	**1**
4	Feedback connection types.	**3**
	Effect of Gain and bandwidth with feedback.	**1**
	Hybrid Π and T models of BJT.	**1**
	Zi, Zo, Av, Ai of different feedback amplifiers.4.	**4**
5	Classification, criterion for oscillation.	**2**
	RC phase shift oscillator, Wien bridge oscillator, Derivation of gain and frequency of oscillations.	**2**
	Tuned Oscillator circuits: Basics of resonant circuit oscillator, Colpitts and Hartley oscillators.	**3**
	Crystal oscillators: Series and parallel resonance of quartz crystal.	**2**

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Analyse static and dynamic characteristics of pn junctions.
2. Describe the Forward bias and reverse bias in diodes.
3. Describe clipping and clamping using diodes.

Course Outcome 2 (CO 2):

1. Compare the performance of Half wave and Full wave rectifiers.
2. Explain the working of SMPS.

Course Outcome 3 (CO 3):

1. Explain the need of DC biasing of BJT and how operating (Q) point is fixed.
2. How Voltage divider biased circuit is designed in CE transistor circuit.
3. Describe BJT small signal ac analysis.

Course Outcome 4 (CO 4):

1. Which are the different types of feedback amaplifiers?
2. What is the effect of negative feedback in the gain and bandwidth of an amplifier?

Course Outcome 5 (CO 5):

1. Explain the concept of Barkhausen criteria to convert the amplifier as an oscillator.
2. Derive the frequency of oscillations of RC phase shift and Wien bridge oscillator.
3. Describe the resonant circuit operation for Hartley and Colpitts oscillators.

MODEL QUESTION PAPER

QP CODE: **Pages: 2**

Reg.No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

FIRST SEMESTER B TECH DEGREE EXAMINATION, DECEMBER 2024

Course Code: B24EC1T04

ANALOG CIRCUITS 1

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Draw the dynamic and static resistance of a forward biased diode.
2. Design and draw a positive clipped diode circuit at 3 V level, given Sinewave input at 10 kHz $10V_{pp}$.
3. Derive the expression for PIV of the diode in half wave rectifier.
4. Draw and explain the block diagram of SMPS.
5. How the term “transistor” is formed from “transfer resistor” term.
6. Obtain the relation between α and β in npn transistor.
7. Enumerate different feedback amplifiers.
8. Draw and explain hybrid Pi model of BJT.
9. Show that Aβ=1 in a transistorized oscillator circuit.
10. Draw the circuit diagram of a Colpitts Oscillator.

PART B

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

11. a. Design and draw the circuit diagram of a Clamper circuit with clamping levels at +5 V . Given a sinewave input at 1 kHz 5Vpp. Draw the input and output waveforms to scale. 7

    b. Design and draw the circuit diagram of a Trapezoidal clipper circuit with clipping levels at +3 V and -4V. Given a sinewave input at 1 kHz 12Vpp. Draw the input and output waveforms to scale. 7

OR

12. a. Write down the diode current equation and explain its components. Explain the dynamic and static resistance and represent them in V-I characteristics. 7

    b. Describe the operation of an RC integrated circuit. Derive the expression for the transfer function of the same. 7

13. a. Draw a simple Zener regulator circuit and explain its working. How Zener diode differs from conventional diodes in its operation. 7

    b. Design a Full wave rectifier circuit with a capacitor filter using a center tapped transformer with following specifications. Given Vdc =12V, Ripple voltage $<$ 100mV. Draw the circuit diagram and input output waveforms. 7

OR

14. a. With neat block diagram explain the working of SMPS. 7

    b. Design a half wave rectifier circuit with a capacitor filter using a center tapped transformer with following specifications. Given Vdc =12V, Ripple voltage $<$ 100mV. Draw the circuit diagram and input output waveforms. 7

15. a. Explain with necessary diagrams, the common base npn transistor configuration and show that output current is less than input current. 7

    b. Explain the term “Early effect” with the representation in V-I characteristics of a common emitter transistor configuration. 7

OR

16. a. Draw the basic constructional features of a npn transistor and explain the current components and its relations. 7

    b. Draw the V-I output characteristics of CE transistor configuration and explain the linear region of operation. 7

17. a. Derive the transfer function of a current series feedback amplifier. 7

    b. Derive the input and output impedances of current amplifier. 7

OR

18. a. Derive the transfer function of a voltage shunt feedback amplifier. 7

    b. Derive the input and output impedances of voltage amplifier. 7

19. a. Describe the Barkhausen criteria in converting an amplifier to a sinusoidal oscillator. 7

    b. Draw the circuit diagram of an RC phase shift oscillator and derive the expression for gain of the circuit. 7

OR

20. a. Draw the basic circuit and principle of a resonant circuit oscillator and explain its operation. 7

    b. Draw and explain a Wienbridge oscillator circuit with appropriate waveforms. How sustainable oscillations are maintained based on Barkhausen criteria. 7

B24EC1L01	BASIC ELECTRONICS LAB	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		0	0	3	3	2	2024

Preamble

The following experiments are designed to understand the basic building components of Electronics and evaluate and select appropriate device for various projects/product design.

Prerequisite :Nil

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

CO 1	Make different wave shaping circuits and design DC power supplies **(Apply, Analyze)**.
CO 2	Assess the location of Q point from V-I characteristics and predict the amplifier characteristics **(Apply, Analyze)**
CO 3	Understand different amplifier configurations and analyze the gain parameters. **(Apply, Analyze)**.
CO 4	Assemble different sinusoidal oscillators suitable for various applications. **(Apply, Analyze)**.
CO 5	Evaluate the performance characteristics of FET devices and compare with BJT devices. **(Apply, Analyze)**.

Mapping of Course Outcomes With Program Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO 1	3	3	3	2	2	0	0	0	3	1	0	3
CO 2	3	3	3	2	2	0	0	0	3	1	0	2
CO 3	3	3	3	1	2	0	0	0	3	1	0	2
CO 4	3	3	3	1	2	0	0	0	3	1	0	2
CO 3	3	3	3	2	2	0	0	0	3	1	0	2

Mark Distribution

Continuous Internal Evaluation Pattern

Attendance	10 marks
Class Work/ Assessment /Viva-Voce	20 marks
Viva-Voce/Test	20 marks

SYLLABUS

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

LIST OF EXPERIMENTS

(All experiments require appropriate design, development of circuit diagrams, plotting waveforms, graphs and necessary calculations wherever necessary)

1	Diode Experiments: Plotting forward bias, Finding dynamic and static resistance .
2	Zener diode biasing: Plotting forward and reverse bias. Simple voltage regulator circuit and output plotting.
3	Diode circuit applications: Wired gate, Clipping and Clamping circuits with fixed and variable voltage levels, Zener diode clippers
4	DC Power Supplies: Half wave and full wave rectifiers with and without capacitor filters,
5	Experiments on CE and CB npn transistor configurations. Determination of α and β
6	Common Emitter (npn) transistor characteristics, determination of Q point
7	RRC Coupled amplifier, Design and implementation, Record of Frequency response, Determination of bandwidth. Transistor switch operation and waveforms.
8	Cascading of amplifiers, Product of gain
9	Design and implementation of RC phase shift and Wien bridge oscillators
10	Design and implementation of Hartley and Colpitts oscillators.
11	Determination of V-I characteristics JFET. Ohmic region and Active Linear regions, Determination of g_m

Reference Books

1. Robert Boylestad, Electronic Devices and Circuit Theory, Prentice Hall 7th Edition or latest

B24EC1L02	SCIENTIFIC COMPUTING LAB	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		0	0	3	3	2	2024

Preamble

The following experiments are designed to translate the mathematical concepts into system design. The students shall use Python for realization of experiments. Other softwares such as R/MATLAB/SCILAB/LabVIEW can also be used.

Prerequisite

Linear Algebra and Multi Variable Calculus

Course Outcomes

After the completion of the course the student will be able to

CO 1	Describe the needs and requirements of scientific computing and to familiarize one programming language for scientific computing and data visualization (Cognitive Knowledge Level : Apply).
CO 2	Approximate an array/matrix with matrix decomposition (Cognitive Knowledge Level : Apply).
CO 3	Implement numerical integration and differentiation (Cognitive Knowledge Level : Apply).
CO 4	Solve ordinary differential equations for engineering applications (Cognitive Knowledge Level : Apply).
CO 5	Simulate random processes and understand their statistics (Cognitive Knowledge Level : Apply).

Mapping of Course Outcomes With Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	3	3	2	3				3	1		3
CO 2	3	3	1	2	3				3			1
CO 3	3	3	1	1	3							1
CO 4	3	3	1	1	3							1
CO 5	3	3	2	2	3				3	1		1

Mark Distribution

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

Continuous Internal Evaluation Pattern

Attendance	10 marks
Class Work/ Assessment /Viva-Voce	20 marks
Viva-Voce/Test	20 marks

SYLLABUS

LIST OF EXPERIMENTS

1	Find the factorial of a given number and display the output.
2	Find the sum of n numbers and display the output.
3	Display Fibinocci series.
4	Display the factors of a given number.
5	Input a row array and column array. Input a square matrix. Find the rank, inverse, transpose, determinant and eigen values of the matrix. Plot the real and imaginary values of eigen vectors.
6	Input a complex number in each quadrant. Find the absolute value, real and imaginary values, argument in degrees. Also perform arithmetic operations using complex numbers.
7	Realize the functions sint, cost, sinht, cosht for the vector a. t = [0, 10] with increment 0.01. b. t =[-4*pi, 4*pi] with increment 0.01*pi Compute the first and second derivatives of these functions. Plot the first derivatives of the above functions in a single window. .
8	Write a program to return the first and second derivative of the function f(t) = 3t4 + 5 for the vector t = [-3; 3].
9	Write a program to return the value of an integral function
10	Write a program to return the value of an integral function using Trapezoidal and Simpson method.
11	Implement and plot the functions using stem plots, line plots, box plots, bar plots and scatter plots. Create legends in plots. f(t) = cos t f(t) = cos t cos 5t + cos 5t
12	Obtain the histogram of a given data and plot it.
13	Simulate a coin toss that maps a head as 1 and tail as 0. Toss the coin N = 100, 500,1000 and 5000 times and compute the probability (p) of head in each case. Compute the absolute error in each case and plot against N and understand the law of large numbers.

14	Create a uniform random vector with maximum magnitude 10, plot and observe. Set a threshold and Count how many times the function has gone above and below the threshold.
15	Write and execute a function to toss three fair coins simultaneously. Compute the probability of getting exactly two heads for 100 and 1000 number of tosses.
16	Write a program to solve the first order and second order differential equation.
17	Two dice are rolled 50 times. Count the occurrence of 5 in both dice.
18	Obtain the sum of the series $f = 1^2 + 2^2 + 3^2 + 4^2 + ...$ such that the sum does not exceed 1000.The program should display how many terms are used in the sum.

Reference Books

1. Holly Moore, MATLAB for Engineers, Pearson.
2. William Palm, MATLAB for Engineering Applications, McGraw Hill.

B24MC1T03	PROFESSIONAL COMMUNICATION AND ETHICS	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		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.

Prerequisite

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	PO 12
CO 1						2	1	2	3	1	2	
CO 2						3	1	3	3	2	2	
CO 3						3	1	3	3	3	3	
CO 4	3	3	2	2	2	2	2	3	2	2	2	2
CO 5	2	2	2	2	2	2	2	3	2	2	2	3

Assessment Pattern

Bloom's Category	Continuous Assessment	End Semester Examination (% Marks)
	Test (% Marks)	
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
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", 2^{nd} Edition, McGraw Hill Education, 2017.

2. Meenakshi Raman and Sangeetha Sharma, "Technical Communication: Principles and Practice", 2^{nd} 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, 6^{th} edition, 2015.

7. Mike W Martin and Roland Schinzinger, Ethics in Engineering,4^{th} 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	Topic	No of Lecture/Tutorial Hours
	Total Hours	36 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

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 ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

SECOND SEMESTER B.TECH DEGREE EXAMINATION, JUNE 2025

Course Code: B24MC1T03

Course Name: 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)

B24MC1L02	IDEA LAB	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		0	0	2	2	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.

Prerequisite

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	PO 12
CO 1	2	1	3		2				1	1		
CO 2	1		1		1						1	1
CO 3	2	2	2	2	2	1	1	1	2	2	2	2
CO 4	1	2	3	2	3	2	3	3	3	3	3	3
CO 5						1				3		

Mark Distribution

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

Continuous Internal Evaluation Pattern

Attendance	10 marks
Class Work/ Assessment	30 marks
Viva-Voce/ 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.

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 ATHANASIUS COLLEGE OF ENGINEERING

Government Aided, Autonomous Institution, Kothamangalam, Kerala, India

B.Tech

Electronics And Communication Engineering

SEMESTER 3

SYLLABUS

SEMESTER 3

SLOT	COURSE NO.	COURSES	L-T-P-S	HOURS	CREDIT
A	B24MA2T03A	Complex Variables and Applications of PDE	3-1-0-3	4	4
B	B24EC2T01	Analog Circuits 2	3-1-0-3	4	4
C	B24EC2T02	Computer Architecture and Microcontrollers	3-1-0-3	4	4
D	B24EC2T03	Network Theory	2-1-0-2	3	3
E	B24HU2T01	Business Economics and Financial Management	3-0-0-3	3	3
G	B24EC2L03	Logic Circuit Design Lab	0-0-3-3	3	2
H	B24EC2L04	Electronic Circuits Lab	0-0-3-3	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	B24ECM3X	Minor	3-1-0-3	4	
			TOTAL	**32**	**22**

MINOR

COURSE NO	Courses
B24ECM31	Electronic Circuits
B24ECM32	Analog Communication
B24ECM33	Introduction To Signals And Systems

B24MA2T03A	COMPLEX VARIABLES AND APPLICATIONS OF PDE	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		3	1	0	3	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. To understand the basic theory of functions a complex variable residue integration and conformal transformation.

Prerequisites

A basic course in partial differentiation and complex numbers.

Course Outcomes

After 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 and differentiability. (Cognitive Knowledge Level: Apply)
CO 4	Evaluate complex integrals using Cauchy's integral theorem and Cauchy's 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	PO 12
CO 1	3	2	1		1							1
CO 2	3	2	1		1							1
CO 3	3	2	1		1							1
CO 4	3	2	1		1							1
CO 5	3	2	1		1							1

Assessment Pattern

Bloom's Category	**Continuous Assessment**		**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	15 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 two questions from each module, out of which one is to be answered. Each question carries 14 marks and can have a maximum of two subdivisions.

SYLLABUS

MODULE 1 (9 hours)

Partial Differential Equations

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 - Lagrange's linear equation, non-linear equations of the first order - Charpit's method, solution of equation by method of separation of variables.

(Text 1: Relevant topics from sections 17.1, 17.2, 17.3, 17.4, 17.5, 17.7, 18.1, 18.2)

MODULE 2 (9 hours)

Applications of Partial Differential Equations

One-dimensional wave equation- vibrations of a stretched string, solution of the wave equation using the method of separation of variables, D'Alembert's solution of the wave equation. One-dimensional heat equation, solution of the heat equation.

(Text 1: Relevant topics from sections 18.3, 18.4, 18.5)

MODULE 3 (9 hours)

Complex Variable – Differentiation

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.

(Text 2: Relevant topics from sections 13.3, 13.4, 17.1, 17.2)

MODULE 4 (9 hours)

Complex Variable - Integration

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.

(Text 2: Relevant topics from sections 14.1, 14.2, 14.3, 14.4)

MODULE 5 (9 hours)

Complex Variable - Residue Integration

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

(Text 2: Relevant topics from sections 15.4, 16.1, 16.2, 16.3)

Text Books

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

Reference Books

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

COURSE CONTENTS AND LECTURE SCHEDULE

No.	Topic	No of Lecture/Tutorial Hours
	Module 1: Partial Differential Equations	**9**
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 - Lagrange's linear equation, non-linear equations of the first order - Charpit's method	4
1.3	Boundary value problems, method of separation of variables	2
	Module 2: Applications of Partial Differential Equations	**9**
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, D'Alembert's solution of the wave equation	3

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
	Module 3: Complex Variable – Differentiation	**9**
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
	Module 4: Complex Variable – Integration	**9**
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
	Module 5: Complex Variable – Residue Integration	**9**
5.1	Taylor series and Maclaurin series	2
5.2	Laurent's 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 (CO 1)

1. Form the partial differential equation given $z = f(x + it) + g(x - it)$, where $i = \sqrt{-1}$.
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 seperation of variables.

Course Outcome 2 (CO 2)

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 kept at 20^0C and 80^0C.
3. A string is stretched between the fixed points $(0, 0)$and $(l, 0)$ and released at rest from the initial deflection given by $f(x) = \begin{cases} \frac{2k}{l}x \ , & \text{when } 0 < x < \frac{l}{2} \\ \frac{2k}{l}(l-x) \ , & \text{when } \frac{l}{2} < x < l \end{cases}$
4. 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 (CO 3)

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 $e^{2x}\left(x \cos 2y - y \sin 2y\right)$.
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 (CO 4)

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 $\oint_C \frac{sinz}{z+4iz}\ dz$ where C is $|z| = 1$ in counter clockwise direction.
4. Integrate $\oint_C \frac{sinh2z}{(z-\frac{1}{2})^4}\ dz$ 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 (CO 5)

1. Find the Maclaurin series expansion of $\frac{z+2}{1-z^2}$.
2. Find all singular points and residue of the function *cosec z*.
3. Find the Laurents series of $\frac{-2z+3}{z^2-3z+2}$ valid in (i) $1 \leq |z| \leq 2$ (ii) $|z| \geq 2$.
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 ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

THIRD SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2025

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 20^0C and 80^0C.
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 $f(z) = \begin{cases} \frac{Re(z)}{1-|z|} \ , z = 0 \\ 0 \ , z \neq 0 \end{cases}$
6. Show that an analytic function with constant real part is constant.
7. Evaluate $\oint_{-\pi i}^{\pi i} cosz \, dz$.
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 $f(z) = \frac{sinhz}{z^4}$.

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 marks)

 (b) Solve $(y + zx)p - (x + yz)q = x^2 - y^2$. (7 marks)

OR

12. (a) Solve $q + xp = p^2$. (7 marks)

 (b) Using method of separation of variables, solve $x^2 \frac{\partial u}{\partial x} + y^2 \frac{\partial u}{\partial y} = 0$. (7 marks)

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 marks)

 (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 marks)

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 marks)

 (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 seperable method. (7 marks)

15. (a) Check whether $f(z) = iz\bar{z}$ is analytic. (7 marks)

 (b) Find the image of $x > 1,\ y > 0$ under the transformation $w = 1/z$. (7 marks)

OR

16. (a) Show that$u = x^3 - 3xy^2 - 5y$ is harmonic. Also find the corresponding harmonic conjugate function. (7 marks)

 (b) Find the image of $|z| \leq 2$, $\frac{\pi}{6} < Argz < \frac{\pi}{3}$ under the mapping $w = z^2$. (7 marks)

17. (a) Evaluate$\oint_C (z + \frac{1}{z})dz$ where C is the unit circle traversed counterclockwise. (7 marks)

 (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 marks)

OR

18. (a) Integrate counterclockwise around the unit circle $\oint_C \frac{sin2z}{z^4}\, dz$. (7 marks)

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

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

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

OR

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

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

B24EC2T01	ANALOG CIRCUITS 2	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		3	1	0	3	4	2024

Preamble

This course explores the core principles of MOSFET and BJT devices, from their construction and characteristics to advanced circuit applications. It covers MOSFET sub-circuits, biasing, single-stage and multi-stage amplifiers, and frequency response optimization. Differential amplifiers and BJT-based power amplifiers are examined for their design and performance. Students will learn to design and improve basic analog and power electronic circuits.

Prerequisites

B24ESIT02: Basics of Electronics Engineering
B24ESIT04: Analog Circuits 1

Course Outcomes

After the completion of the course the student will be able to :

CO 1	Students will be able to explain the construction, types, and current-voltage characteristics of MOSFETs, including second-order effects like body effect and channel length modulation [Understand].
CO 2	Students will be able to design MOS sub-circuits such as current mirrors and active resistors, and apply biasing techniques like constant current source biasing to MOS amplifier circuits [Apply].
CO 3	Students will be able to analyze the input impedance, output impedance, and gain of single-stage MOSFET amplifiers (common source, common drain, and common gate), along with their frequency response [Apply].
CO 4	Students will be able to describe the operation of MOS differential pairs and cascode amplifiers, including their DC and AC characteristics, and explain advantages like improved bandwidth and reduced Miller effect [Understand].
CO 5	Students will be able to recall the operational principles and circuit configurations of BJT-based power amplifiers, including Class A, Class B, Class AB, Class C, and Class D [Remember].

Mapping of Course Outcomes With Program Outcomes

Assessment Pattern

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	3	2	3	0	0	0	3	1	0	1
CO 2	3	3	3	2	3	0	0	0	3	1	0	1
CO 3	3	3	3	2	3	0	0	0	3	1	0	1
CO 4	3	3	3	2	3	0	0	0	3	1	0	1
CO 5	3	3	3	2	3	0	0	0	3	1	0	1

Bloom's Category	**Continuous Assessment**		**End Semester Examination**
	Test 1	**Test 2**	
Remember	30	30	30
Understand	40	40	40
Apply	30	30	30
Analyze	0	0	0

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/Class work	15 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-division.

SYLLABUS

MODULE 1

MOSFET basics: : Construction, types, working, current-voltage characteristics.
Second-order effects: body effect, channel length modulation, sub-threshold conduction, low-frequency and high-frequency small-signal MOS model.

MODULE 2
MOS Sub-circuits: MOS Switch, Active Resistor, Current Sinks and Sources. Current Mirrors: Simple Current Mirror.
Biasing of MOS Amplifier Circuits Biasing by Fixing V_{GS}, Biasing using Drain-to-Gate Feedback Resistor, Biasing using constant current source.

MODULE 3
MOS Single Stage Amplifiers: Common source , Common drain amplifier as voltage follower, Common gate amplifier as a current follower (all with resistive and active loads,derivation of input impedance, output impedances and gain). Frequency response of the CS amplifier. Miller effect and bandwidth enhancement techniques. Frequency compensation in MOSFET amplifier circuits.

MODULE 4
Differential and Multi-stage Amplifiers MOS Differential pair, operation with common-mode input voltage, operation with differential input voltage. DC Analysis - transfer characteristics, AC analysis - differential and common mode gains, CMRR. MOSFET Cascode Amplifier (CS-CG Configuration).Advantages over single-stage amplifiers (high gain, improved bandwidth, reduced Miller effect)

MODULE 5
Power Amplifiers using BJT: Introduction, series–fed Class A amplifier, Transformer-Coupled Class A amplifier, Class B amplifier operation, Class B amplifier circuits,class AB power amplifier, distortion of amplifiers, Class C and Class D amplifier.

Text Books

1. Adel S. Sedra, Kenneth Carless Smith, Arun N. Chandorkar, Microelectronic circuits: theory and applications, Oxford University Press, New Delhi, 2009
2. J. B. Gupta, Electronic Devices and Circuits, Kataria, S. K., & Sons, 2010

Reference Books

1. Robert Boylestad and L Nashelsky, Electronic Devices and Circuit Theory, Pearson, 2015.
2. Electronic Devices and Circuits, S.Salivahanan,N.Suresh kumar, McGraw Hill.
3. B. Razavi , "Fundamentals of Microelectronics", Wiley
4. Donald A Neamen. : Electronic Circuit Analysis and Design, 3/e, Tata Mc.Graw Hill.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Topic	No of Lecture/Tutorial Hours
	Module 1	**8**
1.1	**MOSFET basics:** Construction, types, working, characteristics.	**3**
1.2	**Second-order effects:** body effect, channel length modulation, sub-threshold conduction.	**2**
1.3	low-frequency and high-frequency small-signal MOS model.	**3**
	Module 2	**8**
2.1	**MOS Sub-circuits:** MOS Switch, Active Resistor	**2**
2.2	Current Sinks and Sources, Simple Current Mirror	**3**
2.3	**Biasing of MOS Amplifier Circuits:** Biasing by Fixing V_{GS}, Biasing using Drain-to-Gate Feedback Resistor, Biasing using constant current source.	**3**
	Module 3	**12**
3.1	Common Source amplifier with resistive, diode con- nected and current source loads.	**3**
3.2	Common drain amplifier as a voltage follower.	**3**
3.3	Common gate amplifier as a current follower (derivation of input impedance, output impedances and gain).	**3**
3.4	Frequency response of the CS amplifier. Miller effect and bandwidth enhancement techniques. Frequency compensation in MOSFET amplifier circuits.	**3**
	Module 4	**10**
4.1	MOS Differential pair, operation with commonmode input voltage, operation with differential input voltage.	**2**
4.2	DC Analysis - transfer characteristics, AC analysis - differential and common mode gains, CMRR	**3**
4.3	MOSFET Cascode Amplifier (CS-CG Configuration).	**3**
4.4	Advantages over single-stage amplifiers (high gain, improved bandwidth, reduced Miller effect)	**2**
	Module 5	**8**
5.1	Power Amplifiers using BJT: Introduction, series–fed Class A amplifier, Transformer-Coupled Class A amplifier.	**3**
5.2	Class B amplifier operation, Class B amplifier circuits,class AB power amplifier, Amplifier distortion.	**3**
5.3	Class C and Class D amplifier.	**2**
	Total	**46**

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Explain the VI characteristics of MOSFET
2. Explain the 2nd order effects in MOSFET

Course Outcome 2 (CO2):

1. Explain the working of Simple Current Mirror.
2. Compare the operation of a MOS switch in triode and cutoff regions.

Course Outcome 3 (CO3):

1. Explain the working principle of a Common Source (CS) amplifier with a resistive load. Derive the expression for voltage gain.
2. Evaluate the trade-offs between using a resistive load and an active load in a CS amplifier.

Course Outcome 4 (CO4):

1. Derive the DC transfer characteristics of a MOSFET differential amplifier and discuss its significance.
2. Derive the common-mode gain of a MOS differential pair.

Course Outcome 5 (CO5):

1. Differentiate between voltage and power amplifiers.
2. Explain the working of class AB power amplifier.

MODEL QUESTION PAPER

QP CODE: **Pages: 5**

Reg.No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

THIRD SEMESTER B TECH DEGREE EXAMINATION, DECEMBER 2024

Course Code: B24EC2T01

COURSE NAME: ANALOG CIRCUITS 2

Max. Marks: 100 Duration: 3 hours

PART A

(Answer all questions. Each question carries 3 marks.)

1. Explain the classification of MOSFET.
2. What is body effect
3. Explain the working of MOS resistor.
4. Explain the limitations of biasing a MOS amplifier by fixing V_{GS}.
5. Why is a Common Drain (CD) amplifier called a voltage follower? Explain its significance in impedance matching.
6. What is the Miller effect, and how does it affect the bandwidth of a CS amplifier?
7. What is CMRR?
8. What are the advantages of a cascode amplifier compared to a single-stage amplifier?
9. What is Crossover Distortion in power amplifiers?
10. What is a push-pull arrangement in power amplifiers?

PART B

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

Module I

11. a. With a neat diagram explain the working of n-channel enhancement MOSFET. (10 marks)

    b. What is channel length modulation? (4 marks)

12. a. With a neat diagram explain the working of p-channel enhancement MOSFET. (10 marks)

    b. What is sub-threshold conduction? (4 marks)

Module II

13. a. Explain the working of a simple current mirror using MOSFETs. Derive the equation for the mirrored current and discuss its limitations. (10 marks)

    b. With a neat circuit diagram, explain MOS current sink. (4 marks)

14. a. Explain biasing using a constant current source in MOS amplifiers. Derive the expressions and discuss its advantages over other biasing methods. (8 marks)

    b. Compare different MOSFET biasing techniques in terms of stability, noise performance, and power efficiency. (6 marks)

Module III

15. a. Derive the expression for voltage gain and output impedance of common drain amplifier. (10 marks)

    b.How does the resistive load differ from an active load in MOS amplifiers?(4 marks)

16. a. Explain the frequency response of a CS amplifier and derive the expressions for low-frequency and high-frequency cutoff points. (9 marks)

    b.Why is frequency compensation necessary in MOSFET amplifier circuits?(5 marks)

Module IV

17. a.Derive the expression for voltage gain and output impedance of differential amplifier. (10 marks)

    b. Find out the input difference mode range of a differential amplifier. (4 marks)

18. a. Explain MOSFET cascode amplifier configuration. (7 marks)

    b. Explain the transfer characteristics of a MOS differential amplifier (7 marks)

Module V

19. a. Explain the working principle of a series-fed Class A amplifier with a neat circuit diagram. Derive expressions for efficiency and power dissipation. (10 marks)

    b.How power amplifiers are classified (4 marks)

20. a. Explain the working of class AB power amplifier. (10 marks)

    b. What is cross over distortion? (4 marks)

B24EC2T02	COMPUTER ARCHITECTURE AND MICRO-CONTROLLERS	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		3	1	0	3	4	2024

Preamble:
The 8051 microcontroller course provides students with a solid foundation in embedded system design through an in-depth exploration of 8051 architecture, programming, and interfacing techniques. By emphasizing the seamless integration of hardware and software, the course equips students with practical skills to develop real-world applications such as automation and control systems.

Prerequisites: B24EC1T03 : LOGIC CIRCUIT DESIGN

Course Outcomes:

After the completion of the course the student will be able to:

CO 1	Understand the Architecture and features of the 8051 Microcontroller. [Remember, Understand]
CO 2	Understand and apply data transfer, arithmetic, logical, bit manipulation, and control transfer instructions, along with addressing modes, to write and debug simple assembly and C programs for embedded systems. [Understand, Apply]
CO 3	Configure timers, counters, and interrupts in the 8051 microcontroller for precise and efficient embedded system applications. [Understand, Apply]
CO 4	Understand and implement serial communication using UART in 8051, and effectively interface peripherals like LEDs, switches, 7-segment displays, ADC, DAC, LCD, and keypads for embedded system applications[Understand, Apply]
CO 5	Interface advanced peripheral devices to 8051 microcontroller and design embedded system applications for real-world solutions. [Understand, Apply, 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	PO 12
CO 1	3											2
CO 2	3	2	2	1	2							2
CO 3	3	2	2	1	2							2
CO 4	3	3	3	3	3	2	2		2			3
CO 5	3	3	3	3	3	2	2	1	3	3	3	3

Assessment Pattern

Bloom's Category	Continuous Assessment		End Semester Examination (% Marks)
	Test 1 (% Marks)	Test 2 (% Marks)	
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	15 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-division.

SYLLABUS

MODULE 1

Introduction to Microcontrollers and the 8051

Overview of Microcontrollers: Microcontrollers vs. Microprocessors, Applications of microcontrollers in embedded systems.
Introduction to 8051 Microcontroller: Features and specifications of the 8051 family, Internal architecture and block diagram of the 8051, Pin configuration and functions, Memory organization: Program memory and data memory, Internal RAM and ROM, Stack and stack pointer.

MODULE 2

8051 Instruction Set and Programming the microcontroller

Instruction Set: Data transfer instructions, Arithmetic and logical instructions, Bit manipulation instructions, Control transfer (Branching) instructions.
Addressing Modes: Immediate, Direct, Register, Indirect and Indexed addressing modes.
Assembly Language Programming: Basics of assembly language, Writing and debugging simple programs, Example programs: Data transfer, Arithmetic operations, Logical operations.
C Programming: Learn the basics of C programming and explore advanced interfacing techniques for embedded system development.

MODULE 3

Timers, Counters, and Interrupts

Timers and Counters: Concept of timers and counters in 8051, Timer modes: Mode 0, Mode 1, Mode 2, Mode 3, Programming timers for delays and event counting.
Interrupts: Interrupt structure and vector table in 8051, Interrupt priorities, Programming external and internal interrupts, Applications of interrupts in embedded systems.

MODULE 4

Serial Communication and Peripheral Interfacing

Serial Communication: Basics of serial communication, UART and its configuration in 8051, Serial communication programming (mode selection, baud rate configuration).
Peripheral Interfacing: LED and switch interfacing, Interfacing 7-segment displays, Interfacing ADC (Analog to Digital Converter) and DAC (Digital to Analog Converter), LCD interfacing, keypad interfacing.

MODULE 5

Applications and Real-World Projects

Motor Control: Stepper motor interfacing, DC motor interfacing using H-bridge, Servo motor interfacing.
Embedded System Applications: Temperature monitor and control system.

Text Books

1. Muhammad Ali Mazidi.Janice Gillispie Mazidi , Rolin D. McKinlay. ”The 8051 Microcontroller and Embedded Systems Using Assembly and C”, Printice Hall -Inc,Second, 2007.

2. Kenneth J Ayala, Dhananjay V GadreThe, ”8051 Microcontroller Architecture, Programming and Applications”, Cengage Learning, 2010.

Reference Books

1. Lyla B. Das, ”Microprocessors and Microcontrollers”, Pearson Education,2011.

2. Datasheet, ”8051 hardware Description”, Intel Corporation,1992.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Topic	No of Lecture/Tutorial Hours
	Module 1 (Introduction to Microcontrollers and the 8051)	**8 hours**
1.1	Microcontrollers vs. Microprocessors, Applications of microcontrollers in embedded systems	1 hour
1.2	Features and specifications of the 8051 family, Inter- nal architecture and block diagram of the 8051	1 hour
1.3	Internal architecture and block diagram of the 8051	1 hour
1.4	Pin configuration and functions	1 hour
1.5	Memory organization: Program memory and data memory	1 hour
1.6	Internal RAM	1 hour
1.7	Internal ROM	1 hour
1.8	Stack and stack pointer	1 hour
	Module 2 (8051 Instruction Set and Programming)	**10 hours**
2.1	Data transfer instructions,	1 hour
2.2	Arithmetic instructions	1 hour
2.3	Logical instructions	1 hour
2.4	Bit manipulation instructions, Control transfer (Branching) instructions	1 hour
2.5	Addressing Modes: Immediate, Direct addressing modes, Register addressing mode	1 hour
2.6	Indirect and Indexed addressing modese	1 hour
2.7	Memory organization – RAM and ROM	1 hour
2.8	Basics of assembly language, Writing and debugging simple programs	1 hour
2.9	Basics of C Programming, Writing and debugging simple programs	1 hour
2.10	Example programs: Data transfer, Arithmetic operations, Logical operations and device interfaces.	1 hour

	Module 3 (Timers, Counters, and Interrupts)	**10 hours**
3.1	Concept of timers and counters in 8051, Associated registers and configurations	2 hour
3.2	Timer modes: Mode 0, Mode 1, Mode 2, Mode 3	2 hour
3.3	Programming timers for delays and event counting	1 hour
3.4	Interrupt structure and vector table in 8051	1 hour
3.5	Interrupt priorities	1 hour
3.6	Programming external and internal interrupts	2 hour
3.7	Applications of interrupts in embedded systems	1 hour
	Module 4 (Serial Communication and Peripheral Interfacing)	**9 hours**
4.1	Basics of serial communication	1 hour
4.2	UART and its configuration in 8051	1 hours
4.3	Serial communication programming (mode selection, baud rate configuration)	1 hours
4.4	LED and switch interfacing	1 hours
4.5	Interfacing 7-segment displays - Multiplexing modes	1 hours
4.6	Interfacing ADC (Analog to Digital Converter)	1 hours
4.7	Interfacing DAC (Digital to Analog Converter)	1 hours
4.8	LCD interfacing	1 hour
4.9	Keypad interfacing	1 hour
	Module 5 (Applications and Real-World Projects)	**8 hours**
5.1	Stepper motor interfacing	2 hour
5.2	DC motor interfacing using H-bridge	2 hour
5.3	Servo motor interfacing	1 hour
5.4	Embedded System Applications - general considerations	1 hour
5.5	Temperature monitor and control system	2 hour
	Total Hours	**45 Hours**

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. How a microcontroller is different from a microprocessor?
2. What are the peripherals available in 8051 microcontroller?
3. Explain the multiplexing of port pins in 8051 uC.

Course Outcome 2 (CO 2):

1. How the RAM area of 8051 uC is divided?
2. What is the use of bit addressable area in the 8051?

3. What is the maximum size of internal RAM, External data memory and external code memory in 8051 uC?

Course Outcome 3 (CO 3):

1. Write an ALP to find the biggest in a block of data of 10bytes stored in internal RAM locations starting from 30H and send it to port P1.
2. Write an embedded C program to sort the content of memory locations 10H to 20H in descending order.
3. Write an ALP to multiply the numbers stored in two consecutive memory locations and store the result in the consecutive memory locations.

Course Outcome 4 (CO 4):

1. Draw a circuit to show how an LED and a switch to control the LED are connected to the 8051 uC. Write an ALP to control the LED using the switch.
2. Draw a circuit to show how a relay is connected to the port pin of 8051 uC.
3. Draw a circuit to show how a temperature sensor is connected to the 8051 uC.

Course Outcome 5 (CO 5):

1. Draw an interface of a temperature sensor and a fan to the 8051 uC. Write an ALP to control the room temperature.
2. Draw an interface of a photo transistor and an LED light to the 8051 uC. Write an ALP to control the light intensity in the room.
3. Draw an interface of an RFID reader and a digital door lock to the 8051 uC. Write an ALP to control the door lock by using an RFID tag.

MODEL QUESTION PAPER

QP CODE: **Pages: 2**

Reg.No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

THIRD SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2025

Course Code: B24EC2T02

Course Name: COMPUTER ARCHITECTURE AND MICROCONTROLLERS

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. What is the size of the RAM in 8051?
2. Define address bus, data bus and control bus.
3. Draw and explain the PSW of 8051 microcontroller.
4. Write the functions of the following instructions. a) ANL A,@R1 b)RLC A c)MOVX A,@R0
5. What is a constant in embedded C?
6. Write an ALP to copy a block of 8 bytes of data from the RAM location 20H to another location with address 80H.
7. What is the difference between a timer and a counter?
8. Explain the format of the SCON special function register.
9. The 8051 microcontroller typically uses a crystal frequency of 11.0592 MHz. Why?
10. What are the predefined interrupt priorities in the 8051 microcontroller, and how can they be modified?

PART B

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

1. (a) Draw and explain the architecture of the 8051 microcontroller. (8 Marks)
   (b) How does a computer execute instructions stored in its memory? (6 Marks)

OR

2. (a) What are the rotate and shift instructions in the 8051 microcontroller used for? (5 Marks)
   (b) How is the RAM of the 8051 microcontroller divided? (9 Marks)

3. (a) Differentiate the branching instructions SJMP, AJMP and LJMP in the 8051 microcontroller. (8 Marks)
   (b) Write an ALP to transfer 10 data bytes stored at locations starting from 21H to another location in RAM starting from 51H. Find the second largest value in the data. (6 Marks)

OR

4. (a) Write an ALP to sort an array of 10 bytes stored in the memory location starting from 20H. (9 Marks)
   (b) Explain the addressing modes of 8051 with examples (5 Marks)

5. (a) Explain the TCON and TMOD special function registers of 8051 microcontroller. (8 Marks)
   (b) Write an ALP to generate a square wave of frequency 100kHz on pin P1.0 using timer 1 operating in mode 0. Assume a crystal frequency 11.0592 MHz. (6 Marks)

OR

6. (a) Illustrate the interface diagram showing the connection of the 8051 microcontroller to the DAC8080 via port P1. Additionally, write a program to generate a ramp signal. (9 Marks)
   (b) Write a C program to read the port P1. Compare the value with 100. If it is less than 100, send it to port P0; if it is greater than 100, send it to port P2. (5 Marks)

7. (a) What is the maximum delay that can be generated using an 8051 timer in Mode 1 with a 12 MHz crystal oscillator? Show the calculations. (9 Marks)
   (b) Write an ALP to generate a sine wave of frequency 100kHz on pin P1.0 using timer 1 operating in mode 0. Assume a crystal frequency of 12MHz. (5 Marks)

OR

8. (a) Write an embedded C program for the 8051 uC to send a letter 'A' serially with a baud rate of 9600 continuously. (8 Marks)

(b) Draw the circuit diagram to show interface between 8051 uC and 16x2 LCD module. Write an embedded C program to send the message ”Hello world” to the LCD. (6 Marks)

9. (a) Draw the circuit diagram to show the interface between the 8051 uC and ADC chip. Write an embedded C program to read an analog value from the potentiometer. (9 Marks)

(b) Draw the circuit diagram to show the interface between 8051 uC and the 4x4 keypad. Display the key pressed on an LCD. Design the interface and write an embedded C program for the implementation. (5 Marks)

OR

10. (a) Draw the circuit diagram to show the interface between the 8051 uC and a DC motor. Write an embedded C program to rotate the motor clockwise. (8 Marks)

(b) Explain interfacing of the stepper motor with the 8051 uC. Write a C program to continuously rotate the motor in a clockwise direction in full strep mode. (6 Marks)

B24EC2T03	NETWORK THEORY	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		2	1	0	2	3	2024

Preamble

This course aims to equip students with the knowledge and skills to analyze circuit networks, focusing on a clear understanding of basic circuit elements and transforms.

Prerequisites

B24EC1T02 : Electrical Circuit Theory
B24ES1T02 : Basics of Electrical & Electronics Engineering.

Course Outcomes

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

CO 1	Utilize fundamental concepts and circuit laws to effectively solve simple AC and DC electric circuits.[Remember, Understand, Apply]
CO 2	Develop and solve AC and DC circuits using circuit analysis and network theorems [Remember, Understand]
CO 3	Apply Laplace transform to solve networks and determine the transient behaviour of RL,RC and RLC networks. [Understand, Apply]
CO 4	Apply Network functions to analyse the single port and two port networks. [Understand, Apply]
CO 5	Understand and examine the two port network parameters.[Remember, 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	PO 12
CO 1	3	2	3	2		1						3
CO 2	3	2	3	2		1						3
CO 3	3	2	3	2		1						3
CO 4	3	2	3	2		1						3
CO 5	3	2	3	2		1						3
CO 6	3	2	3	2		1						3

Assessment Pattern

Bloom's Category	Continuous Assessment		End Semester Examination (% Marks)
	Test 1 (%Marks)	Test 2 (%Marks)	
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/Class work/Tutorial Problems	15 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-division.

SYLLABUS

MODULE 1

Fundamental Concepts of Circuit Theory: Introduction to mesh and node analysis, Mesh and node analysis of AC and DC networks containing independent and dependent sources (Review and Problems). Supermesh and Supernode analysis. .
Resonance : Series resonance, Parallel resonance (bandwidth, Q factor and Selectivity), include simple problems on Q factor and bandwidth.

MODULE 2

Network Theorems : Thevenin's theorem, Norton's theorem, Superposition theorem, Reciprocity theorem, Maximum power transfer theorem. (Applied to both dc and ac circuits having independent and dependent sources). .

MODULE 3

Application of Laplace Transforms : Laplace Transforms and Inverse Laplace Transforms, Initial value theorem and Final value theorem, Transformation of basic signals and circuits into s-domain.
Transformed Impedance: Analysis of networks with transformed impedance and dependent sources. Transient analysis of RL, RC, and RLC networks (using time-domain and Laplace transform techniques) with impulse, step and sinusoidal inputs (with and without initial conditions).

MODULE 4

Network functions: Network functions for the single port and two port network. Properties of driving point and transfer functions. Problems to find driving point and transfer functions. Network functions, Significance of poles and zeros, Pole-zero plot from network functions.

MODULE 5

Two port network Parameters : Impedance, Admittance, Transmission and Hybrid parameters of two port network, properties of parameters: reciprocity and symmetry, Problems on DC and simple problems on AC circuits. Series and parallel connections of two port networks.

Text Books

1. Ravish R., “Network Analysis and Synthesis”, 2/e, McGraw-Hill, 2015.

2. Sudhakar A, Shyammohan S. P., “Circuits and Networks- Analysis and Synthesis”, McGraw Hill, 5/e, 2015 .

3. W. Hayt, J. Kemmerly, J. Phillips, S. Durbin, “Engineering Circuit Analysis,” McGraw Hill .

Reference Books

1. Valkenburg V., “Network Analysis”, Pearson, 3/e, 2019.

2. Edminister, “Electric Circuits – Schaum’s Outline Series”, McGraw-Hill, 2009 .

3. K. S. Suresh Kumar, “Electric Circuits and Networks”, Pearson, 2008.

4. William D. Stanley, “Network Analysis with Applications”, 4/e, Pearson, 2006.

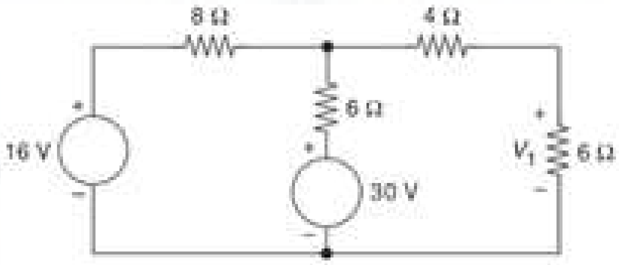
COURSE CONTENTS AND LECTURE SCHEDULE

No	Topic	No of Lecture/Tutorial Hours
	Module 1	**6**
1.1	Introduction to mesh and node analysis	1
1.2	Mesh and node analysis of AC and DC networks containing independent and dependent sources (Review and Problems	3
1.3	Series resonance, Parallel resonance (bandwidth, Q factor and Selectivity)	1
1.4	Simple problems on Q factor and bandwidth.	1
	Module 2	**7**
2.1	Thevenin's theorem,Norton's theorem	2
2.2	Superposition theorem	2
2.3	Reciprocity theorem	1
2.4	Maximum power transfer theorem. (Applied to both dc and ac circuits having independent and dependent sources	2
	Module 3	**9**
3.1	Laplace Transforms and Inverse Laplace Trans- forms	1
3.2	Initial value theorem and Final value theorem	1
3.3	Transformation of basic signals and circuits into s-domain	2
3.4	Analysis of networks with transformed impedance and dependent sources	1
3.5	Transient analysis of RL, RC, and RLC networks (using time-domain and Laplace transform techniques) with impulse, step and sinusoidal inputs (with and without initial conditions)	4
	Module 4	**6**
4.1	Network functions for the single port and two port network. Properties of driving point and transfer functions	2
4.2	Problems to find driving point and transfer functions	2
4.3	Network functions, Significance of poles and zeros	1
4.4	Pole-zero plot from network functions.	1
	Module 5	**8**
5.1	Impedance, Admittance, Transmission and Hybrid parameters of two port network	3
5.2	Properties of parameters: reciprocity and symmetry	1
5.3	Problems on DC and simple problems on AC circuits	2
5.4	Series and parallel connections of two port networks.	2
	Total Hours	**36 Hours**

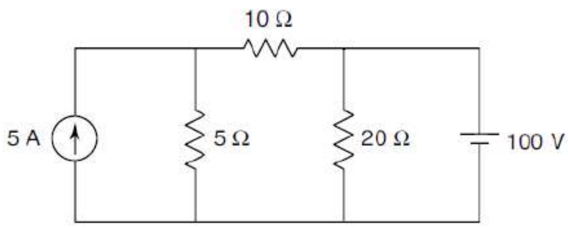
CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Find the voltage V_1 across the 6 ohm resistance using (i) the nodal analysis and (ii) the mesh analysis.

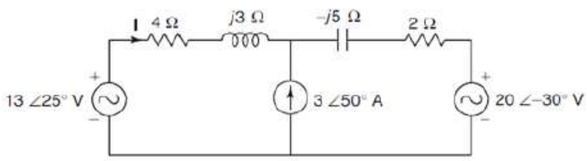


2. Determine the values for the three mesh currents

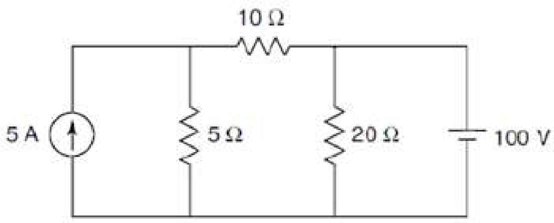


Course Outcome 2 (CO 2):

1. Find the current I in the network using superposition theorem



2. Find the current through the 20 Ω resistor using Thevenin's theorem.

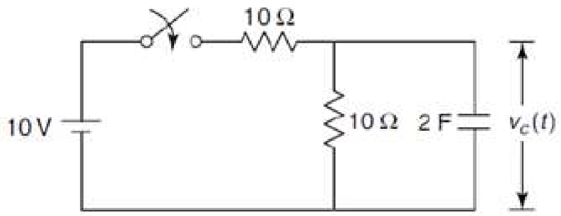


Course Outcome 3 (CO 3):

1. Find the inverse Laplace transform of

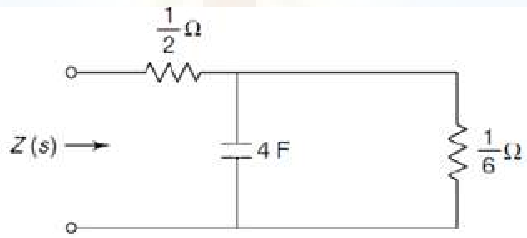
$$\frac{(S+2)}{S^2(S+3)}$$

2. The switch in the network is closed at t = 0. Determine the voltage across the capacitor.

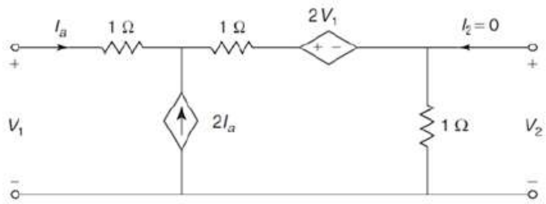


Course Outcome 4 (CO 4):

1. Determine the poles and zeros of the impedance function Z (s)

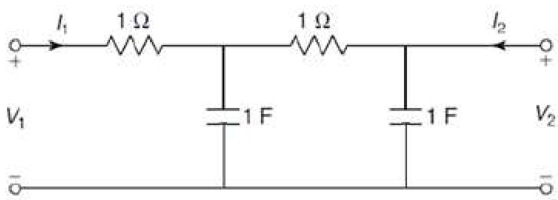


2. Find the voltage transfer function V2/V1 for the network.

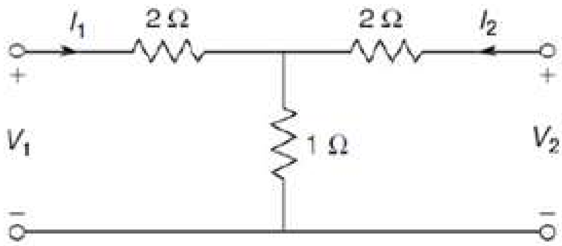


Course Outcome 5 (CO 5):

1. Obtain the admittance parameters for the network.



2. Two identical network sections are connected in series. Obtain the Z-parameters of the overall connection.



MODEL QUESTION PAPER

QP CODE: **Pages: 5**

Reg.No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

THIRD SEMESTER B TECH DEGREE EXAMINATION, DECEMBER 2025

Course Code: B24EC2T03

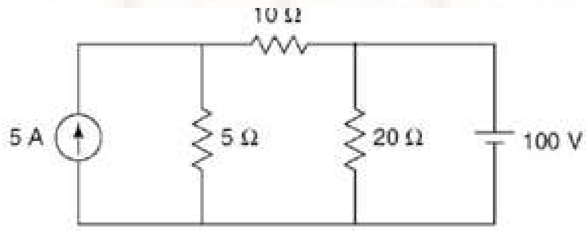
Course Name: NETWORK THEORY

Max. Marks: 100 Duration: 3 hours

PART A

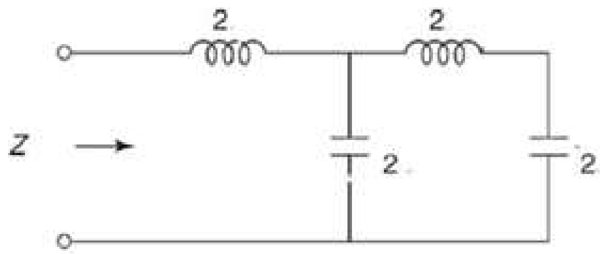
Answer all questions. Each question carries 3 marks

1. Differentiate between mesh analysis and node analysis.
2. Explain the concept of super-mesh with the help of a suitable example.
3. State maximum power transfer theorem.
4. Find the current through 20 Ω resistor using superposition theorem.



5. State the initial value theorem and find the initial value of the function, f(t) which have Laplace transform,
$$F(s) = \frac{s^2+1}{s(2s+3)(s+5)}.$$
6. Find the expression for the current through an RC circuit due to impulse as input.
7. State the properties of a network transfer function.

8. Find the driving point impedance function of the following network.



9. Derive the conditions of reciprocity in a two-port network in terms of its transmission parameters.

10. Consider a two-port network with the open circuit impedance parameter matrix

$$\begin{bmatrix} 2 & 1 \\ 3 & 2 \end{bmatrix}$$

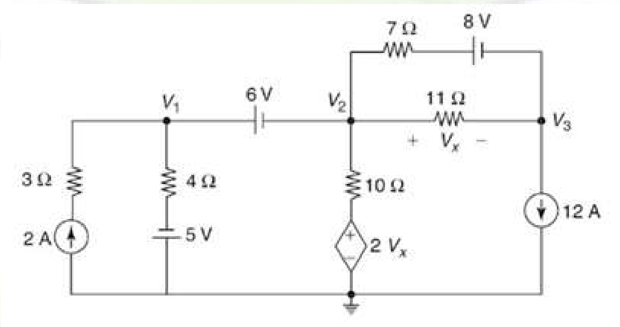
Check whether the network is symmetric and reciprocal.

PART B

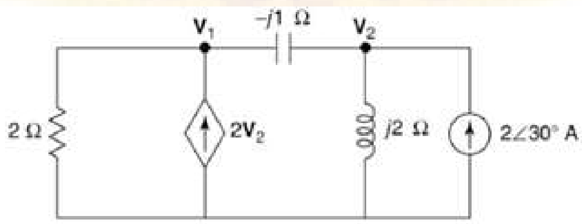
Answer any one question from each module. Each question carries 14 marks

Module I

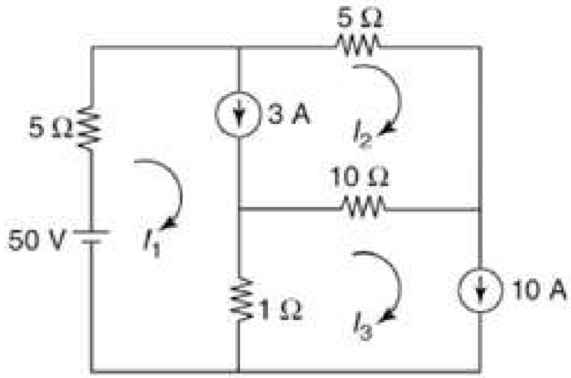
11. a) Using node analysis determine the voltage Vx. (7)



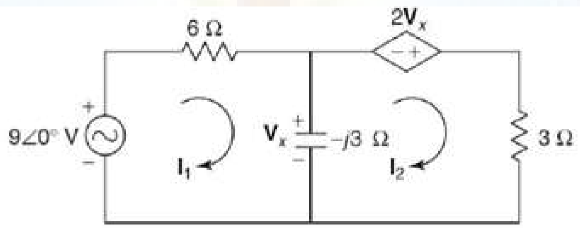
b) Find the node voltages of the following circuit. (7)



12. a. Find the current through 10 Ω resistor using mesh analysis. (7)

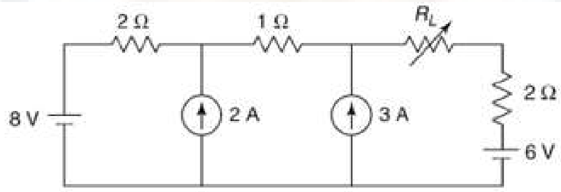


b. Find the loop current I1 and I2 in the given network. (7)

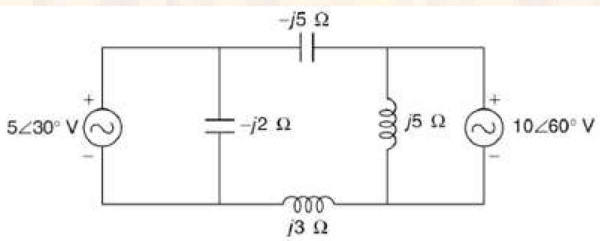


Module II

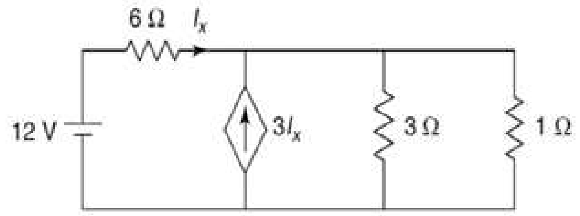
13. a) Find the value of RL such that maximum power is transferred to it. Also find the maximum power transferred to RL. (8)



b) Find the current through j3 Ω using superposition theorem. (6)



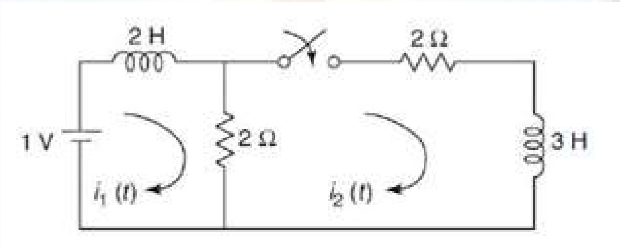
14. Determine the Thevenin and Norton equivalent circuit across the terminals 1 Ω. (14)



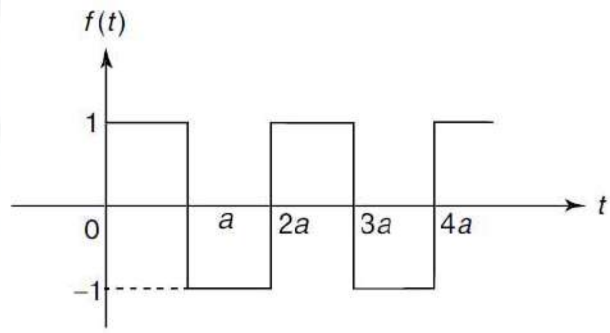
Module III

15. a) Find the Laplace transform of the following signals (i) f(t)=$\int_0^t e^{-4t} \sin 2t\, dt$ (ii)f(t)=$\frac{1-e^{-t}}{t}$ (6)

b) In the circuit, the switch is closed at t = 0. Determine current through the inductor with inductance 3H for t > 0. Assume the steady state being reached before t =0. (8)

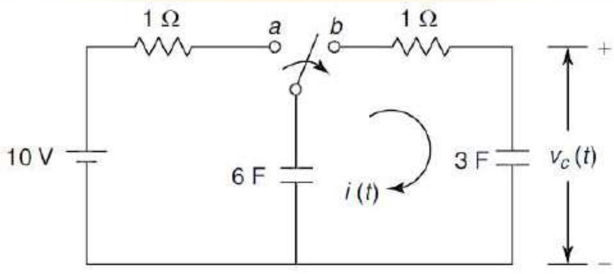


16. a) Find the Laplace transform of the waveform f(t).



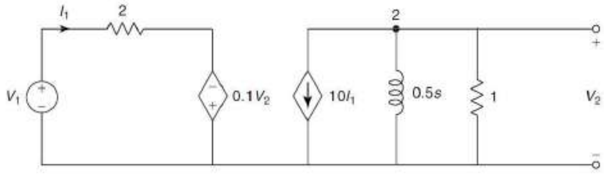
(7)

b) In the given network, the switch is moved from position a to b at t = 0. Determine the voltage, Vc(t). (7)



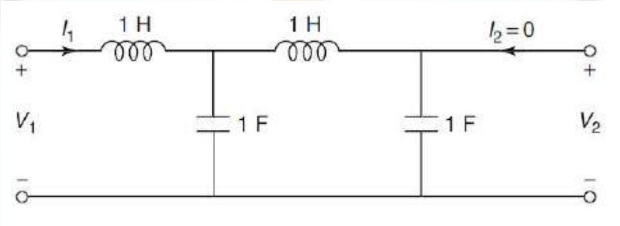
Module IV

17. a) Find the driving point admittance function, $Y_{11} = \frac{I_1}{V_1}$ of the following network. (8)



b) The voltage of a network is given as $V(s) = \frac{(s+2)(s+6)}{(s+1)(s+5)}$ Plot the pole-zero diagram and hence obtain V(t). (6)

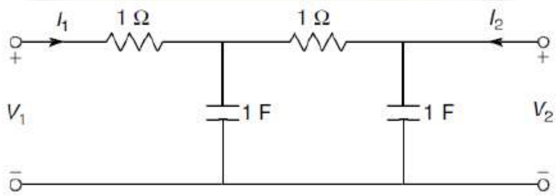
18. Find the network functions $\frac{V_1}{I_1}$, $\frac{V_2}{V_1}$ and $\frac{V_2}{I_1}$ of the following network. (14)



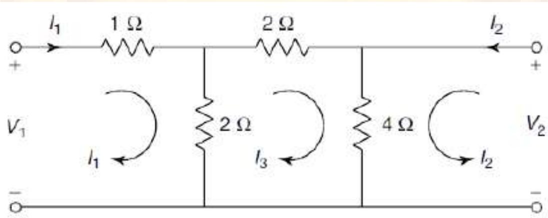
Module V

19.

a) Obtain the admittance parameters for the network. (7)



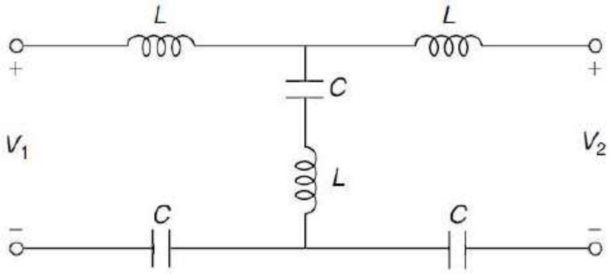
b) Determine h parameters for the network. Determine whether the network is reciprocal. (7)



20.

a) Show that when 2 two-port networks are connected in series, the resultant Z-matrix is the sum of Z-matrices of each individual network. (6)

b) Find the open circuit impedance parameters of the following circuit using the concept of series interconnection of two-port networks.. (8)



B24HU2T01	BUSINESS ECONOMICS AND FINANCIAL MANAGEMENT	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		3	0	0	3	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	PO 12
CO 1	1	1	1	1	1	1					1	1
CO 2	1	1	1	1	1	1					1	1
CO 3	1	1	1	1	1	1	1				2	1
CO 4	1	1	1	1	1	2		1	1		2	2
CO 5	1	1	1	1	2	2		1	1		2	2

Assessment Pattern

Bloom's Category	**Continuous Assessment**		**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	15 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 one is to be answered. Each question carries 14 marks and can have maximum of two subdivisions.

SYLLABUS

MODULE 1 (8 hours)

Fundamentals of Business Economics

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 (7 hours)

Cost, Revenue and Markets

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 (7 hours)

National Income, Inflation and International Trade

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 (7 hours)

Fundamentals of Financial Management

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 (7 hours)

Business Financing

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 Leaning India, 2022.
3. Prasanna Chandra, *Financial Management*, McGraw Hill, 2020.

Reference Books

1. Paul A. Samuelson, *Economics*, McGraw Hill, 2019.
2. A. Koutsoyiannis, *Modern microeconomics*, Palgrave McMillan, 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 Leaning India, 2020.
8. James C. Van Horne, *Financial Management and Policy*, Pearson Education, 2020.

COURSE CONTENTS AND LECTURE SCHEDULE

No.	Topic	No of Lecture/Tutorial Hours
	Total Hours	36 Hours
	Module 1: Fundamentals of Business Economics	**8**
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	
	Module 2: Cost, Revenue and Markets	**7**
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	
	Module 3: National Income, Inflation and International Trade	**7**
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	
	Module 4: Financial Management	**7**
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.	
	Module 5: Business Financing	**7**
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	

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1)

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 (CO 2)

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 (CO 3)

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 (CO 4)

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 (CO 5)

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 ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

FOURTH SEMESTER B.TECH DEGREE EXAMINATION, MAY 2026

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.

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 = 30 L1/2K1/2, 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. 50000 per month, the quantity demanded of a good was 100 units. When his income increased to Rs.80000, his demand increased to 110 units. Is the good a normal or an inferior one? Give reason. (7 marks)

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 firms 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. 100000. Its fixed cost is Rs. 20000, while its variable cost is Rs.50000. 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.20000. (7 marks)

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,
(a) Gross National Product = Rs 14700 crores
(b) GST = Rs 1100 crores
(c) Undisbursed Profit = Rs 2000 crores
(d) Corporate Income Tax = Rs 1000 crores
(e) Depreciation = Rs 1500 crores
(f) Net Factor Income from abroad = Rs 5200 crores
(g) Income Tax = Rs 500 crores
(h) Subsidies = Rs 400 crores
(i) 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 2000 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)

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)

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)

B24EC2L03	LOGIC CIRCUIT DESIGN LAB	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		0	0	3	3	2	2024

Preamble

This course aims to expose students to digital logic design by having them model digital circuits using LTSpice and construct logic circuits using fundamental logic gates and ICs.

Prerequisite

B24EC1T03 : LOGIC CIRCUIT DESIGN

Course Outcomes

After the completion of the course the student will be able to

CO 1	Design and demonstrate the functioning of various combinational circuits using ICs. [Understand, Apply]
CO 2	Design and demonstrate the functioning of various sequential circuits using ICs. [Understand, Apply]
CO 3	Familiarize simulation of circuits by Implementing digital circuits using LTSpice. [Apply]
CO 4	Function effectively as an individual and in a team to accomplish the given task. [Understand]

Mapping of Course Outcomes With Program Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO 1	3	3	3	2	1					1		1
CO 2	3	3	3	2	1					1		1
CO 3	3	1	3	2	3					1		1
CO 4									3	2	1	3

Mark Distribution

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

Continuous Internal Evaluation Pattern

Attendance	10 marks
Continuous Assessment	20 marks
Internal Test	15 marks
Lab Record	5 marks

End semester Examination pattern

Preliminary Work	30 marks
Performance and Implementation	20 marks
Result and Inference	30 marks
Viva	20 marks

SYLLABUS

LIST OF EXPERIMENTS

It is compulsory to conduct a minimum of 6 experiments from Part A and a minimum of 4 experiments from Part B.

PART A(Any 6)

1	Realization of functions using basic and universal gates (SOP and POS forms).
2	Design and Realization of half/full adder and subtractor using basic gates and universal gates.
3	4 bit adder/subtractor and BCD adder using 74283(4-bit Full Adder IC).
4	Realization of combinational circuits using MUX DEMUX ICs.
5	Study of Flip Flops: S-R, D, T, JK and Master Slave JK FF using NAND gates.
6	Asynchronous Counter:3 bit up/down counter ,Realization of Mod N counter.
7	Synchronous Counter: Realization of 3-bit up/down counter,Realization of Mod-N counters.
8	Ring counter and Johnson Counter. (using FF or 74194 ic(4 bit parallel access shift register).
9	Realization of counters using counter IC's and show the output using 7-segment display
10	Random Sequence generator using LFSR(linear-feedback shift register).

PART B(Any 4)

1	Adders in LTSpice (a) Development of half adder, full adder,half subtractor and full subtractor using LTSpice.

2	MUX and DEMUX in LTSpice (a) Development of a 8x1 MUX and 1x8 DEMUX using LTSpice. (b) Realize the logic function f (A, B, C) = $\sum m(0,1,3,7), f(A,B,C,D) = \sum m(0,1,3,7,10,12)$ by partitioning the truth table and full adder using 8:1 MUX.
3	Flip-Flop Conversion using LTSpice. (a) Implement and test the conversions such as T to D, D to T, J-K to T and J-K to D.
4	Counters and Random Sequence Generator (a) Development of binary decade counter using LTSpice. (b) Development of Random Sequence Generator using LTSpice.
5	Universal Shift Register using LTSpice (a) Development of a 4-bit universal shift register using D-flip-flops. (b)Development of 4-bit Ring and Johnson counters using JK-flip-flops.
6	BCD to Seven Segment Decoder using LTSpice. (a) Make a gate level design of a seven segment decoder and test it with seven segment display using LTSpice.

Reference Books

1. Digital design. Mano M. Morris, India: Prentice Hall.
2. Digital Electronics,G. K. Kharate,OUP India.
3. Digital Fundamentals,Thomas L Floyd,Pearson India.

B24EC2L04	ELECTRONIC CIRCUITS LAB	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		0	0	3	3	2	2024

Preamble

The Electronic Circuits Lab is designed to provide hands-on experience with the analysis, design, and implementation of MOSFET-based circuits and power amplifiers.By the end of the lab sessions, students will develop practical skills in circuit design, testing, and simulation, reinforcing theoretical knowledge essential for careers in analog electronics, VLSI design, and related fields.

Prerequisite

B24EC1T04 : Analog Circuit I

Course Outcomes

After the completion of the course the student will be able to

CO 1	Understand and analyze the operation of MOSFETs. [Understand, Analyze]
CO 2	Utilize MOSFETs in switching and resistive applications.[Apply]
CO 3	Design and analyze MOSFET biasing and amplifier circuits [Apply]
CO 4	Analyze and simulate MOSFET-based differential amplifiers, cascode amplifiers, and current mirrors. [Apply,Analyze]
CO 5	Simulate and analyze the efficiency of a Class AB amplifier using BJTs

Mapping of Course Outcomes With Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	3	3									1
CO 2	3	3	1									1
CO 3	3	3	3	1	2							1
CO 4	3	3	1	1	2							1
CO 5	3	3	3	1	2							1

Mark Distribution

Continuous Internal Evaluation Pattern

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

Attendance 10 marks
Continuous Assessment 20 marks
Internal Test 15 marks
Lab Record 5 marks

End semester Examination pattern

Preliminary Work 30 marks
Performance and Implementation 20 marks
Result and Inference 30 marks
Viva 20 marks

SYLLABUS

LIST OF EXPERIMENTS

Any three experiments among this must be done in hardware.

1	Study the I-V characteristics of an N-channel MOSFET and plot the drain current (I_D) vs. drain-source voltage (V_{DS}) for different gate-source voltages (V_{GS}).
2	Design and analyze the Q-point of a MOSFET with fixed biasing.
3	Design and analyze a MOSFET as a switch.
4	Analyze a MOSFET operating as an active resistor.
5	Study the operation of a simple MOSFET current mirror.
6	Design and analyze a common-source amplifier and plot the Frequency Response.
7	Design and set up a source follower(Common Drain) circuit for voltage buffering and signal amplification.
8	Implement and evaluate a MOS differential amplifier, study its transfer characteristics, and measure differential gain, common-mode gain, and common-mode rejection ratio (CMRR).
9	Design and Simulate Cascode Amplifier (MOS CS-CG Configuration) .
10	Simulate a Class AB amplifier using BJT and analyze its efficiency

Reference Books

1. Adel S. Sedra and Kenneth C. Smith ”Microelectronic Circuits”

2. Behzad Razavi,Design of Analog CMOS Integrated Circuits

3. Phillip E. Allen and Douglas R. Holberg,CMOS Analog Circuit Design.

4. Robert L. Boylestad and Louis Nashelsky, Electronic Devices and Circuit Theory

B24MC2T04	UNIVERSAL HUMAN VALUES AND CONSTITUTIONAL RIGHTS	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		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	PO 12
CO 1						2	1	2	1	1	1	2
CO 2						2	2	2	2	1	1	2
CO 3						2	2	2		2		2
CO 4						2	2	2		2		2

Assessment Pattern

Bloom's Category	**Continuous Assessment**	**End Semester Examination (% Marks)**
	Test 1 (% Marks)	
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 (1 number) 25 marks
(Conducted for 50 marks and reduced to 25)
Assignments/Quiz/Course Project/Seminar 15 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 (6 hours)

Introduction to Values

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 (5 hours)

Harmony in the Human Being, Family and Society

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 (5 hours)

Introduction to Constitution of India

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 (8 hours)

State Policies and Fundamental Rights

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. R R Gaur, R Asthana, G P Bagaria, *A Foundation Course in Human Values and Professional Ethics*, Excel Books, New Delhi, 3rd ed., 2023.

2. R R Gaur, R Asthana, G P Bagaria, *The Teacher's Manual for a Foundation Course in Human Values and Professional Ethics*, Excel Books, New Delhi, 3rd ed., 2023.

3. D D Basu, *Introduction to the constitution of India*, Lexis Nexis,New Delhi, 26th ed., 2022.

4. P M Bhakshi, *The constitution of India*, Universal Law, 19th ed., 2023.

Reference Books

1. M Govindarajan, S Natarajan and V S Senthil Kumar, *Engineering Ethics*, PHI Learning Private Ltd, 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,. Hayt W. H., Kemmerly J. E., and Durbin S. M., *The constitution of India*, Govt of India, New Delhi, 2019.

4. J N Pandey, *The constitutional Law of India*, Central Law Agency, Allahabad, 51th ed., 2019.

5. M V Pylee, *Indias Constitution*, S Chand and Company, New Delhi, 16th ed., 2016.

COURSE CONTENTS AND LECTURE SCHEDULE

No.	Topic	No of Lecture/Tutorial Hours
	Module 1: Introduction to Values	**6**
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
	Module 2: Harmony in the Human Being, Family and Society	**5**
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
	Module 3:Introduction to Constitution of India	**5**
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
	Module 4: State Policies and Fundamental Rights	**8**
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
	Total Hours	**24 Hours**

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1)

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 (CO 2)

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 (CO 3)

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 (CO 4)

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, DECEMBER 2025

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 (I1) and another Self '. 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)

B24MC2T05	ENERGY CONSERVATION AND ENVIRONMENTAL SUSTAINABILITY	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		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	PO 12
CO 1	2					2	3	1		1		2
CO 2	2					2	3	1		1		2
CO 3	2					2	3	1		1		3
CO 4	2					3	3	1		1		3

Assessment Pattern

Bloom's Category	**Continuous Assessment**	**End Semester Examination (% Marks)**
	Test 1 (% Marks)	
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 (1 number) 25 marks
(Conducted for 50 marks and reduced to 25)
Assignment/Quiz/Course Project/Seminar 15 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 one has 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 (6 hours)

Energy Resources and Conservation

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 (6 hours)

Renewable Energy Technologies

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 (6 hours)

Environmental Impact and Pollution Control

Pollution Types and Sources: Air pollution: industrial emissions, vehicular sources - Water pollution: domestic, industrial, agricultural waste - Soil pollution: hazardous waste, agrochemicals, 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 (6 hours)

Sustainability and Green Practices

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.

Text Books and References

1. Charles M. Gottschalk, *Industrial Energy Conservation*, John Wiley & Sons, 1996.
2. G. D. Rai, *Non-Conventional Energy Sources*, Khanna Publishers.
3. R. R. Rao, *Environmental Science and Engineering*, PHI.
4. Craig B. Smith, *Energy Management Principles*, Pergamon Press.
5. Paul O'Callaghan, *Energy Management*, McGraw Hill Book Co.
6. Wayne C. Turner, *Energy Management Hand Book*, The Fairmount Press, Inc., 1997.
7. Allen, D. T. and Shonnard, D. R., *Sustainability Engineering: Concepts, Design and Case Studies*, Prentice Hall.
8. Bradley, A. S, Adebayo, A. O., Maria, P., *Engineering applications in sustainable design and development*, Cengage learning.

COURSE CONTENTS AND LECTURE SCHEDULE

No.	Topic	No of Lecture/Tutorial Hours
	Module 1: Energy Resources and Conservation	**6**
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 and technological interventions	1
1.3	Energy Policy and Planning: National Energy Policy, Energy Conservation Act, BEE initiatives	1
1.4	Energy Auditing: Preliminary and Detailed audits, Performance Indicators, Case Studies	2
1.5	Energy-efficient Buildings and Smart Cities: Passive design, daylighting, automation	1
	Module 2: Renewable Energy Technologies	**6**
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
	Module 3: Environmental Impact and Pollution Control	**6**
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
	Module 4: Sustainability and Green Practices	**6**
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 Hours	**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 ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

THIRD SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2025

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 any one 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)

B24ECM31	ELECTRONIC CIRCUITS (Minor)	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		3	1	0	3	4	2024

Preamble

This course aims to develop the skill for the design of various analog circuits.

Prerequisites

B24ES1T02 : Basics of Electrical and Electronics Engineering.
B24ES1T08 : Fundamentals of Electronics Engineering.

Course Outcomes

After the completion of the course the student will be able to:

CO 1	Realize simple circuits using diodes, resistors and capacitors. [Understand , Apply]
CO 2	Design amplifier and oscillator circuits. [Apply, Analyze]
CO 3	Design power supplies, D/A and A/D converters for various applications. [Apply, Analyze]
CO 4	Design and analyze circuits using opertational amplifiers. [Apply, Analyze]
CO 5	Design and analyze circuits using Digital to Analog converters and Analog to Digital Converters. [Apply, 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	PO 12
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

Assessment Pattern

Mark Distribution

Bloom's Category	Continuous Assessment		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			

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/Class work	15 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-division.

SYLLABUS

MODULE 1

Wave shaping circuits: Sinusoidal and non-sinusoidal wave shapes, Principle and working of RC differentiating and integrating circuits, Clipping circuits - Positive, negative and biased clipper. Clamping circuits - Positive, negative and biased clamper.
Transistor biasing: Introduction, operating point, concept of load line, thermal stability (derivation not required), fixed bias, self bias, voltage divider bias.

MODULE 2

MOSFET: Structure, Enhancement and depletion types, principle of operation and characteristics
Amplifiers: Classification of amplifiers, RC coupled amplifier-design and working, voltage gain and frequency response. Multistage amplifiers - effect of cascading on gain and bandwidth.
Feedback in amplifiers-Effect of negative feedback on amplifiers. MOSFET Amplifiers-Circuit diagram, design and working of common source MOSFET amplifier.

MODULE 3

Oscillators: Classification, criterion for oscillation, Wien bridge oscillator, Hartley and Crystal oscillator. (design equations and working of the circuits;analysis not required).
Regulated Power supplies: Review of simple zener voltage regulator, series voltage regulator, 3 pin regulators-78XX and 79XX, DC to DC conversion, Circuit/block diagram and working of SMPS.

MODULE 4

Operational Amplifiers: Characteristics of Op-Amps(gain, bandwidth, slewrate, CMRR, offset voltage, offset current), comparison of ideal and practical op-amp(IC741), applications of op-amp-scale changer, sign changer, adder/summing amplifier, subtractor, integrator, differentiator, comparator, instrumentation amplifier.

MODULE 5

Integrated circuits:D/A and A/D converters - important specifications, Sample and hold circuit, R-2R ladder type D/A converters. Flash and sigma-delta type A/D Converters.

Circuit diagram and working of Timer IC555, astable and monostable multivibrators using IC555

Text Books
1. Robert Boylestad and L Nashelsky, Electronic Devices and Circuit Theory, Pearson, 2015.
2. Salivahanan S. and V. S. K. Bhaaskaran, Linear Integrated Circuits, Tata McGraw Hill, 2008

Reference Books
1. David A Bell, Electronic Devices and Circuits, Oxford University Press, 2008.

2.Neamen D., Electronic Circuits, Analysis and Design, 3/e, TMH, 2007

3.Millman J. and C. Halkias, Integrated Electronics, 2/e, McGraw-Hill, 2010.

4.Op-Amp and Linear Integrated Circuits, Ramakant A Gayakwad, PHI, 2000.

5.K. Gopakumar, Design and Analysis of Electronic Circuits, Phasor Books, Kollam, 2013.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Topic	No of Lecture/Tutorial Hours
	Module 1	**9**
1.1	Sinusoidal and non-sinusoidal wave shape.	1
1.2	Principle and working of RC differentiating and integrating circuits.	2
1.3	Clipping circuits - Positive, negative and biased clipper.	2
1.4	Clamping circuits - Positive, negative and biased clamper.	2
1.5	Introduction, operating point, concept of load line, thermal stability, fixed bias, self bias, voltage divider bias..	2
	Module 2	**9**
2.1	MOSFET-Structure, Enhancement and depletion types, principle of operation and characteristics	2
2.2	Amplifiers-Classification of amplifiers, RC coupled amplifier-design and working, voltage gain and frequency response.	3
2.3	Multistage amplifiers - effect of cascading on gain and bandwidth.	1
2.4	Feedback in amplifiers-Effect of negative feedback on amplifiers.	1
2.5	MOSFET Amplifiers-Circuit diagram, design and working of common source MOSFET amplifier.	2
	Module 3	**9**
3.1	Oscillators - Classification, criterion for oscillation.	1
3.2	Wien bridge oscillator, Hartley and Crystal oscillator.	3
3.3	Regulated Power Supplies-Review of simple zener voltage regulator, series voltage regulator.	3
3.4	3 pin regulators-78XX and 79XX,	1
3.5	DC to DC conversion, Circuit/block diagram and working of SMPS.	1
	Module 4	**10**
4.1	Operational Amplifiers	2
4.2	Characteristics of Op-Amps(gain,bandwidth,slewrate,CMRR, offset voltage, offset current), comparison of ideal and practical op-amp(IC741).	2
4.3	applications of op-amp-scale changer, sign changer, adder/-summing amplifier, subtractor, integrator, differentiator.	3
4.4	Comparator, instrumentation amplifier.	3
	Module 5	**8**
5.1	Integrated Circuits- D/A and A/D converters - important specifications, Sample and hold circuit.	1
5.2	R-2R ladder type D/A converters.	2

5.3	Flash and sigma-delta type A/D Converters.	2
5.4	Circuit diagram and working of Timer IC555, astable and monostable multivibrators using IC555	3
	Total Hours	**45 Hours**

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1): Realize simple circuits using diodes, resistors and capacitors

1. For the given specification design a differentiator and integrator circuit.
2. For the given input waveform and circuit, draw the output waveform and transfer characteristics.
3. Explain the working of RC differentiator and integrator circuits and sketch the output waveform for different time periods.

Course Outcome 2 (CO 2): Design amplifier and oscillator circuits.

1. For the given transistor biasing circuit, determine the resistor values, biasing currents and voltages.
2. Explain the construction, principle of operation and characteristics of MOSFETs.
3. Design a RC coupled amplifier for a given gain.
4. Design a Hartley oscillator to generate a given frequency.

Course Outcome 3 (CO 3): Design Power supplies, D/A and A/D converters for various applications.

1. Design a series voltage regulator.
2. For the regulator circuit, find the output voltage and current through the zener diode.
3. In a 10 bit DAC, for a given reference voltage, find the analog output for the given digital input.

Course Outcome 4 (CO 4):Design circuits using operational amplifiers for various applications

1. For the given difference amplifier, find the output voltage.
2. Derive the expression for frequencyof oscillation of Wien bridge oscillator using op-amp.
3. Realize a summing amplifier to obtain a given output voltage.

Course Outcome 5 (CO 5):Design and analyze circuits using Digital to Analog converters and Analog to Digital Converters.

1. In a 10 bit DAC, for a given reference voltage, find the analog output for the given digital input.
2. Design a square wave circuit with 50% duty cycle using IC555.

MODEL QUESTION PAPER

QP CODE: **Pages: 5**

Reg.No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

THIRD SEMESTER B TECH DEGREE (MINOR) EXAMINATION, DECEMBER 2025

Course Code: B24ECM31

Course Name: ELECTRONIC CIRCUITS

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks

1. Design a negative biased clamper circuit and draw the transfer characteristics.
2. Give the importance of biasing in transistors. Mention significance of operating points.
3. What is line regulation and load regulation in the context of a voltage regulator? Explain with equation for percentage of regulation.
4. Compare the features of FET with BJT.
5. What is the effect of cascading in gain and bandwidth of amplifier?
6. Discuss about simple zener shunt voltage regulator.
7. Realize a circuit to obtain $V_O = -2V_1 + 3V_2 + 4V_3$ using operational amplifier. Use minimum value of resistance as 10 $K\Omega$.
8. Design a monostable multivibrator using IC555 timer for a pulse period of 1ms.
9. Describe the working of a Flashtype A/D Converter, with example.
10. Define i) Slew rate ii) CMRR iii) Offset voltage and current

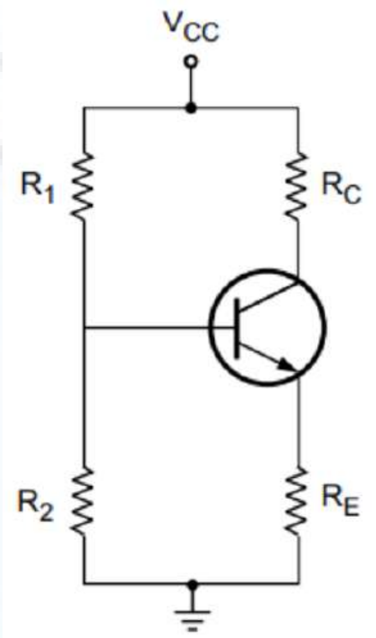
PART B

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

Module I

11. a) Define a differentiator circuit for a square wave signal with $V_{pp} = 10$ and frequency $10KHz$ (5)

    b) Consider a self biasing circuit shown in figure below with $V_{cc} = 20V$, $R_c = 1.5K\Omega$, which is operated at Q-point ($V_{cc} = 8V, I_C = 4mA$, if $h_{fe} = 100$, find $R_1, R_2, and R_e$. Assume $V_{BE} = 0.7V$ (9)



12. Explain the working of a RC differentiator circuit for a square wave input with period T. Sketch its output waveform for $RC > T$, $RC < T$ and $RC = T$. (14)

Module II

13. a) With neat sketches, explain the construction, principle of operation and characteristics of a N-Channel enhancement MOSFET. (9)

    b) Draw the circuit of an RC coupled amplifier and explain the functions of each element. (5)

14. a) Draw the circuit of a common source amplifier using MOSFET. Derive the expressions for voltage gain and input resistance. (9)

    b) Sketch the frequency response of a RC coupled amplifier write the reasons for gain reduction in both the ends. (5)

Module III

15. a) Design a Hartley oscillator to generate a frequency of $150KHz$ (5)

    b) Draw the circuit of a series voltage regulator. Explain its working when the input voltage and the load current vary. Design a circuit to deliver 5V, 100mA maximum load current. (9)

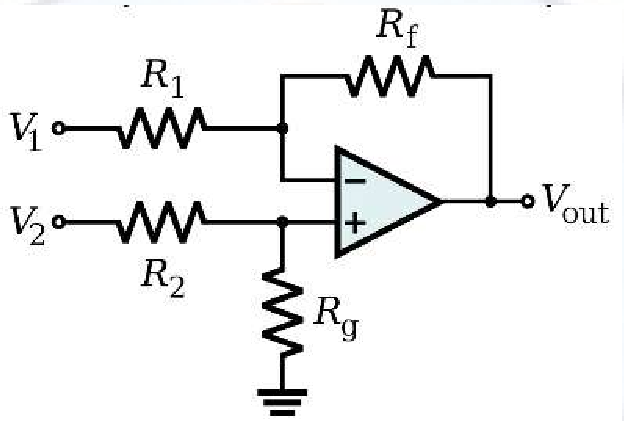
16. a) With neat diagram and equations explain the working of a Wien bridge oscillator using BJT.
.
(7)

b) Derive the expression for the frequency of oscillation of Wien bridge oscillator using BJT. (7)

Module IV

17. a) With circuit, relevant equations and waveforms, explain the working of a Schmit trigger using op-amp (9)

b) The difference amplifier shown in the figure have $R_1 = R_2 = 5K\Omega$, $F_f = 10K\Omega$, $R_g = 1K\Omega$. Calculate the output voltage (5)



18. a) With the circuits and equations show that an op-amp can act as an integrator, differentiator, adder and substractor. (9)

b) what do you mean by differential amplifier? With neat sketches explain the working of an open loop op-amp differential amplifier. (5)

Module V

19. a) Explain the working of an R-2R ladder type DAC. In a 10-bit DAC, reference voltage is given as 15V. Find analog output for digital input of 1011011001. (10)

b) With neat diagram explain the working of IC555 timer. (4)

20. a) Design an astable multivibrator using IC555 timer for a frequency of 1KHz and a duty cycle of 70%. Assume $c = 0.1\mu F$ (7)

b) Draw and explain sample and hold circuit and explain the necessity of this circuit in ADC. (7)

B24ECM32	ANALOG COMMUNICATION (Minor)	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		3	1	0	3	4	2024

Preamble

The course is designed to provide a comprehensive understanding of analog modulation techniques and their practical implementations. It focuses on two primary objectives: first, to explore the principles and applications of two key analog modulation schemes—amplitude modulation (AM) and frequency modulation (FM)—and second, to examine the design and functionality of transmitter and receiver systems employed in AM and FM communication. Through this study, students will gain insight into the foundational concepts of analog communication and the technical frameworks that enable effective signal transmission and reception.

Prerequisites

Nil

Course Outcomes

After the completion of the course the student will be able to:

CO 1	Describe the key components of a communication system and their roles in the process [Understand].
CO 2	Identify different sources of noise in a communication system and explain how they impact signal quality.[Understand]
CO 3	Demonstrate how amplitude modulation and its variants are implemented for a sinusoidal message signal.[Apply]
CO 4	Illustrate the application of frequency modulation and its variants to a sinusoidal message signal.[Apply]
CO 5	Outline the different transmitter and receiver systems used in AM and FM, and compare their features.[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	PO 12
CO 1	3	3										
CO 2	3	3										
CO 3	3	3										
CO 4	3	3										
CO 5	3	3										

Assessment Pattern

Bloom's 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/Class work	15 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-division.

CO Assessment Questions

Course Outcome 1 (CO1): Explain various components of a communication system

1. What is the need of a modulator in a radio communication system.
2. What are the various frequency bands used in radio communication
3. Why base band communication is infeasible for terrestrial air transmission?

Course Outcome 2 (CO2): Discuss various sources of noise, and its effect in a communication system.

1. What is thermal noise?
2. Describe the noise voltage generated across resistor.
3. Why is it that noise voltage cannot be used as a source for power?

Course Outcome 3 (CO3): Explain amplitude modulation and its variants for a sinusoidal message.

1. Write down the equation for an AM wave for a sinusoidal message.
2. What is the significance of modulation index?
3. Describe envelope detector.

Course Outcome 4 (CO4): Explain frequency modulation and its variants for a sinusoidal message

1. How is practical bandwidth for an FM wave determined?
2. What are the value of frequency deviation, bandwidth for a typical FM station?
3. What is PLL?

Course Outcome 5 (CO5): List and compare various transmitter and receiver systems of AM and FM

1. Draw the block diagram of a super heterodyne receiver.
2. How is adjacent channel rejection achieved in superhet? How is image rejection achieved in a superhet?
3. Explain the working principle of one FM generator, and one FM demodulator.

Syllabus

MODULE I

Introduction, Elements of communication systems, Examples of analog communication systems, Frequency bands, Need for modulation. Noise in communication system, Definitions of Thermal noise (white noise), Various types of noise – Shot noise, Partition noise, Flicker noise, Burst noise, (No analysis required) Signal to noise ratio, Noise factor, Noise temperature, Narrow band noise.

MODULE II

Brief overview of signals and systems – Signals, Classification of signals, Energy and power of signals, Basic signal operations, Impulse function, Properties of impulse function, Convolution, LTI system, Fourier Transform, Basic properties, Using Fourier transform to study LTI system.

MODULE III

Amplitude modulation (AM), Double-side band suppressed carrier (DSB-SC) modulation Single sideband modulation (SSB) – spectrum, power, efficiency of all the three variants. (Study of only tone modulation in DSB-SC, AM, and SSB.) Amplitude-modulator implementations – switching modulator, balanced modulator. AM demodulators – Coherent demodulator. Envelope detector.

MODULE IV

Frequency modulation – modulation index, frequency deviation, average power, spectrum of tone modulated FM. Heuristics for bandwidth of FM. Narrow band FM and wide-band FM. FM generation: Varactor diode modulator, Armstrong's method. FM demodulation – slope detection, PLL demodulator.

MODULE V

Super heterodyne receiver, Principle of Carrier synchronization using PLL, NTSC Television broadcasting.

Text Books

1. Kennedy, Davis, “Electronic Communication Systems,” 4th Edition, Tata McGra

2. Wayne Tomasi, “Electronic Communication Systems – Fundamentals through Advanced,”5th edition, Pearson.

3. B. P. Lathi, Zhi Ding, Modern Digital and Analog Communication Systems, 4th edition, Oxford University Press.

Reference Books

1. Leon W. Couch, Digital and Analog Communication Systems, 8th edition, Prentice Hall

COURSE CONTENTS AND LECTURE SCHEDULE

No	Topic	No of Lecture/Tutorial Hours
	Module I	**8**
1.1	Introduction, Elements of communication systems, Examples of analog communication systems, Frequency bands, Need for modulation	3
1.2	Noise in communication system, Definitions of Thermal noise (white noise), Shot noise, Partition noise, Flicker noise, Burst noise, (No analysis required) Signal to noise ratio, Noise factor, Noise temperature, Narrow band noise.	5
	Module II	**13**
2.1	Brief Overview of Signals and Systems: Signals, Classification of signals, Energy and power of signals, Basic signal operations	4
2.2	Impulse function, Properties of impulse function, Convolution,	2
2.3	Definition of Linear time-invariant system. Input-output relation of LTI system	2
2.4	Definition of Fourier Transforms, Some Properties of Fourier Transform – Linearity, Time-shift, Modulation theorem, Parsevals theorem. Using Fourier Transform to study LTI systems.	5
	Module III	**9**
3.1	Amplitude modulation (AM) – modulation index, spectrum,power, efficiency.	2
3.2	Double-side band suppressed carrier (DSB-SC) modulation –spectrum, power, efficiency.	1
3.3	Single sideband modulation (SSB) – spectrum, power, efficiency. (Study of only tone modulation in DSB-SC, AM, and SSB.)	1
3.4	Amplitude-modulator implementations – switching modulator, balanced modulator (at block diagram level).	2
3.5	AM demodulators – Coherent demodulator. Envelope detector.	3
	Module 4	**9**
4.1	Frequency modulation – modulation index, frequency deviation, average power, spectrum of tone modulated FM	4
4.2	Heuristics for bandwidth of FM. Narrow band FM and wide-band FM.	1
4.3	FM generation: Varactor diode modulator, Armstrongs method. FM demodulation – slope detection, PLL demodulator.	4
	Module V	**6**

5.1	Receivers for AM/FM: Super heterodyne receiver (block diagram)	1
5.2	Adjacent channel selectivity, Image rejection, Double conversion.	2
5.3	Carrier Synchronization using PLL	1
5.4	NTSC Television broadcasting using AM, FM radio broadcasting.	2

Model Question Paper

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

THIRD SEMESTER BTECH DEGREE (MINOR) EXAMINATION DECEMBER 2024

Course Code:B24ECM32

Course Name:ANALOG COMMUNICATION

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions, each carries 3 marks

1. Explain the need for modulation. (3)
2. A receiver connected to an antenna whose resistance is 50 ohm has an equivalent noise resistance of 30 ohm. Calculate receiver noise figure in decibels & its equivalent noise temperature? (3)
3. Plot the signal $x(t) = u(t + 1) + 2u(t) - u(t - 3)$. (3)
4. State Parseval's theorem for DTFT. What is its significance? (3)
5. Define amplitude modulation? Give the frequency spectrum for AM wave? (3)
6. Derive the expression for total power of AM wave? (3)
7. Explain the following terms: (a) Modulation index (b) Instantaneous frequency deviation. (3)
8. Compare AM & FM systems. (3)
9. What are the advantages that the super heterodyne receiver has over the receivers? Are there any disadvantages? (3)
10. Give the limitations of NTSC systems? (3)

PART B

Answer any one full question from each module, each carries 14 marks.

Module I

11. (a) Explain the following: (i) Thermal noise (ii) Flicker noise. (6)
    (b) Explain the elements of communication systems in detail? (8)

OR

12. (a) Define the signal-to-noise ratio and noise and noise figure of a receiver? How is noise temperature related to noise figure? (8)
(b) List the basic functions of a radio transmitter & the corresponding functions of the receiver? (6)

Module II

13. (a) Distinguish between energy & power signals. Give an example for each category? (7)
(b) State and prove the linearity and time-shifting property of Fourier Transform? (7)

OR

14. (a) Check whether the systems are linear & stable: (i) $y(t) = e^{x(t)}$ (ii) $y[n] = x[n-1]$. (6)
(b) Find convolution of signal $x[n] = [1, -1, 1, 1]$ with itself? Distinguish between causal & non-causal systems with suitable examples? (8)

Module III

15. (a) Derive the expression of total power in SSB wave? (7)
(b) Describe the AM demodulation using envelope detector? (7)

OR

16. (a) Describe the DSB-SC wave generation process using balanced modulation. (9)
(b) Give the spectrum of SSB & DSB-SC waves? Make a comparison of bandwidth requirements. (5)

Module IV

17. (a) Explain the direct method of generating FM signal using a varactor diode? (7)
(b) Explain frequency modulation and its average power? (7)

OR

18. (a) Explain with relevant mathematical expressions, the demodulation of FM signal using PLL? (10)
(b) Give the spectrum of tone modulated FM? (4)

Module V

19. (a) Explain the super heterodyne receiver with a detailed block diagram? (10)
(b) Explain how the use of RF amplifier improves the NR of a super heterodyne receiver? (4)

OR

20. (a) Explain the TV broadcasting system using AM? (10)
(b) What is image frequency, and how does it arise? (4)

B24ECM33	INTRODUCTION TO SIGNALS AND SYSTEMS (Minor)	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		3	1	0	3	4	2024

Preamble

This course aims to provides the foundational principles for analyzing, processing, and understanding signals and the systems that manipulate them, essential for modern engineering applications.

Prerequisites

Nil

Course Outcomes

After the completion of the course the student will be able to:

CO 1	Classify and represent continuous-time and discrete-time signals and systems, and perform basic signal operations. [Understand , Apply]
CO 2	Model and analyze continuous-time and discrete-time systems using differential and difference equations, focusing on stability and causality. [Apply, Analyze]
CO 3	Apply Fourier series, Fourier transforms, and Laplace transforms to analyze continuous-time signals in the frequency domain, including sampling and aliasing effects. [Apply, Analyze]
CO 4	Represent and analyze discrete-time signals using Discrete Time Fourier Series (DTFS) and Discrete Time Fourier Transform (DTFT) along with their properties for spectral and frequency-domain analysis.[Apply, Analyze]
CO 5	Analyze discrete-time signals and LTI systems using Z-transform, DTFT, and their properties, including system transfer functions, magnitude, and phase responses, for comprehensive frequency-domain characterization.[Apply, 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	PO 12
CO 1	3	3	2	2	1							1
CO 2	3	3	3	2	2							1
CO 3	3	3	2	2	2							1
CO 4	3	3	3	2	2							1
CO 5	3	3	3	3	2							2

Assessment Pattern

Bloom's Category	Continuous Assessment		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	15 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-division.

SYLLABUS

MODULE 1

Basics of Signals and Systems: Elementary Signals, Classification and representation of continuous time and discrete time signals, Signal operations.- Continuous time and discrete time systems - Classification, Properties.

MODULE 2

System Representation and Analysis : Representation of systems: Differential equation representation of continuous time systems, Difference equation representation of discrete systems. Discrete time LTI systems and linear convolution,- Stability and causality of LTI systems.

MODULE 3

Frequency Domain Representation of continous time signals: . Frequency domain representation of continuous time signals-Continuous time Fourier series Continuous time fourier transform,-Laplace Transform (Basics only),Sampling and Aliasing.

MODULE 4

Frequency domain representation of discrete time signals -Discrete time fourier series and its properties.- Discrete time fourier transform (DTFT) and its properties

MODULE 5

Discrete-Time LTI System Analysis: Z transform, ROC, Inverse transform, properties, Unilateral Z transform, Relation between DTFT and Z transform, Analysis of discrete time LTI systems using Z transforms and DTFT, Transfer function, Magnitude and phase response

Text Books

1. 1. Signals and Systems: Oppenheim Alan- V- Willsky Alan. S- Pearson Edn

2. 2. Communication Systems: Haykin Simon- John Wiley

Reference Books

1.Anand Kumar, Signals and Systems, PHI, 3/e, 2013.

2. B P. Lathi, Priciples of Signal Processing & Linear systems, Oxford University Press.

3. Gurung, Signals and System, PHI.

4. Mahmood Nahvi, Signals and System, Mc Graw Hill (India), 2015.

5.P Ramakrishna Rao, Shankar Prakriya, Signals and System, MC Graw Hill Edn 2013 .

COURSE CONTENTS AND LECTURE SCHEDULE

No	Topic	No of Lecture/Tutorial Hours
	Module 1	**9**
1.1	Elementary Signals	1
1.2	Classification and representation of continuous time and discrete time signals	1
1.3	Signal operations	1
1.4	Continuous time systems-Classification, Properties	3
1.5	Discrete time systems- Classification, Properties	3
	Module 2	**9**
2.1	Differential equation representation of continuous time systems	2
2.2	Difference equation representation of discrete systems	2
2.3	Discrete time LTI systems and linear convolution	2
2.4	Stability of LTI systems	2
2.5	Causality of LTI systems	1
	Module 3	**9**
3.1	Frequency domain representation of continuous time signals	2
3.2	Continuous time Fourier series and Continuous time fourier transform	2
3.3	Laplace Transform (Basics only)	2
3.4	Sampling and Aliasing	3
	Module 4	**8**
4.1	Discrete time fourier series and its properties	4
4.2	Discrete time fourier transform (DTFT) and its properties	4
	Module 5	**10**
5.1	Z transform, ROC	2
5.2	Inverse transform, properties	2
5.3	Unilateral Z transform, Relation between DTFT and Z transform	2
5.4	Analysis of discrete time LTI systems using Z transforms and DTFT	2
5.5	Transfer function, Magnitude and phase response	2
	Total Hours	**45 Hours**

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. (a) Define and sketch the following elementary signals: i. Unit Step Signal ii. Unit Impulse Signal iii. Ramp Signal

   (b) Differentiate between continuous-time and discrete-time signals using suitable examples.

2. (a) Define and explain the classification of continuous-time systems based on the following properties with examples: i. Linearity ii. Time Invariance iii. Causality

   Course Outcome 2 (CO 2):

   (a) Evaluate the discrete-time convolution sum with required plots for the following signal

   $$y[n] = 3^n \, u[-n+3] \cdot u[n-2]$$

   (b) Determine whether the following system is static, time invariant, linear, and causal. $x(t)$ and $y(t)$ denote the input and output, respectively. Give an explanation for each.

   $$y(t) = t^2 x(t) + x(t-2)$$

   Course Outcome 3 (CO 3):

   (a) Derive the Fourier series representation of the periodic signal:

   $$x(t) = \begin{cases} 1, & 0 \le t < \frac{T}{2}, \\ -1, & \frac{T}{2} \le t < T, \end{cases}$$

   where T is the period.

   (b) Derive the Fourier transform of the signal:

   $$x(t) = e^{-at} u(t),$$

   where $a > 0$ and $u(t)$ is the unit step function.

   (c) A signal

   $$x(t) = \cos(2000\pi t)$$

   is sampled at a rate of 800 Hz. Determine whether aliasing occurs.

   Course Outcome 4 (CO 4):

(a) A periodic signal $x[n]$ is given as:

$$x[n] = \begin{cases} 1 & \text{if } n = 0, 1, 2, \\ 0 & \text{otherwise.} \end{cases}$$

Compute its Discrete-Time Fourier Series (DTFS) coefficients.

(b) A signal $x[n] = 0.5^n u[n]$ is given, where $u[n]$ is the unit step function. Compute its Discrete-Time Fourier Transform (DTFT) and plot its magnitude spectrum.

Course Outcome 5 (CO 5):

(a) Given the discrete-time signal

$$x[n] = (0.5)^n u[n],$$

where $u[n]$ is the unit step function, find its Z-transform and determine the Region of Convergence (ROC). Discuss the significance of the ROC in the context of system stability.

(b) Define the unilateral Z-transform and explain how it differs from the bilateral Z-transform. Calculate the unilateral Z-transform of the following signal:

$$x[n] = u[n] - u[n-2],$$

where $u[n]$ is the unit step function.

(c) Given a system with impulse response

$$h[n] = (0.5)^n u[n],$$

where $u[n]$ is the unit step function, find the system's transfer function using the Z-transform. Also, determine its frequency response using the Discrete-Time Fourier Transform (DTFT).

(d) Find the transfer function of a discrete-time LTI system characterized by the difference equation:

$$y[n] - 0.5y[n-1] = x[n],$$

and then analyze the system's stability based on the poles of the transfer function.

MODEL QUESTION PAPER

QP CODE: **Pages: 5**

Reg.No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

THIRD SEMESTER B TECH DEGREE MINOR EXAMINATION, DECEMBER 2024

Course Code: B24ECM33

Course Name: INTRODUCTION TO SIGNALS AND SYSTEMS

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks

1 What are the differences between continuous-time and discrete-time systems in terms of their classification and properties?

2 Define and explain periodic and aperiodic signals with examples in continuous and discrete time.

3 Explain the differential equation representation of continuous-time systems and the difference equation representation of discrete-time systems.

4 Discuss the concepts of stability and causality in Linear Time-Invariant (LTI) systems. How do they affect the system's performance?

5 Define the Continuous-Time Fourier Series (CTFS). Explain how it is used to represent periodic continuous-time signals in the frequency domain.

6 What is the process of sampling? Explain the concept of aliasing and how it can affect the representation of continuous-time signals when sampled at a lower rate than the Nyquist rate.

7 Discuss the symmetry properties of the DTFS. Prove that if x[n] is real and even, then its DTFS coefficients are real and even.

8 State and prove the time-shifting property of the Discrete-Time Fourier Transform (DTFT). How does the frequency spectrum of a signal change if the signal is shifted in time?

9 Explain the relationship between the Z-transform and DTFT. How does the Z-transform reduce to the DTFT when evaluated on the unit circle?

10 State and explain the time-shifting property of the Z-transform. Illustrate it with an example.

PART B

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

Module I

11 a) Explain the operations on continuous-time signals, such as time-shifting, time-scaling, and time-reversal. Provide examples and discuss their impact on the signal. (7)

b) Explain the classification of discrete-time systems based on properties like linearity, time-invariance, causality, and stability. Provide examples and discuss their real-world applications. (7)

12 a) Discuss the concept of energy and power signals. Explain the mathematical conditions for a signal to be classified as energy or power, and provide examples for each. (7)

b) Discuss the properties of continuous-time systems (linearity, time-invariance, causality, stability, memory). Provide examples of systems that exhibit these properties. (7)

Module II

13 a) Compute the convolution of the sequences:

$$x[n] = \{1, 2, 1\}, \quad h[n] = \{1, -1, 2\}$$

(7)

b) Show that convolution is commutative for two discrete-time signals $x[n]$ and $h[n]$. That is, prove that:

$$x[n] * h[n] = h[n] * x[n]$$

(7)

14 a) Prove that an LTI system is stable if and only if the impulse response $h[n]$ is absolutely summable: (7)

$$\sum_{n=-\infty}^{\infty} |h[n]| < \infty$$

b) Determine whether the system described by the equation

$$y[n] = x[n] + x[n-1]$$

is causal and stable. (7)

Module III

15 a) Determine the Laplace Transform and express the ROC of the signal:

$$x(t) = e^{-t}u(t) + e^{-2t}u(t)$$

(7)

b) Derive the Fourier transform of the signal

$$x(t) = e^{-at}u(t)$$

where $a > 0$ and $u(t)$ is the unit step function. (7)

16 a) Explain the concept of the region of convergence (ROC) in the Laplace transform and its significance for system stability.
. (7)

b) For a bandlimited signal with maximum frequency $f_m = 5\,\text{kHz}$, determine the minimum sampling frequency required to avoid aliasing. (7)

Module IV

17 a) Discuss the linearity and time-shifting properties of the DTFT with appropriate mathematical proofs and examples. (7)

b) Explain any two properties of the DTFS and illustrate their applications with examples. (7)

18 a) Derive the Discrete-Time Fourier Series (DTFS) representation of a periodic discrete-time signal x[n]. Clearly explain the significance of each term in the DTFS equation. (7)

b) A discrete-time signal is given by

$$x[n] = e^{j\frac{2\pi n}{3}}$$

which is periodic. Using the Discrete-Time Fourier Series (DTFS), find the frequency spectrum and discuss the result. (7)

Module V

19 a) For a discrete-time system with transfer function

$$H(z) = \frac{z}{z - 0.9}$$

calculate the magnitude and phase response at $z = e^{j\omega}$. Discuss the behavior of the system in terms of its frequency response. (7)

b) List and explain at least three important properties of the Z-transform and provide examples for each. How do these properties help in simplifying the analysis of discrete-time signals? (7)

20 a) Find the inverse Z-transform of the following expression using the partial fraction method:

$$X(z) = \frac{z}{z^2 - 0.5z + 0.25}$$

(7)

b) Explain the relationship between the Discrete-Time Fourier Transform (DTFT) and the Z-transform. What is the significance of the unit circle in the Z-plane when analyzing a signal using DTFT? (7)

MAR ATHANASIUS COLLEGE OF ENGINEERING

Government Aided, Autonomous Institution, Kothamangalam, Kerala, India

B.Tech

Electronics And Communication Engineering

SEMESTER 4

SYLLABUS

SEMESTER 4

SLOT	COURSE NO.	COURSES	L-T-P-S	HOURS	CREDIT
A	B24MA2T04A	Stochastic Processes and Numerical Methods	3-1-0-3	4	4
B	B24EC2T04	Solid State Devices	3-1-0-3	4	4
C	B24EC2T05	Signals and Systems	3-1-0-3	4	4
D	B24EC2T06	Linear Integrated Circuits	3-1-0-3	4	3
E	B24HU2T02	Entrepreneurship and Management Skills for Engineers	2-1-0-2	3	3
F	B24EC2T07	FPGA Based System Design	2-1-0-2	3	3
G	B24EC2L05	Microcontroller Lab	0-0-3-3	3	2
H	B24EC2L06	HDL Lab	0-0-3-3	3	2
M	B24ECM4X	Minor	3-1-0-3	4	
N	B24ECH4X	Honors	3-1-0-3	4	
			TOTAL	**36**	**25**

MINOR

COURSE NO	Courses
B24ECM41	Microcontrollers
B24ECM42	Digital Communication
B24ECM43	Introduction To Digital Signal Processing

HONORS

COURSE NO	Courses
B24ECH41	Nano Electronics
B24ECH42	Stochastic Processes For Communication
B24ECH43	Stochastic Signal Processing

B24MA2T04A	STOCHASTIC PROCESSES AND NUMERICAL METHODS	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		3	1	0	3	4	2024

Preamble:

This course introduces students to the modern theory of probability and statistics, covering important models of random variables and analysis of random processes using appropriate time and frequency domain tools. 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	Understand the concept, properties, and important models of discrete random variables and, using them, analyse suitable random phenomena. (Cognitive Knowledge Level: Apply)
CO 2	Understand the concept, properties, and important models of continuous random variables and, using them, analyse suitable random phenomena. (Cognitive Knowledge Level: Apply)
CO 3	Analyse stochastic processes using autocorrelation, power spectrum, and understand multivariable probability distribution. (Cognitive Knowledge Level: Apply)
CO 4	Compute 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	PO 12
CO 1	3	2	1		1							1
CO 2	3	2	1		1							1
CO 3	3	2	1		1							1
CO 4	3	2	1		1							1
CO 5	3	2	1		1							1

Assessment Pattern

Bloom's Category	Continuous Assessment		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	15 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 one is to be answered. Each question carries 14 marks and can have a maximum of two subdivisions.

SYLLABUS

MODULE 1 (8 hours)

Univariate Discrete Probability Distributions

Discrete random variables and their probability distributions, expectation, mean, and variance, binomial distribution, poisson distribution, poisson approximation to the binomial distribution.

(Text 1: Relevant topics from sections 3.1-3.4, 3.6)

MODULE 2 (8 hours)

Univariate Continuous Probability Distributions

Continuous random variables and their probability distributions, expectation, mean, and variance, uniform, exponential, and normal distributions and Central limit theorem (without proof).

(Text 1: Relevant topics from sections 4.1-4.4, 3.6)

MODULE 3 (11 hours)

Bivariate Probability Distribution and Stochastic Processes

Discrete bivariate distributions, marginal distributions, independent random variables, expectation (multiple random variables). Continuous bivariate distributions, marginal distributions, independent random variables, expectation (multiple random variables), i.i.d random variables. Random processes and classification, mean and autocorrelation, wide sense stationary (WSS) processes, autocorrelation and power spectral density of WSS processes and their properties.

(Text 2 : Relevant topics from sections 8.1-8.5, 8.7, Text 1: Relevant topics from section 5.1)

MODULE 4 (9 hours)

Numerical Methods - I

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).

(Text 3: Relevant topics from sections 19.1, 19.2, 19.3, 19.5)

MODULE 5 (9 hours)

Numerical methods - II

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 3: Relevant topics from sections 20.3, 20.5, 21.1)

Text Books

1. Jay L. Devore, *Probability and Statistics for Engineering and the Sciences*, Cengage, 8th ed., 2012.

2. Oliver C. Ibe, *Fundamentals of Applied Probability and Random Processes*, Elsevier, 2005.

3. Erwin Kreyszig, *Advanced Engineering Mathematics*, John Wiley & Sons, 10th ed., 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. V. Sundarapandian, *Probability, Statistics and Queueing theory*, PHI Learning, 2009.

3. Gubner, *Probability and Random Processes for Electrical and Computer Engineers*, Cambridge University Press, 2006.

4. B. S. Grewal, *Higher Engineering Mathematics*, Khanna Publishers, 36th ed., 2010.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Topic	No of Lecture/Tutorial Hours
1	**Module 1: Univariate Discrete probability Distributions**	**8**
1.1	Discrete Probability distributions	4
1.2	Binomial distribution-mean, variance, poisson distribution-mean, variance, poisson approximation to binomial	4
2	**Module 2: Univariate Continuous Probability Distributions**	**8**
2.1	Continuous random variables and probability distributions, expected value, mean and variance	3
2.2	Uniform, exponential and normal distributions, mean and variance of these distributions	4
2.3	Central limit theorem	1
3	**Module 3: Stochastic processes**	**11**
3.1	Discrete bivariate distributions, marginal distributions, independence of random variables (discrete), expected values	2.5
3.2	Continuous bivariate distributions, marginal distributions, independent random variables, expected values	2.5
3.3	Random process - definition and classification, mean, autocorrelation	2
3.4	WSS processes its autocorrelation function and properties	2
3.5	Power spectral density	2
4	**Module 4: Numerical methods-I**	**9**
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**
5.1	Solution of linear systems - Gauss-Seidel 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	**45 Hours**

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1)

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. A random variable follows Poisson distribution such that $P(X = 0) = \frac{2}{3}P(X = 1)$ Find

   (a) P(X=1)

   (b) P(X>1)

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 (CO 2)

1. The heights of adult men in a city are normally distributed with a mean $\mu = 70$ inches and a standard deviation $\sigma = 3$ inches. What is the probability that a randomly selected man is taller than 73 inches?

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. Derive the mean and variance of uniform distribution

Course Outcome 3 (CO 3)

1. A random process $X(t)$ has a power spectral density given by

$$S_{XX}(\omega) = \begin{cases} 4 - \frac{\omega^2}{9}, & |\omega| \leq 6 \\ 0, & \text{otherwise} \end{cases}$$

   Determine the average power.

2. A random process $X(t)$ is given by $X(t) = Ycos(2\pi t)$, $t \geq 0$ where Y is a random variable that is uniformly distributed between 0 and 2. Find the expected value and auto correlation function of $X(t)$.

3. A random process $Y(t)$ is given by $Y(t) = Acos(\omega t + \phi)$ where A, ω, ϕ are independent variables. Assume that A has mean 3 and a variance of 9, ϕ is uniformly distributed between $-\pi$ and π, and ω is uniformly distributed between -6 and 6. Determine if the process is stationary in the wide sense.

Course Outcome 4 (CO 4)

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 (CO 5)

1. Solve the equations using Gauss elimination 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 $y = a + bx^2$.

MODEL QUESTION PAPER

QP CODE: **Pages: 3**

Reg.No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

FOURTH SEMESTER B.TECH DEGREE EXAMINATION, MAY 2026

Course Code: B24MA2T04A

Course Name: STOCHASTIC PROCESSES AND NUMERICAL METHODS
Common to EEE and ECE

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Determine the binomial distribution for which mean is 4 and 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 exponential distribution.
4. Find mean and variance of the Uniform distribution $f(x) = \frac{1}{10}$, $10 \leq x \leq 20$.
5. Define stationary random process. Define two types of stationary random process.
6. Write down the properties of the power spectral density.
7. Use trapezoidal rule to evaluate $\int_0^1 x^3$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. Write the normal equations for fitting the curve $y = a + bx^2$.

PART B

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

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 marks)

    (b) Suppose that 20% of all copies of a particular textbook fail a certain binding 7 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 marks)

OR

12. (a) The number of gamma rays emitted per second by a certain radioactive substance follows a Poisson distribution with mean 8. Determine the probability that (i) three particles are emitted in one second (ii) at most one particle is emitted in one second (iii) more than one particle is emitted in one second. (7 marks)

    (b) Derive the mean and variance of binomial distribution.

    (7 marks)

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 marks)

    (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 marks)

OR

14. (a) The time (in hours) required to repair a machine is exponentially distributed with mean 2. (i) What is the probability that the repairing time exceeds 2 hours? (ii) What is the conditional probability that a repair takes at least 10 hours given that its duration exceeds 9 hours? (7 marks)

    (b) The life time of a certain type of electric bulbs may be considered to follow exponential distribution with mean $50hrs$. Use central limit theorem to find the approximate probability that 100 of these electric bulbs will provide a total of more than $6000hrs$ of burning time. (7 marks)

15. (a) Verify whether X and Y are independent if $f(x, y) = 24xy$, $0 \leq X \leq 1$, $0 \leq Y \leq 1$, $X + Y \leq 1$. (7 marks)

    (b) Find the power spectral density function of the WSS process whose autocorrelation function is $e^{-\alpha\tau^2}$.

    (7 marks)

OR

16. (a) The power spectral density of a WSS process is $\dfrac{\omega^2+9}{\omega^4+5\omega^2+4}$. Find the auto-correlation function and power of the process.

(7 marks)

(b) The joint probability distribution of X and Y is given by $f(x,y) = \dfrac{2x+3y}{54}$, $X = 1,2$; $Y = 1,2,3$. Find the marginal distributions of X and Y.

(7 marks)

17. (a) Use Lagrange's interpolation formula to find $y(2)$ from the following table

X	1	3	4
Y	1	27	64

(7 marks)

(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 marks)

OR

18. (a) Evaluate $\int_0^2 xe^x dx$ using Simpson's $\frac{1}{3}$rd rule with $n = 8$. (7 marks)

(b) The positive root of the equation $x^3 + x + 1 = 0$ using Newton-Raphson method correct to 4 decimal places.

(7 marks)

19. (a) Solve by Gauss-Seidel method the following system:

$28x + 4y - z = 32$
$x + 3y + 10z = 24$
$2x + 17y + 4z = 35$

(7 marks)

(b) Fit a straight line to the points (0,2), (2,0), (3, -2) , (5, -3) using method of least squares. (7 marks)

OR

20. (a) Apply Gauss-Seidel method to solve the equations

$20x + y - 2z = 17$
$3x + 20y - z = -18$
$2x - 3y + 20z = 25$ (7 marks)

(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 marks)

B24EC2T04	SOLID STATE DEVICES	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		3	1	0	3	4	2024

Preamble

This course equip the students to understand the physics and working of solid state devices.

Prerequisites

B24PH1T01A: Engineering Physics
B24ES1T02 : Basics Of Electrical & Electronics Engineering.

Course Outcomes

After the completion of the course the student will be able to:

CO 1	Students will be able to recall the concepts of intrinsic and extrinsic semiconductors, Fermi level, and doping effects on energy band diagrams. [Remember]
CO 2	Students will be able to explain the mechanisms of carrier drift, diffusion, and the relationship between mobility, conductivity, and temperature in semiconductors. [Understand]
CO 3	Students will be able to explain PN junction basics (contact potential, biasing, ideal diode equation), metal-semiconductor contacts (current-voltage traits), and BJT operation (amplification, base width modulation). [Understand]
CO 4	Explain the concept of MOSFETs and derive the expression for drain current in MOSFETs.[Understand,Apply]
CO 5	Analyse different short channel effects due to scaling of MOSFET, special diodes.[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**	**PO 12**
CO 1	2	3	3	1								2
CO 2	1	3	3	1								2
CO 3	3	2	2		1							2
CO 4	3	2	2	1	1							2
CO 5	2	3	3	3	1							2

Assessment Pattern

Bloom's Category	Continuous Assessment		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/Class work	15 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-division.

SYLLABUS

MODULE I

Introduction to semiconductors: Elemental and compound semiconductors, Intrinsic and Extrinsic semiconductors, concept of effective mass, Fermi Dirac distribution, Fermi level, Doping & Energy band diagram, Equilibrium and steady state conditions, Density of states & Effective density of states, Equilibrium concentration of electrons and holes.
Excess carriers in semiconductors : Generation and recombination mechanisms of excess carriers (derivation not needed), quasi Fermi levels.

MODULE 2

Carrier transport in semiconductors : Drift, conductivity and mobility, variation of mobility with temperature and doping.
Charge Carrier Dynamics : Diffusion, Einstein relations, Poisson equations, Continuity equations, Current flow equations, Concept of Diffusion length. Gradient of quasi Fermi level.

MODULE 3

PN junctions : Contact potential, Electrical Field, Potential and Charge distribution at the junction, Biasing and Energy band diagrams, Ideal diode equation and its application. Metal Semiconductor contacts, Electron affinity and work function, Ohmic and Rectifying Contacts, current voltage characteristics.
Bipolar Junction Transistor : Transistor action and amplification parameters, Base width modulation.

MODULE 4

MOS Devices: Ideal MOS capacitor, band diagrams at equilibrium, accumulation, depletion and inversion, CV characteristics, threshold voltage, body effect.
MOSFET: Structure, types, Drain current equation (derive)- linear and saturation region, Drain characteristics, transfer characteristics.

MODULE 5

MOSFET scaling : Need for scaling, constant voltage scaling and constant field scaling. Sub threshold conduction in MOS.
Short channel effects : Channel length modulation, Drain Induced Barrier Lowering, Velocity Saturation, Threshold Voltage Variations and Hot Carrier Effects.
Specialized Transistor Structures: Operation of HEMT, FinFET and IGBT.
Special Diodes : Tunnel diode, Photo diode ,LED.

Text Books
1. Ben G Streetman and Sanjay Kumar Banarjee, Solid State Devices, Pearson 6/e, 2010.

2. Sung Mo Kang, CMOS Digital integrated circuits : Analysis and Design, Tata Mc GrawHill Third Edition 2002.

Reference Books
1. Neamen, Semiconductor Physics and Devices, McGraw Hill, 4/e, 2012

2. Sze S.M., Semiconductor Devices: Physics and Technology, John Wiley, 3/e, 2005

3. Pierret, Semiconductor Devices Fundamentals, Pearson, 2006

4. Sze S.M., Physics of Semiconductor Devices, John Wiley, 3/e, 2005

5. Achuthan, K N Bhat, Fundamentals of Semiconductor Devices, 1e, McGraw Hill,2015.

6. Yannis Tsividis, Operation and Modelling of the MOS Transistor, Oxford University Press.

7. Jan M.Rabaey, Anantha Chandrakasan, Borivoje Nikolic, Digital Integrated Circuits - A Design Perspective, PHI.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Topic	No of Lecture/Tutorial Hours
	Module 1	**10**
1.1	Elemental and compound semiconductors, Intrinsic and Extrinsic semiconductors, Effective mass.	2
1.2	Fermi Dirac distribution, Fermi level, Doping and Energy band diagram,	2
1.3	Equilibrium and steady state conditions, Density of states and Effective density of states	1
1.4	Equilibrium concentration of electrons and holes.	1
1.5	Excess carriers in semiconductors: Generation and recombination mechanisms of excess carriers, quasi Fermi levels.	2
1.6	TUTORIAL.	2
	Module 2	**8**
2.1	Carrier transport in semiconductors, drift, conductivity and mobility, variation of mobility with temperature and doping.	2
2.2	Diffusion equation	1
2.3	Einstein relations, Poisson equations	1
2.4	Poisson equations, Continuity equations, Current flow equations	1
2.5	Concept of diffusion length, Gradient of quasi Fermi level	1
2.6	TUTORIAL	2
	Module 3	**11**
3.1	PN junctions : Contact potential, Electrical Field, Potential and Charge distribution at the junction, Biasing and Energy band diagrams,	2
3.2	Metal Semiconductor contacts, Electron affinity and work function, Ohmic and Rectifying Contacts, current voltage characteristics.	2
3.3	Ideal diode equation and its application.	2
3.4	Bipolar junction transistor – working,, current components, Transistor action, Base width modulation.	2
3.5	Derivation of terminal currents in BJT	2
3.6	TUTORIAL	1
	Module 4	**8**
4.1	Ideal MOS capacitor, band diagrams at equilibrium, accumulation, depletion and inversion, C-V characteristics	2
4.2	Threshold voltage, body effect	1
4.3	MOSFET-structure, working, types,	2
4.4	Drain current equation (derive)- linear and saturation region, Drain characteristics, transfer characteristics	2
4.5	TUTORIAL	1

	Module 5	**11**
5.1	MOSFET scaling – need for scaling, constant voltage scaling and constant field scaling.	2
5.2	Sub threshold conduction in MOS.	1
5.3	Short channel effects- Channel length modulation, Drain Induced Barrier Lowering, Velocity Saturation, Threshold Voltage Variations and Hot Carrier Effects.	3
5.4	Non-Planar MOSFETs: Fin FET –Structure, operation and advantages	1
5.5	Operation of HEMT,Fin FET and IGBT.	2
5.6	Special Diodes : Tunnel diode, Photo diode ,LED.	2
	Total Hours	**48 Hours**

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO1): Solve for the carrier concentration inside semiconductors using the concepts of band diagram and Fermi Dirac distribution function.

1. Derive the expression for equilibrium electron and hole concentration.
2. Explain the different recombination mechanisms circuit.
3. Solve numerical problems related to carrier concentrations at equilibrium, energy band diagrams and excess carrier concentrations in semiconductors.

Course Outcome 2 (CO2) : Apply current flow equations to calculate drift and diffusion currents inside semiconductors.

1. Derive the expression for diffusion current and drift current in semiconductors.
2. Show that diffusion length is the average distance a carrier can diffuse before recombining.

Course Outcome 3 (CO3): Explain the energy band diagrams and charge distribuions in pn junction diodes,metal semiconductor junctions and bipolar junction transistors.

1. Derive ideal diode equation.
2. Derive the expression for minority carrier distribution and terminal currents in a BJT.

3. Solve numerical problems related to PN junction diode and BJT

Course Outcome 4 (CO4): Explain the concept of MOSFETs and derive the expression for drain current in MOSFETs.

1. Illustrate the working of a MOS capacitor in the three different regions of operation.
2. Explain the working of MOSFET and derive the expression for drain current.
3. Solve numerical problems related to currents and parameters associated with MOSFETs.

Course Outcome 5 (CO5): Analyse diffent short channel effects due to scaling of MOSFET, special diodes.

1. Explain the different MOSFET scaling techniques.
2. Explain the short channel effects associated with reduction in size of MOSFET.
3. Discuss some special diodes.

MODEL QUESTION PAPER

QP CODE: **Pages: 5**

Reg.No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

FOURTH SEMESTER B TECH DEGREE EXAMINATION, DECEMBER 2024

Course Code: B24EC2T04

Course Name: SOLID STATE DEVICES

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks

1. Define Fermi Dirac distribution function of semiconductor.
2. Draw the energy band diagram under equilibrium for i) Intrinsic ii)n -type iii)p-type semiconductors.
3. Distinguish between lattice scattering and ionized impurity scattering.
4. Show that diffusion length is the average length a carrier moves before recombination.
5. Derive the expression for contact potential in a PN junction diode.
6. Explain Early effect? Mention its effect on terminal currents of a BJT.
7. Derive the expression for threshold voltage of a MOSFET.
8. Explain the transfer characteristics of a MOSFET in linear and saturation regions.
9. Explain Subthreshold conduction in a MOSFET. Write the expression for Subthreshold current.
10. How does channel length modulation affect the drain characteristics of a MOSFET ?

PART B

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

Module I

11. a) Derive law of mass action (8)

    b) An n-type Si sample with $N_d = 10^5\,\text{cm}^{-3}$ is steadily illuminated such that $g_{op} = 10^{21}\,\text{EHP/cm}^3\,\text{s}$. If $\tau_n = \tau_p = 1\,\mu\text{s}$ for this excitation, calculate the separation in the Quasi-Fermi levels $(F_n - F_p)$. Draw the Energy band diagram. (6)

12. a) Explain the different types of indirect recombination mechanism in a semiconductor. How do they differ from direct recombination. (8)

    b) The Fermi level in a Silicon sample at 300 K is located at 0.4 eV below the bottom of the conduction band. The effective densities of states N_C= 2.82 X $10^{19}\ cm^{-3}$ and N_V=1.53 x $10^{19} cm^{-3}$. Determine (a) the electron and hole concentrations at 300K (b) the intrinsic carrier concentration at 400 K. (6)

Module II

13. a) Derive the expression for mobility, conductivity and Drift current density in a semiconductor. (8)

    b) A Si bar 0.1 µm long and 100 m^2 in cross-sectional area is doped with $10^{17} cm^{-3}$ phosphorus. Find the current at 300 K with 10 V applied. (b). How long will it take an average electron to drift 1 µm in pure Si at an electric field of 100 V/cm? (6)

14. a) A GaAs sample is doped so that the electron and hole drift current densities are equal in an applied electric field. Calculate the equilibrium concentration of electron and hole, the net doping and the sample resistivity at 300 K.
    Given $\mu_n = 8500\ cm^2/V_s, \mu_p = 400\ cm^2$/Vs, $n_i = 1.79$ x $10^6 cm^{-3}$. (7)

    b) Define Hall effect ? Derive the expression for carrier concentration and mobility in terms of Hall voltage. (7)

Module III

15. a) With suitable assumptions derive the expression of the ideal diode equation.Plot the minority carrier distribution across the pn junction in forward bias condition. (9)

    b) Boron is implanted into an n-type Si sample ($N_d = 10^{16} cm^{-3}$), forming an abrupt junction of square cross section with area = 2 x $10^{-3} cm^2$. Assume that the acceptor concentration in the p-type region is $N_a = 4x10^{18} cm^{-3}$. Calculate V_0, W, Q^+ and E_0 for this junction at equilibrium (300 K). (5)

16. With the aid of energy band diagrams, explain how a metal – N type Schottky contact function as rectifying and ohmic contacts. . (14)

Module IV

17. a) Starting from the fundamentals, derive the expression for drain current of a MOSFET in the two regions of operation. (8)

b) Find the maximum depletion width, minimum capacitance Ci, and threshold voltage for an ideal MOS capacitor with a 10-nm gate oxide (SiO_2) on p-type Si with $N_a = 10^{16} cm^{-3}$. (b) Include the effects of flat band voltage, assuming an n + polysilicon gate and fixed oxide charge of 5 x 10^{10} q (C/cm^2). (6)

18. a) Explain the CV characteristics of an ideal MOS capacitor. (8)

b) For a long channel n-MOSFET with W = 1V, calculate the V_G required for an $I_{D(sat.)}$ of 0.1 mA and $V_{D(sat.)}$ of 5V. Calculate the small-signal output conductance g and V the transconductance $g_{m(sat.)}$ at $V_D = 10$V. Recalculate the new ID for $(V_G - V_T) = 3$ and $V_D = 4$V. (6)

Module V

19. Explain the concept of constant field scaling. What are the advantages compared to constant voltage scaling (14)

20. With the aid of suitable diagrams explain the structure and working of a FINFET. List its advantages (14)

B24EC2T05	SIGNALS AND SYSTEMS	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		3	1	0	3	4	2024

Preamble

This course introduces signals and systems in continuous and discrete-time domains, emphasizing signal analysis and classification. Students will learn frequency-domain techniques using Fourier series, Fourier transforms, and Z-transforms, along with LTI system design and stability analysis. It prepares students for advanced topics in digital signal processing, communication, and control systems.

Prerequisites

Nil

Course Outcomes

After the completion of the course the student will be able to:

CO 1	Classify and differentiate continuous and discrete-time signals and systems based on their properties and perform basic signal operations [Remember, Understand]
CO 2	Analyze signals in the frequency domain using various transforms and evaluate their properties [Apply, Analyze]
CO 3	Evaluate the stability and causality of linear time-invariant (LTI) systems using convolution operations [Apply, Analyze]
CO 4	Apply sampling theorem to discretize continuous time signals [Apply, Analyze]
CO 5	Interpret the use of various transforms to analyze continuous and discrete time LTI systems [Understand, Apply, 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**	**PO 12**
CO 1	3	2	1	2	1							2
CO 2	3	3	2	3	1							2
CO 3	3	3	2	3	1							2
CO 4	3	2	2	2	1							2
CO 5	3	3	3	3	2							2

Assessment Pattern

Bloom's Category	Continuous Assessment		End Semester Examination (% Marks)
	Test 1 (%Marks)	Test 2 (%Marks)	
Remember	20	20	20
Understand	20	20	20
Apply	40	40	40
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/Class work	15 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-division.

SYLLABUS

MODULE 1

Classification of Signals and Systems: Elementary signals, Continuous time and Discrete time signals and systems: Step - Ramp - Pulse - Impulse - Real and Complex Exponentials - Sinusoids. Signal Transformations: Time Shifting - Time Scaling - Time Reversal - Amplitude Scaling. Classification of Signals: Continuous Time (CT) and Discrete Time (DT) Signals - Periodic & Aperiodic Signals - Deterministic & Random Signals - Energy & Power Signals-Even and Odd Signals. Classification of Systems: Continuous-Time (CT) systems and discrete-time (DT) systems - Linear & Nonlinear Systems - Time-Variant & Time-Invariant Systems - Causal & Non-Causal Systems - Stable& Unstable Systems.

MODULE 2

Frequency domain representation of continuous time signals : Continuous time Fourier series - Exponential Fourier series-representation of periodic signals. Continuous-time Fourier transform and its properties. Convergence and Gibbs phenomenon, Continuous-time Fourier transform of standard signals. Review of Laplace Transform, ROC of Transfer function, Properties of ROC, Stability and causality conditions. Relation between Fourier and Laplace transforms.

MODULE 3

Linear Time-Invariant Continuous Time Systems : Impulse Response - Convolution Integrals - Differential Equations. Analysis of LTI systems using Laplace and Fourier transforms. Concept of transfer function, frequency response, magnitude, and phase response.

MODULE 4

Frequency domain representation of discrete time signals: Baseband Signal Sampling - Sampling of continuous time signals, Sampling theorem for low pass signals, aliasing Discrete time Fourier series for discrete periodic signals. Discrete time Fourier transform (DTFT) and its properties. Z-Transforms: ROC, properties of Z-Transforms (Proof not needed) Inverse Z-Transforms.

MODULE 5

Linear Time-Invariant Discrete Time Systems : Impulse Response - Difference Equations - Convolution Sum. Relation between DTFT and Z transform, Analysis of discrete time LTI systems using Fourier and Z transforms, Transfer function. Stability and causality using the Z transform

Text Books

1. Alan V. Oppenheim and Alan Willsky, Signals and Systems, PHI, 2/e, 2015.

2. Simon Haykin, Signals & Systems, John Wiley, 2/e, 2021.

Reference Books

1.Anand Kumar, Signals and Systems, PHI, 3/e, 2013.
2. B P. Lathi, Priciples of Signal Processing & Linear systems, Oxford University Press. 2/e, 2009.
3. Mahmood Nahvi, Signals and System, Mc Graw Hill (India), 2015.
4. P Ramakrishna Rao, Shankar Prakriya, Signals and System, MC Graw Hill Edn 2013.
5. Rodger E. Ziemer, Signals & Systems - Continuous and Discrete, Pearson, 4/e, 2013.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Topic	No of Lecture/Tutorial Hours
	Module 1	**10**
1.1	Elementary signals, Continuous time and Discrete time signals and systems: Step - Ramp - Pulse - Impulse - Real and Complex Exponentials - Sinusoids	2
1.2	Signal Transformations: Time Shifting - Time Scaling - Time Reversal - Amplitude Scaling.	2
1.3	Classification of Signals: Continuous Time (CT) and Discrete Time (DT) Signals - Periodic & Aperiodic Signals - Deterministic & Random Signals - Energy & Power Signals-Even and Odd Signals	3
1.4	Classification of Systems: Continuous Time (CT) Systems and Discrete Time (DT) Systems - Linear & Nonlinear Systems - Time-Variant & Time-Invariant Systems - Causal & Non-Causal Systems - Stable & Unstable Systems	3
	Module 2	**9**
2.1	Frequency domain representation of continuous time signals- Continuous time Fourier series - Exponential Fourier series-representation of periodic signals.	2
2.2	Continuous time Fourier transform and its properties. Convergence and Gibbs phenomenon,	2
2.3	Continuous time Fourier transform of standard signals	2
2.4	Review of Laplace Transform, ROC of Transfer function, Properties of ROC, Stability and causality conditions. Relation between Fourier and Laplace transforms.	3
	Module 3	**8**
3.1	Linear Time-Invariant Continuous Time Systems-Impulse Response - Convolution Integrals - Differential Equations	3
3.2	Analysis of LTI systems using Laplace and Fourier transforms	2
3.3	Concept of transfer function, Frequency response, Magnitude and phase response.	3
	Module 4	**10**
4.1	Baseband Signal Sampling - Sampling of continuous time signals, Sampling theorem for low pass signals, aliasing	2
4.2	Discrete time Fourier series for discrete periodic signals	2
4.3	Discrete time Fourier transform (DTFT) and its properties	2
4.4	Z-Transforms: ROC, properties of Z-Transforms (Proof not needed) Inverse Z-Transforms,	4
	Module 5	**8**
5.1	Linear Time-Invariant Discrete Time Systems-Impulse Response - Difference Equations - Convolution Sum	2

5.2	**R**elation between DTFT and Z-Transform	1
5.3	Analysis of discrete time LTI systems using Fourier and Z transforms	3
5.4	Transfer function. Stability and causality using Z transform	2
	Total Hours	**45 Hours**

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Demonstrate the relationship between Unit step, Unit ramp and Unit Impulse functions
2. Sketch the signal and test whether it is causal $x(n) = u(n+5) - u(n-3) + u(n-2)$

Course Outcome 2 (CO 2):

1. Show that a square wave has only odd harmonics.
2. Find the Laplace Transform of $x(t) = e^{-2t}\left[u(t) - u(t-2)\right]$

Course Outcome 3 (CO 3):

1. Define convolution of x(t) and h(t).
2. Evaluate the discrete-time convolution sum with required plots for the following signal $y[n] = 3^n\, u[-n+3] \cdot u[n-2]$

Course Outcome 4 (CO 4):

1. What should be the minimum sampling frequency for the correct sampling of the signal $x(t) = 4\sin(2\pi t) + \cos(5\pi t + 0.1) + \cos(\pi t)$
2. Explain with the help of figures, the effect of sampling in the frequency domain

Course Outcome 5 (CO 5):

1. Give the frequency response of a first-order low pass filter. What is the 3-dB cut off frequency?
2. Obtain the transfer function and impulse response for a stable and causal system with difference equation

$$y[n] + \frac{1}{6}y[n-1] - \frac{1}{6}y[n-2] = 3x[n] - \frac{1}{6}x[n-1]$$

MODEL QUESTION PAPER

QP CODE: **Pages: 5**

Reg.No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

FOURTH SEMESTER B TECH DEGREE EXAMINATION, DECEMBER 2024

Course Code: B24EC2T05

Course Name: SIGNALS AND SYSTEMS

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks

1. Check whether the given signal $x(t) = (1 + e^{-2t})\, u(t)$ is an energy signal or power signal.

2. Check for shift invariance & linearity the systems represented by $y(t) = x^2(t-1)$

3. State the Dirichlet's conditions for the convergence of Fourier series

4. Find Laplace Transform and sketch ROC for the signal $x(t) = e^{2t}\, u(t) + e^{-3t}\, u(t)$

5. A continuous-time signal $x(t) = e^{-5t}u(t)$ is applied to a continuous-time system as the input, and the impulse response of the system is $h(t) = u(t-3)$. Obtain the output of the system.

6. Explain what is the transfer function of a system and define the poles and zeros of the transfer function

7. A continuous-time signal $x(t) = \cos(40t) - \cos(60t)$ is sampled with a time period T. Can $x(t)$ be recovered from the samples $x(nT)$ for $T = \frac{\pi}{30}$? State the reason for the same..

8. Define the Discrete-Time Fourier Transform (DTFT) of a signal $x[n]$. Prove that the DTFT is periodic with period 2π.

9. What is the output sequence of an LTI system with impulse response $h(n) = [2, 2]$ to the input $x(n) = [1, 2, 3, 1]$?

10. Determine the impulse response of the system described by the difference equation $y(n) = ay(n-1) + x(n)$.

PART B

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

Module I

11. a) Test whether the following signals are periodic or not. If periodic, determine the fundamental period and frequency.

    i. $x(t) = 3\cos(5t + \frac{\pi}{6})$

    ii. $x(t) = e^{(j\pi-2)t}$

    (6)

    b) Determine whether the following system is static, time invariant, linear, and causal. $x(t)$ and $y(t)$ denote the input and output, respectively. Give an explanation for each.

    $$y(t) = t^2x(t) + x(t-2)$$

    (8)

12. a) Check whether the following signals are energy or power signals.

    i. $x(t) = e^{-a|t|}, \quad a > 0$

    ii. $x(t) = tu(t)$

    (6)

    b) Define an LTI system. Check whether the following system is an LTI system or not.

    $$y(t) = 3x(t) + 5$$

    (8)

Module II

13. a) Using the standard transforms and properties find Fourier Transforms of the following signals.

    i. $x(t) = te^{-2t}u(t)$

    ii. $x(t) = \sin(2\pi t)e^{-t}u(t)$

    (6)

    b) Determine the Laplace Transform and express the ROC of the signal:

    $$x(t) = e^{-t}u(t) + e^{-2t}u(t)$$

    (8)

Module III

14. a) Compute the Fourier series of a half wave rectified sinusoid with period T and amplitude A (6)

    b) i. Using the frequency shifting property, find the Fourier Transform of

$$x(t) = e^{j2t}u(t)$$

    ii. Using the Time Reversal property, find the Fourier Transform of

$$x(t) = u(-t)$$

. (8)

15. a) Evaluate the continuous time convolution integral for the following with proper plots.

$$y(t) = (u(t) - u(t-2)) * u(t)$$

(7)

    b) i) A certain continuous LTI system is described by the following differential equation.

$$\frac{dy(t)}{dt} + 5y(t) = x(t)$$

    ii) Determine $y(t)$ using the Fourier Transform for the following inputs:

    i. $x(t) = e^{-2t}u(t)$

    ii. $x(t) = \delta(t)$

(7)

Module IV

16. a) Find the response of an LTI system whose input $x(t)$ and impulse response $h(t)$ are given: $x(t) = u(t), \quad h(t) = e^{-at}u(t)$ (8)

    b) Analyze and characterize the LTI system $x(t)$ using Laplace Transform:

$$x(t) = \frac{2}{3}e^{-t}u(t) + \frac{1}{3}e^{2t}u(t)$$

(6)

17. a) Find the DTFT of the discrete-time signal $x(n) = a^{|n|}$, $-1 < a < 1$. (6)

    b) Consider the signal $x(t) = \cos(2000\pi t) + 10\sin(10000\pi t) + 20\cos(5000\pi t)$. Determine:

    i. Nyquist rate for this signal

    ii. If the sampling rate is 5000 samples per second, then what is the discrete-time signal $x(nT_s)$ obtained after sampling, where T_s is the sampling period and n is an integer.

(8)

18. (a) Fourier series coefficients of a discrete-time periodic signal $x[n]$ are given by $C_k = \cos\left(\frac{k\pi}{4}n + \sin\left(\frac{3k\pi}{4}\right)\right)$. The period of $x[n]$ is $N = 8$. Determine the sequence $x[n]$. (8)

(b) Determine the z-transform of the function $x(n) = (n + 0.5)\left(\frac{1}{3}\right)^n u(n)$.

(6)

Module V

19. a) Perform linear convolution of signals $x_1[n] = [2, 2, 2, 2]$ and $x_2[n] = [1, 1, 1, 1]$. (6)

b) Write the impulse response of the system function whose algebraic expression is given below. Also check and justify the causality and stability.

$$H(z) = \frac{1}{1 - \frac{1}{2}z^{-1}} + \frac{1}{1 - 2z^{-1}}, \quad \frac{1}{2} < |z| < 2$$

(8)

20. a) Determine the transfer function of the system given by the difference equation:

$$y(n) + \frac{1}{4}y(n-1) = x(n) - x(n-1)$$

Calculate the frequency response from its transfer function. Also, obtain the magnitude and phase responses of the given system.

(7)

b) A certain LTI system is described by the following system function $H(z) = \frac{z+\frac{1}{2}}{(z-1)(z-\frac{1}{2})}$. Find the system response to the input $x(n) = 4^{-(n+2)}u(n)$. (7)

B24EC2T06	LINEAR INTEGRATED CIRCUITS	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		3	1	0	3	3	2024

Preamble

Analog integrated circuits (ICs) are fundamental components that play a pivotal role in the design of modern electronic systems. Unlike digital ICs, which operate with binary signals, analog ICs process continuous signals that can take on any value within a specified range. These circuits are the backbone of many applications, from amplifying signals in audio systems to controlling power in industrial equipment. The versatility of analog ICs allows them to perform a wide range of functions, such as amplification, filtering, oscillation, and signal modulation, making them indispensable in communication, instrumentation, automotive, and consumer electronics.

Prerequisites

B24ECIT04: Analog Circuits 1
B24EC2T03: Analog Circuits 2

Course Outcomes

After the completion of the course the student will be able to:

CO 1	Understand the structure, characteristics, configurations, and performance parameters of operational amplifiers, including applications like amplifiers, converters, and voltage followers. [Remember, Understand]
CO 2	Apply operational amplifiers in designing and analyzing various signal processing circuits such as arithmetic circuits, amplifiers, waveform shaping circuits, and filters for real-world applications. [Apply]
CO 3	Understand the operation, types, and applications of analog multipliers and phase-locked loops (PLLs) including IC-based solutions used in modulation, detection, and synchronization.[Understand]
CO 4	Understand the working principles, architectures, and specifications of digital-to-analog and analog-to-digital converters, and their role in mixed-signal systems. [Understand]
CO 5	Apply Op Amps and special function ICs such as 555 timers and voltage regulators to design waveform generators, timing circuits, and power management solutions. [Apply]

Mapping of Course Outcomes With Program Outcomes

Assessment Pattern

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	2										1
CO 2	3	2	3	3	2							2
CO 3	3				2							2
CO 4	3	2	2	2	2							2
CO 5	3	2	2	2	2							

Bloom's Category	**Continuous Assessment**		**End Semester Examination**
	Test 1	**Test 2**	
Remember	30	30	30
Understand	40	40	40
Apply	30	30	30
Analyze			

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/Class work	15 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-division.

SYLLABUS

MODULE 1

BASICS OF OPERATIONAL AMPLIFIERS

Operational amplifiers (Op Amps): The 741 Op Amp, Block diagram, Ideal Op Amp parameters, typical parameter values for 741, equivalent circuit, DC and AC performance characteristics, slew rate, Open and closed loop configurations, voltage transfer curve, frequency response curve. Inverting Amplifier, Non-Inverting Amplifier and Differential Amplifier. Voltage Follower, V-to-I and I-to-V converters.

MODULE 2

APPLICATIONS OF OPERATIONAL AMPLIFIERS

Arithmetic Circuits : Design and Practical applications with an example of Adder, subtractor , Integrator, Differentiator. Instrumentation amplifier and its application for acquiring small output from wheatstone bridge using Strain gage . Logarithmic amplifier, Antilogarithmic amplifier, Comparators, Schmitt trigger, Precision rectifier- half and full wave, peak detector, clipper and clamper, Low-pass, high-pass and band-pass Butterworth filters.

MODULE 3

ANALOG MULTIPLIER AND PLL

Analog Multiplier using Emitter Coupled Transistor Pair - Gilbert Multiplier cell – Variable trans conductance technique, analog multiplier ICs(AD633,LM1496) and their applications, Operation of the basic PLL, Closed loop analysis, Voltage controlled oscillator, Monolithic PLL IC 565, application of PLL for AM detection, FM detection, FSK modulation and demodulation and Frequency synthesizing and clock synchronization.

MODULE 4

ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTERS

Analog and Digital Data Conversions, D/A converter – specifications - weighted resistor type, R-2R Ladder type, Voltage Mode and Current-Mode R - 2R Ladder types - switches for D/A converters, high speed sample-and-hold circuits, A/D Converters – specifications - Flash type - Successive Approximation type - Single Slope type – Dual Slope type - A/D Converter using Voltage-to-Time Conversion - Over-sampling A/D Converters, Sigma – Delta converters.

MODULE 5

WAVEFORM GENERATORS AND SPECIAL FUNCTION IC's

Op Amp based Astable and Monostable Multivibrators, Sine-wave generators, and Triangular wave generator, Saw-tooth wave generator. Timer IC 555, Astable and Monostable operations, Timer circuits, LED and Relay drivers.
IC Voltage regulators Three terminal fixed and adjustable voltage regulators - IC 723 general purpose regulator with fold back protection features- Monolithic switching regula-

tor, Low Drop – Out(LDO) Regulators - Switched capacitor filter IC MF10, Frequency to Voltage and Voltage to Frequency converters.

Text Books

1. D.Roy Choudhry, Shail Jain, "Linear Integrated Circuits", New Age International Pvt. Ltd., 2018, Fifth Edition. (Unit I – V).
2. Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", 4th Edition, Tata Mc Graw-Hill, 2016 (Unit I – V).

Reference Books

1. Ramakant A. Gayakwad, "OP-AMP and Linear ICs", 4th Edition, Prentice Hall / Pearson Education, 2015
2. Robert F.Coughlin, Frederick F.Driscoll, "Operational Amplifiers and Linear Integrated Circuits", Sixth Edition, PHI, 2001.
3. S.Salivahanan and V.S. Kanchana Bhaskaran, "Linear Integrated Circuits", TMH,2nd Edition, 4th Reprint, 2016.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Topic	No of Lecture/Tutorial Hours
	Module 1 (BASICS OF OPERATIONAL AMPLIFIERS)	8 hours
1.1	741 Operational Amplifier – Block diagram, ideal parameters, typical parameter values.	2 hours
1.2	741 equivalent circuit, DC and AC performance characteristics, slew rate, Open and closed loop configurations, voltage transfer curve, frequency response curve.	2 hours
1.3	Inverting Amplifier, Non-Inverting Amplifier and Differential Amplifier.	3 hour
1.4	Voltage Follower, V-to-I and I-to-V converters .	1 hour
	Module 2 (APPLICATIONS OF OPERATIONAL AMPLIFIERS)	8 hours
2.1	Arithmetic Circuits :Design and Practical applications with an example of Adder, subtractor , Integrator,Differentiator.	2 hours
2.2	Instrumentation amplifier and its application for acquiring small output from wheatstone bridge.	2 hours
2.3	Logarithmic amplifier, Antilogarithmic amplifier, Comparators, Schmitt trigger .	2 hours
2.4	Precision rectifier- half and full wave, peak detector, clipper and clamper.	2 hours
2.5	Filtering Techniques – Low-pass, high-pass, and band-pass Butterworth filters	2 hours
	Module 3 (ANALOG MULTIPLIER AND PLL)	10 hours
3.1	Analog Multiplier Basics – Emitter coupled transistor pair, Gilbert multiplier cell .	2 hours
3.2	Variable Transconductance Technique – Analog multiplier ICs (AD633, LM1496) and applications.	2 hours
3.3	Phase Locked Loop (PLL) Basics – Operation, closed-loop analysis	2hours
3.4	Voltage Controlled Oscillator (VCO) – Monolithic PLL IC 565.	2 hours
3.5	PLL Applications AM and FM detection, FSK modulation and demodulation, frequency synthesis, clock synchronization.	2 hours
	Module 4 (ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTERS)	10 hours
4.1	Introduction to A/D and D/A Conversion – Analog and digital data conversions .	1 hour
4.2	D/A Converters – Specifications, weighted resistor type, R-2R ladder type.	2 hours

4.3	D/A Converter Modes – Voltage mode, current-mode R-2R ladder types, switches for D/A converters.	2 hours
4.4	High-Speed Circuits – Sample-and-hold circuits .	1 hour
4.5	A/D Converter Types and Specifications – Flash, successive approximation, single slope, dual slope	2 hours
4.6	Advanced A/D Techniques – Voltage-to-time conversion, oversampling, Sigma-Delta converters	2 hours
	Module 5 (WAVEFORM GENERATORS AND SPECIAL FUNCTION IC's)	10 hours
5.1	Op Amp based Astable and Monostable Multivibrators, Sine-wave generators and Triangular wave generator, Saw-tooth wave generator.	2 hours
5.2	Timer IC 555, Astable and Monostable operations, Timer circuits, LED and Relay drivers.	2 hours
5.3	Voltage Regulators – Three terminal fixed and adjustable voltage regulators - IC 723 general purpose regulator with fold back protection features.	2 hours
5.4	Switching Regulators – Monolithic switching regulators, Low Drop-Out (LDO) regulators.	2 hours
5.5	Special Function ICs – Switched capacitor filter IC MF10, frequency-to-voltage and voltage-to-frequency converters.	2 hours
	Total Hours	48 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. What are the ideal characteristics of an op-amp.?
2. Define Slew rate?
3. Draw equivalent circuit of 741 and bring out the DC and AC performance characteristics.
4. Draw and explain the circuit of a voltage to current converter with grounded load and derive its transfer function.

Course Outcome 2 (CO 2):

1. State how practical integrator is different from simple integrator circuit, with relevant sketches.

2. What are the advantages of active filters over passive filters?
3. Design the circuits to obtain the following output, Vo. (i) Vo = (5V1) (ii) Vo= V1+ 2V2 (iii) Vo = −(V1+V2+V3) (iv) Vo = - 2V1- 5V2
4. D4. Analyze a Butterworth High pass filter and explain its working.

Course Outcome 3 (CO 3):

1. Explain the principle of operation of an analog multiplier IC.
2. How does AD633 function in signal processing applications?.
3. Explain the operation of PLL. What is its lock range and capture range.
4. Bring out the application of PLL in FSK modulation and demodulation.

Course Outcome 4 (CO 4):

1. Draw and explain the working of successive approximation type ADC.
2. Draw and explain the working of successive approximation type ADC.
3. Explain the circuit of a 4-bit R-2R ladder DAC.
4. Explain the working of a weighted resistor type DAC. Mention its drawbacks.

Course Outcome 5 (CO 5):

1. List the features of Timer IC 555.
2. Draw the internal diagram of a 555 timer and explain its working as a monostable multivibrator and derive the expression for its pulse-width.
3. Design a free-running multivibrator using 555 for a frequency of 1 KHz and aduty cycle of 60%. Choose C= 0.1 F.
4. List out DAC specifications.

MODEL QUESTION PAPER

QP CODE: **Pages: 2**

Reg.No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

FOURTH SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2025

Course Code: B24EC2T06

Course Name: LINEAR INTEGRATED CIRCUITS

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Find the maximum possible frequency, without distortions, for a sine wave of voltage 10V peak to peak with an op-amp whose slew rate is 10V/ s.
2. Draw the equivalent circuit of the Op-Amp and explain the voltage transfer characteristics.
3. Design the op-amp circuits to obtain the following outputs: a) Vo=5Vin b) Vo= V1+2V2
4. State how a practical differentiator circuit differs from a simple integrator circuit, with relevant sketches.
5. What is the significance of the timing capacitor and resistor values in the NE 565 circuit?.
6. What is frequency synthesizing, and why is it important in communication systems?
7. Find the resolution and dynamic range of a digital-to-analog converter, if the maximum peak-to-peak output voltage is 5V and the input signal is a 10-bit word.
8. Give the specifications of Analog to Digital converter.
9. Design a voltage regulator using IC 723 for an output voltage of 6V and a current of 1A. Assume Vref =7V.
10. Design a monostable multivibrator using 555 to get a pulse width of 2ms.

PART B

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

1. (a) Differentiate between the open loop configurations of inverting and non-inverting amplifiers. (4 marks)

   (b) Analyse differential amplifier for i) Closed loop voltage gain ii) Input resistance iii)Output resistance. (10 marks)

OR

2. (a) Draw the circuit of the non-inverting amplifier and derive the following characteristics i) Closed loop voltage gain ii) Input resistance iii) Output resistance .(8 marks)

   (b) Explain Voltage to Current converter with grounded load . (6 marks)

3. (a) Draw the circuit of an ideal integrator using op-amp and derive the expression for output voltage. Discuss the drawbacks of this circuit and explain how it is rectified in a practical integrator. (8 marks)

   (b) Design a Schmitt Trigger circuit using an op-amp with UTP = 4 V and LTP -3 V. Output saturation voltages are +/- 13 V. (6 marks)

OR

4. (a) Design a Butterworth active high pass filter for a cut-off frequency of 10 kHz with a stop band attenuation of -40dB/decade. (7 marks)

   (b) Draw the circuit diagram of the basic log amplifier and derive the expression for output voltage. (7 marks)

5. (a) Why is the Gilbert Multiplier Cell important in communication systems? (4 marks)

   (b) Explain the application of NE565 as FSK modulator. (10 marks)

OR

6. (a) Explain the working of VCO with relevant diagrams. (8 marks)

   (b) What role do analog multipliers play in automatic gain control (AGC) circuits? (6 marks)

7. (a) An 8-bit DAC produces an output voltage of 2 V for a binary input of 0110 0100. Find the output voltage for a binary input of 1011 0011. (8 marks)

   (b) Why are Sigma-Delta converters preferred for high-resolution applications? (6 marks)

OR

8. (a) With the help of a circuit diagram, explain the working of a binary weighted resistor DAC. (7 marks)

   (b) Design Flash type ADC and explain its working. (7 marks)

9. (a) Using the internal diagram of NE555 IC, explain the working of a symmetric astable multivibrator circuit.

(9 marks)

(b) How does a switched capacitor filter like the MF10 differ from an analog filter? (5 marks)

OR

10. (a) Explain IC 723 Voltage regulator with relevant circuit diagram (9 marks)

(b) What are the advantages of using the 723 voltage regulator in power supply designs? (5 marks)

B24HU2T02	ENTREPRENEURSHIP AND MANAGEMENT SKILLS FOR ENGINEERS	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		2	1	0	2	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

By the end of this course, students 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

Assessment Pattern

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1						1		1	1	1	2	2
CO 2						1		1	2	2	2	2
CO 3											3	2
CO 4											2	2
CO 5						1	1			1	2	2

Bloom's Category	**Continuous Assessment**		**End Semester Examination (% Marks)**
	Test 1 (%Marks)	**Test 2 (%Marks)**	
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/Class work	15 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-division.

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 (7 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 (8 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 (8 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	Topic	No of Lecture/Tutorial Hours
	Module 1	**6**
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
	Module 2	**7**
2.1	Manpower Planning, Job Analysis, Recruitment vs Selection - Motivation Theories: Maslow's Hierarchy of Needs, Herzberg's 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.	
	Module 3	**7**
3.1	Entrepreneurial Mindset – Growth mindset, risk-taking, and decision-making.	1
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).	
	Activity: The students may be encouraged to make a Business model plan of their choice.	
	Module 4	**6**
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
	Module 5	**9**
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 Hours	**35 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 Maslow's Hierarchy of Needs and Herzberg's 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: 2**

Reg.No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

FORTH SEMESTER B TECH DEGREE EXAMINATION, DECEMBER 202

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 Maslow's and Herzberg's 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 I

11 a. Illustrate the three levels of management with suitable examples and describe the role of each in organizational decision-making. (7)

b. Discuss the different types of plans (strategic, tactical, operational, contingency) with examples, and explain how they guide managerial actions. (7)

(OR)

12 a. Explain the five core functions of management and discuss their importance in running a business efficiently. (7)

b. Compare the classical management theories of F.W. Taylor and Henri Fayol with modern approaches like systems and contingency theory. (7)

Module II

13 a. Describe Herzberg's Two-Factor Theory and Maslow's Hierarchy of Needs. How can managers apply them to motivate employees? (7)

b. Explain the steps involved in manpower planning and differentiate between recruitment and selection with examples. (7)

(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)

b. Discuss the impact of communication barriers on leadership effectiveness and provide examples of how leaders can overcome them. (7)

Module III

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)

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)

(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)

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)

Module IV

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)

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)

(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)

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)

Module V

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)

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)

(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)

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)

B24EC2T07	FPGA BASED SYSTEM DESIGN	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		2	1	0	2	3	2024

Preamble

This course offers an overview of Verilog HDL-based design, FPGA architecture, RT-level combinational and sequential circuits, FSM design, and FSMD applications for digital system implementation.

Prerequisites

B24EC1T03 : LOGIC CIRCUIT DESIGN

Course Outcomes

After the completion of the course the student will be able to:

CO 1	Upon completing this course, students will be able to understand and apply Verilog HDL for designing gate-level combinational circuits, develop structural descriptions, create testbenches, and gain a foundational understanding of FPGA devices and EDA software for digital system design. [Understand,Apply]
CO 2	Upon completing this course, students will be able to design RT-level combinational circuits using Verilog, effectively utilize operators, always blocks, conditional statements, and parameters, while following best coding practices and implementing design examples. [Understand, Apply]
CO 3	Upon completing this course, students will be able to design and implement RT-level regular sequential circuits using Verilog, including flip-flops, registers, and testbenches, with applications such as shift registers, counters, PWM generators, and LED time-multiplexing circuits. [Understand, Apply]
CO 4	Upon completing this course, students will be able to design and implement Finite State Machines (FSM) using Verilog, including Mealy and Moore models, and apply them in practical examples such as edge detectors, debounce circuits, and parking lot occupancy counters. [Understand, Apply]
CO 5	Upon completing this course, students will be able to design and implement FSMDs using ASMD charts and Verilog, develop code with explicit data path components, and apply them to practical design examples such as Fibonacci circuits, division circuits, and low-frequency counters. [Understand, 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	PO 12
CO 1	3	3	3	3	2	1						3
CO 2	3	3	3	3	2	1						3
CO 3	3	3	3	3	2	1						3
CO 4	3	3	3	3	2	1						3
CO 5	3	3	3	3	2	1						3

Assessment Pattern

Bloom's Category	**Continuous Assessment**		**End Semester Examination (% Marks)**
	Test 1 (%Marks)	**Test 2 (%Marks)**	
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/Class work	15 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-division.

SYLLABUS

MODULE 1

Verilog HDL – based design, Overview of FPGA and EDA software: Introduction, General description, Basic lexical elements and data types, Data types, Program skeleton, Structural description, Gate-level combinational circuit, Testbench, Introduction and overview of a general FPGA device, Gate-level greater-than circuit, Gate-level binary decoder.

MODULE 2

RT-level combinational circuits: Introduction, Operators, always block for a combinational circuit, if statement, Case statement, General coding guidelines for an always block, Parameter and constant, Design examples.

MODULE 3

RT-level regular sequential circuits: Introduction to Regular Sequential Circuit, HDL code of the FF and register, Test bench for sequential circuits, Design examples: shift register, Binary counters. Testbench for sequential circuits, Case study: LED time-multiplexing circuit, Stopwatch, Programmable square-wave generator, PWM and LED dimmer, Rotating LED banner circuit.

MODULE 4

FSM: Introduction, FSM representation and code development, Mealy and Moore outputs, Design examples: Rising-edge detector, Debouncing circuit, Testing circuit, Case study: Dual-edge detector Alternative debouncing circuit, Parking lot occupancy counter.

MODULE 5

FSMD: Introduction, ASMD chart, Code development of an FSMD, Debouncing circuit based on RT methodology, Code with explicit data path components, Testing circuit, Design examples: Fibonacci number circuit, Division circuit, Binary-to-BCD conversion circuit, Period counter, Accurate low-frequency counter.

Text Books

1. Pong P. Chu, FPGA Prototyping by Verilog Examples, John Wiley & Sons, 2008

2. FPGA-Based System Design –Wayne Wolf, Prentice Hall
3. Modern VLSI Design: System-on-Chip Design (3rdEdition)Wayne Wolf
4. Field Programmable Gate Array Technology - S. Trimberger, Edr,1994, Kluwer Academic
5. Digital Design Using Field Programmable Gate Array, P.K. Chan & S. Mourad, 1994, Prentice Hall
6. Samir Palnitkar, "Verilog HDL: A Guide to Digital Design and Synthesis", Second Edition, Prentice Hall PTR, 2003
7. B. Bala Tripura Sundari, T. R. Padmanabhan, "Design Through Verilog HDL", Wiley India, 2012

COURSE CONTENTS AND LECTURE SCHEDULE

No	Topic	No of Lecture/Tutorial Hours
	Module 1	**10**
1.1	Verilog HDL – based design, Overview of FPGA and EDA software: Introduction, General description.	2
1.2	Basic lexical elements and data types.	1
1.3	Data types, Program skeleton, Structural description.	2
1.4	Gate-level combinational circuit, Testbench.	2
1.5	Introduction and overview of a general FPGA device, Gate-level greater-than circuit, Gate-level binary decoder.	3
	Module 2	**9**
2.1	RT-level combinational circuits: Introduction, Operators.	2
2.2	Always block for a combinational circuit.	1
2.3	If statement, Case statement.	1
2.4	General coding guidelines for an always block, Parameter and constant.	1
2.5	Design examples.	4
	Module 3	**10**
3.1	RT-level Regular sequential circuits: Introduction to Regular Sequential Circuit, HDL code of the FF and register, Test bench for sequential circuits.	2
3.2	Design examples: shift register, Binary counters. Testbench for sequential circuits.	4
3.3	Case study: LED time-multiplexing circuit, Stopwatch.	2
3.4	Programmable square-wave generator, PWM and LED dimmer, Rotating LED banner circuit.	2
	Module 4	**8**
4.1	FSM: Introduction, FSM representation and code development.	2
4.2	Mealy and Moore outputs.	1
4.3	Design examples: Rising-edge detector, Debouncing circuit, Testing circuit.	2
4.4	Case study: Dual-edge detector Alternative debouncing circuit, Parking lot occupancy counter.	3
	Module 5	**8**
5.1	FSMD-Introduction, ASMD chart.	2
5.2	Code development of an FSMD, Debouncing circuit based on RT methodology.	1
5.3	Code with explicit data path components, Testing circuit.	1
5.4	Design examples: Fibonacci number circuit, Division circuit, Binary-to-BCD conversion circuit, Period counter, Accurate low-frequency counter.	4

	Total Hours	**45 Hours**

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Design a gate-level combinational circuit in Verilog that implements a 4-bit binary greater-than comparator. Include a testbench to verify the functionality of the circuit. Explain the process of simulation and results interpretation.
2. Write a Verilog program to create a 3-to-8 binary decoder using structural description. Discuss the FPGA architecture and how this design can be implemented on a general FPGA device. Include the necessary testbench to validate the design.

Course Outcome 2 (CO 2):

1. Design a 4-bit binary multiplier using RT-level combinational logic in Verilog. Use the always block for the design and include appropriate use of operators, constants, and parameters. Provide a testbench to verify the correctness of your design.
2. Write a Verilog code for a 4-to-1 multiplexer using the case statement inside an always block. Explain the use of the if and case statements for conditional logic, and include a testbench to check the functionality of the multiplexer.

Course Outcome 3 (CO 3):

1. Design a 4-bit shift register using RT-level sequential logic in Verilog. Implement the HDL code for the flip-flops (FF) and register, and provide a testbench to simulate and verify the functionality of the shift register.
2. Write a Verilog program to design a PWM (Pulse Width Modulation) generator that controls the brightness of an LED. Include a testbench to validate the PWM waveform and its effect on the LED dimming functionality.

Course Outcome 4 (CO 4):

1. Design a rising-edge detector using an FSM in Verilog. Implement the FSM with a Mealy or Moore output model and provide the necessary testbench to validate its functionality. Explain the design and simulation results.

2. Develop a parking lot occupancy counter using a Moore FSM model in Verilog. The counter should increment when a car enters and decrement when a car leaves. Provide a testbench to verify the behavior of the parking lot counter and discuss the FSM implementation details.

Course Outcome 5 (CO 5):

1. Design an FSMD (Finite State Machine with Data path) for generating Fibonacci numbers in Verilog. Use an ASMD chart for representation, and include the code development with explicit data path components. Provide a testbench to validate the Fibonacci sequence generation.

2. Implement a binary-to-BCD (Binary Coded Decimal) converter using an FSMD model in Verilog. Use the ASMD chart for planning the design, and provide the Verilog code with explicit data path components. Include a testbench to verify the accuracy of the binary-to-BCD conversion.

MODEL QUESTION PAPER

QP CODE: **Pages: 5**

Reg.No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

FORTH SEMESTER B TECH DEGREE EXAMINATION, DECEMBER 2024

Course Code: B24EC2T07

Course Name: FPGA BASED SYSTEM DESIGN

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks

1. Explain the concept of structural description in Verilog HDL. How does it differ from behavioral description?
2. Provide an overview of a general FPGA device.
3. What are the different logical, arithmetic, and relational of operators used in Verilog for combinational circuit design?
4. Explain how the case statement is used in Verilog for designing combinational circuits.
5. What is the role of flip-flops in sequential circuit design?
6. Write Verilog HDL code for a D flip-flop and explain its working.
7. Differentiate between Mealy and Moore FSMs.
8. Explain the concept of FSM representation using a state diagram.
9. What is an FSMD, and how does it differ from a standard FSM?
10. Explain the importance of explicit data path components in FSMD design.

PART B

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

Module I

11. a) Design a gate-level binary decoder in Verilog for a 3-bit input. Explain the logic behind the design and show the Verilog code. (7)

    b) Write Verilog code for a gate-level greater-than (>) circuit for two 4-bit inputs. Include the complete code and explain its functionality. (7)

12. a) Describe the basic lexical elements and data types in Verilog HDL. Provide examples of each and explain their usage. (7)

    b) What is a testbench in Verilog HDL? Describe its role in verifying a digital design and provide an example of a simple testbench. (7)

Module II

13. a) What is the purpose of using parameters and constants in Verilog? Give an example of how parameters can be used to design a parameterized 4-bit adder. (7)

    b) Design a 4-bit binary subtractor using Verilog. Use the always block and appropriate operators for the design and explain your approach. (7)

14. a) Write Verilog code for a 3-to-8 binary decoder using the case statement in an always block. Provide a detailed explanation of the code and its working. (7)

    b) What are the general coding guidelines for writing an always block in Verilog? Discuss best practices to avoid common pitfalls such as latches and incomplete sensitivity lists. (7)

Module III

15. a) Write Verilog code for a programmable square-wave generator. Explain how the frequency of the output wave can be controlled. (7)

    b) What is Pulse Width Modulation (PWM)? Design a PWM generator in Verilog to control the brightness of an LED. (7)

16. a) Write Verilog code for a binary counter that increments every clock cycle. Explain the significance of synchronous and asynchronous resets in the design. (7)

    b) What is a testbench in the context of sequential circuits? Explain its purpose and provide an example of a testbench for a 4-bit binary counter. (7)

Module IV

17. Explain the design of a parking lot occupancy counter using an FSM. Provide the state diagram, Verilog code, and testbench for implementation. (14)

18. Design a debouncing circuit using a Moore FSM model in Verilog. Explain how it eliminates signal noise and provide a testbench to validate the design. (14)

Module V

19. Write Verilog code for a Fibonacci number generator using an FSMD. Include the ASMD chart and explain the implementation. (14)

20. What is binary-to-BCD conversion? Design an FSMD for this conversion and explain its working using an ASMD chart and Verilog code. (14)

B24EC2L05	MICROCONTROLLER LAB	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		0	0	3	3	2	2024

Preamble

The aim of the course is to provide hands-on experience to the learners on microcontroller programming and interface design. This course helps the learners to enhance their capability to design and implement various embedded systems for real-world problems.

Prerequisite

B24EC1T03 : LOGIC CIRCUIT DESIGN

Course Outcomes

After the completion of the course the student will be able to

CO 1	Master 8051 Programming in Assembly language and C language (Cognitive Knowledge Level: Understand, Apply)
CO 2	Implement Timer and Counter for various time base operations (Cognitive Knowledge Level: Understand, Apply)
CO 3	Develop Interrupt-Based Systems for real time operations(Cognitive Knowledge Level: Understand, Apply)
CO 4	Interface and Control External Peripherals (Cognitive Knowledge Level: Understand, Apply, Analyse)
CO 5	Design and Prototype Embedded Applications (Cognitive Knowledge Level: Understand, Apply, Analyse)

Mapping of Course Outcomes With Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	2	2	2	1							2
CO 2	3	2	2	2	2							2
CO 3	3	2	2	2	2							2
CO 4	3	2	2	2	3							2
CO 5	3	3	3	3	3	1	1	1	3	2	2	3

Mark Distribution

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

Continuous Internal Evaluation Pattern

Attendance	10 marks
Continuous Assessment	20 marks
Internal Test	15 marks
Lab Record	5 marks

End semester Examination pattern

Preliminary Work	30 marks
Performance and Implementation	20 marks
Result and Inference	30 marks
Viva	20 marks

SYLLABUS

LIST OF EXPERIMENTS

1	Familiarization with 8051 Development Tools: Study of hardware (8051 development kit) and software (Keil, Proteus, etc.), Setting up the simulation and debugging environment.
2	Basic Assembly Language Programs: Program to transfer data between registers and memory, Program for arithmetic operations (addition, subtraction, multiplication, division), Logical operations (AND, OR, XOR) and bit manipulation.
3	Timer-Based Delay Generation: Programming Timer 0 and Timer 1 in different modes, Generate delays and measure event frequencies.
4	Event Counting Using Counters: Configure counters for counting external pulses.
5	Interrupt Programming: Implement external and timer-based interrupts, Prioritize interrupts and handle multiple interrupts.
6	Serial Communication: Program UART for data transmission and reception, Interfacing 8051 with PC for serial communication.
7	LED and Switch Interfacing: Control LEDs using switches and microcontroller logic.
8	Seven-Segment Display Interfacing: Program 8051 to display numbers on a 7segment display using multiplexing mode
9	Keypad Interfacing: Write a program to detect keypresses and display corresponding outputs.
10	LCD Interfacing: Program to display custom messages on an LCD module.
11	Interface an ADC chip to 8051 to read analog signals
12	Interface a DAC IC to generate analog waveforms.
13	Stepper Motor Interfacing: Program the 8051 to control the direction and steps of a stepper motor.

14	DC Motor Interfacing: Implement speed and direction control using PWM
15	Servo Motor Interfacing: Control speed, direction and angle of rotation using PWM.

Reference Books

1. Datasheet, 8051 Hardware Description, Intel Corporation,1992
2. Lyla B. Das, Microprocessors and Microcontrollers, Pearson Education, 2011
3. Steve Furber, ARM System-on-Chip Architecture, Addison-Wesley Educational Publishers Inc, 2000
4. Joseph Yiu, System-on-Chip Design with Arm(R) Cortex(R)-M Processors, ARM Education Media, 2019

B24EC2L06	HDL LAB	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		0	0	3	3	2	2024

Preamble

This lab course focuses on designing, simulating, and implementing digital systems using Verilog, emphasizing combinational and sequential circuits, FPGA interfacing, and practical real-world applications.

Prerequisite

B24EC1T03 : LOGIC CIRCUIT DESIGN
B24EC2L03 : LOGIC CIRCUIT DESIGN LAB

Course Outcomes

After the completion of the course the student will be able to

CO 1	Develop and simulate Verilog models for combinational and sequential circuits, including decoders, encoders, multiplexers, and flip-flops, to validate their functionality. [Apply]
CO 2	Design and implement a 32-bit Arithmetic Logic Unit (ALU) with multiple functionalities, and validate its behavior using comprehensive testbench scenarios. [Apply]
CO 3	Design clock divider circuits and implement FPGA-based control of DC and stepper motors, effectively managing speed and direction using Verilog. [Apply]
CO 4	Interface DACs with FPGA to generate waveforms like sine waves and design FSM-based control systems, such as an elevator, for real-world applications. [Apply]
CO 5	Develop Verilog modules for analog-to-digital conversion and display sensor outputs on various interfaces like LEDs, 7-segment displays, or LCDs. [Apply]

Mapping of Course Outcomes With Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	3	3	2	3				3	1		3
CO 2	3	3	1	2	3				3			1
CO 3	3	3	1	1	3							1
CO 4	3	3	1	1	3							1
CO 5	3	3	2	2	3				3	1		1

Mark Distribution

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

Continuous Internal Evaluation Pattern

Attendance	10 marks
Continuous Assessment	20 marks
Internal Test	20 marks

End semester Examination pattern

Preliminary Work	30 marks
Performance and Implementation	20 marks
Result and Inference	30 marks
Viva	20 marks

SYLLABUS

LIST OF EXPERIMENTS

PART-A: Simulation

1	Write a Verilog program for the following combinational designs, along with a testbench to verify each design: 1. Realization of a 2-to-4 decoder using only NAND gates 2. 8-to-3 encoder with and without priority 3. 8-to-1 multiplexer using both case and if statements 4. 4-bit binary to Gray code converter using a 1-bit Gray to binary converter, and a 1-bit adder and subtractor
2	Model a full adder and create a testbench with suitable input patterns to verify its behavior.

3	1. Design a 32-bit ALU and validate its functionality by using appropriate test patterns. The ALU should support the following operations: addition, subtraction, increment and decrement of the accumulator by 1, complement, logical OR, and logical AND. Inputs: A[31:0], B[31:0], Enable, Opcode[2:0], and Output: Result[32:0]. 2. Create a testbench to verify the ALU's functionality for all possible input patterns. 3. The enable signal will activate the required functions when enabled; when disabled, all outputs will be set to tri-state. 4. The acknowledge signal will be set high after each operation is completed.
4	Write Verilog code for SR, D, JK flip flops and verify the functionality.
5	Write Verilog code for 4-bit BCD synchronous counter.

PART-B: Interfacing

1	Design a clock divider circuit in Verilog to generate clock frequencies of f/2, f/3, and f/4 from a given input clock. Implement the design on an FPGA and verify its functionality using an oscilloscope.
2	Write Verilog code to interface a DC motor with an FPGA and control its speed and direction.
3	Interface a stepper motor with an FPGA and write Verilog code to control its rotation. Use external DIP switches for the following controls: 1. Rotate the stepper motor by +N steps when Switch 1 is closed. 2. Rotate the stepper motor by +N/2 steps when Switch 2 is closed. 3. Rotate the stepper motor by -N steps when Switch 3 is closed.
4	Interface a DAC to FPGA and write Verilog code to generate Sine wave of desired frequency.
5	Write Verilog code using a finite state machine (FSM) to simulate the operation of an elevator.
6	Write Verilog code to convert the analog output from a sensor into digital form and display the result on an appropriate display, such as LEDs, a 7-segment display, or an LCD.

Reference Books

1. Pong P. Chu, FPGA Prototyping by Verilog Examples, John Wiley & Sons, 2008
2. FPGA-Based System Design –Wayne Wolf, Prentice Hall.

B24ECM41	MICROCON-TROLLERS (Minor)	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		3	1	0	3	4	2024

Preamble

This course offers a focused study on 8051-based microcontrollers, covering their architecture, instruction set, and practical applications in embedded systems development.

Prerequisites

Nil

Course Outcomes

After the completion of the course the student will be able to:

CO 1	Students will gain proficiency in 8051 microcontroller architecture, memory organization, and interfacing techniques while understanding the distinctions between microprocessors and embedded microcontrollers. [Understand]
CO 2	Students will master the 8051 instruction set, addressing modes, and assembly language programming, enabling them to develop efficient embedded applications. [Understand, Apply]
CO 3	Students will develop skills in 8051 stack operations, subroutine programming, and I/O port interfacing through assembly language, enabling the design of practical embedded applications like LED control and data manipulation. [Understand, Apply]
CO 4	Students will acquire the ability to program 8051 timers, counters, and serial ports for tasks like pulse generation and serial data communication using both Assembly and C languages. [Understand, Apply]
CO 5	Students will gain expertise in handling 8051 interrupts and interfacing applications, including ADC, LCD, and stepper motor control, through Assembly and C programming. [Understand, 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	PO 12
CO 1	3	2	3	2		1						3
CO 2	3	2	3	2		1						3
CO 3	3	2	3	2		1						3
CO 4	3	2	3	2		1						3
CO 5	3	2	3	2		1						3

Assessment Pattern

Bloom's Category	Continuous Assessment		End Semester Examination (% Marks)
	Test 1 (%Marks)	Test 2 (%Marks)	
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/Class work	15 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-division.

SYLLABUS

MODULE 1

8051 Microcontroller: Microprocessor Vs Microcontroller, Embedded Systems, Embedded Microcontrollers, 8051 Architecture- Registers, Pin diagram, I/O ports functions, Internal Memory organization. External Memory (ROM & RAM) interfacing.

MODULE 2

8051 Instruction Set: Addressing Modes, Data Transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Bit manipulation instructions. Simple Assembly language program examples to use these instructions.

MODULE 3

8051 Stack, I/O Port Interfacing and Programming: 8051 Stack, I/O Port Interfacing and Programming: 8051 Stack, Stack and Subroutine instructions. Assembly language program examples on subroutine and involving loops - Delay subroutine, Factorial of an 8bit number, Block move without overlap, Addition of N 8bit numbers, Picking smallest/ largest of N 8bit numbers. Interfacing simple switch and LED to I/O ports to switch on/off LED with respect to switch status.

MODULE 4

8051 Timers and Serial Port: 8051 Timers and Counters – Operation and Assembly language programming to generate a pulse using Mode-1 and a square wave using Mode-2 on a port pin. 8051 Serial Communication- Basics of Serial Data Communication, RS-232 standard, 9 pin RS232 signals, Simple Serial Port programming in Assembly and C to transmit a message and to receive data serially.

MODULE 5

8051 Interrupts and Interfacing Applications: 8051 Interrupts. 8051 Assembly language programming to generate an external interrupt using a switch, 8051 C programming to generate a square waveform on a port pin using a Timer interrupt. Interfacing 8051 to ADC-0804, LCD and Stepper motor and their 8051 Assembly language interfacing programming.

Text Books

1. The 8051 Microcontroller and Embedded Systems – using assembly and C, Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D. McKinlay; PHI, Pearson, 2006.

2. The 8051 Microcontroller, Kenneth J. Ayala, 3rd Edition, Thomson/Cengage Learning.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Topic	No of Lecture/Tutorial Hours
	Module 1	**10**
1.1	Microprocessor Vs Microcontroller, Embedded Systems.	2
1.2	Embedded Microcontrollers.	1
1.3	8051 Architecture- Registers, Pin diagram.	2
1.4	I/O ports functions.	2
1.5	Internal Memory organization. External Memory (ROM & RAM) interfacing..	3
	Module 2	**9**
2.1	Addressing Modes.	1
2.2	Data Transfer instructions.	2
2.3	Arithmetic instructions, Logical instructions.	2
2.4	Branch instructions, Bit manipulation instructions.	2
2.5	Simple Assembly language program examples to use these instructions.	2
	Module 3	**10**
3.1	8051 Stack, Stack and Subroutine instructions.	2
3.2	Assembly language program examples on subroutine and involving loops - Delay subroutine, Factorial of an 8bit number.	4
3.3	Block move without overlap,Addition of N 8bit numbers, Picking smallest/ largest of N 8bit numbers.	2
3.4	Interfacing simple switch and LED to I/O ports to switch on/off LED with respect to switch status.	2
	Module 4	**8**
4.1	8051 Timers and Counters.	2
4.2	Operation and Assembly language programming to generate a pulse using Mode-1 and a square wave using Mode-2 on a port pin.	2
4.3	8051 Serial Communication, Basics of Serial Data Communication, RS-232 standard.	2
4.4	9 pin RS232 signals, Simple Serial Port programming in Assembly and C to transmit a message and to receive data serially.	2
	Module 5	**8**
5.1	8051 Interrupts.	2
5.2	8051 Assembly language programming to generate an external interrupt using a switch.	1
5.3	8051 C programming to generate a square waveform on a port pin using a Timer interrupt.	1

5.4	Interfacing 8051 to ADC-0804, LCD and Stepper motor and their 8051 Assembly language interfacing programming.	4
	Total Hours	**45 Hours**

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Compare and contrast microprocessors and microcontrollers. Discuss the role of embedded systems and how embedded microcontrollers like the 8051 differ from general-purpose microprocessors. Include an explanation of the 8051 microcontroller architecture, detailing its registers, pin diagram, and I/O port functions.
2. Explain the internal and external memory organization of the 8051 microcontroller. Provide an in-depth analysis of how internal ROM, RAM, and I/O ports function in the 8051. Additionally, describe the interfacing of external memory (ROM & RAM) with the 8051 microcontroller, including the necessary connections and considerations.

Course Outcome 2 (CO 2):

1. Discuss the different addressing modes in the 8051 microcontroller. Provide examples of data transfer instructions, arithmetic instructions, logical instructions, and branch instructions in 8051 assembly language. Write a simple assembly language program that demonstrates the use of these instructions.
2. Explain the bit manipulation instructions in the 8051 microcontroller. Illustrate their usage with examples and write an assembly language program that utilizes bit manipulation instructions to perform a specific task, such as toggling a bit or testing a bit in a register.

Course Outcome 3 (CO 3):

1. Write an assembly language program for the 8051 microcontroller that calculates the factorial of a given 8-bit number using a subroutine and a loop. The program should prompt the user to input a number, call a subroutine to calculate its factorial, and return the result. Ensure that the program handles the stack properly and can compute factorials for numbers between 0 and 255.

2. Write an assembly language program for the 8051 microcontroller that sums up N 8-bit numbers (where N is specified by the user) using loops and a subroutine. The program should store the sum in a memory location and display the result. Use a subroutine to handle the summation, and implement the loop to process each of the N numbers.

Course Outcome 4 (CO 4):

1. Write an assembly language (or C) program for the 8051 microcontroller to implement serial communication. The program should transmit a message (e.g., ”HELLO”) via the serial port using the RS-232 standard, and then receive a response (e.g., ”ACKNOWLEDGED”) through the same port.
2. Write an assembly language program for the 8051 microcontroller to generate a 1-second delay using Timer 0 in Mode-1 (16-bit timer mode). The program should: Configure Timer 0 in Mode-1. Calculate the appropriate values for the Timer 0 reload register to achieve a delay of 1 second. Implement the delay and output a signal on a port pin (e.g., P1.0) each time the delay completes. Use an infinite loop to continuously toggle the signal every second.

   Hint: Assume the system clock frequency is 12 MHz.

Course Outcome 5 (CO 5):

1. Write an assembly language program for the 8051 microcontroller to interface and display a message on a 16x2 LCD. The program should:

   Initialize the LCD in 8-bit mode. Display the message ”HELLO, 8051!” on the first line of the LCD. Use the second line to display the current message ”LCD INTERFACE”. Provide necessary delays between writing characters to the LCD to ensure proper display timing. Configure the control pins (RS, RW, and E) and data pins (D0-D7) for the interface.
2. Write an assembly language program for the 8051 microcontroller that handles external interrupts and uses an interrupt service routine (ISR) to toggle an LED connected to a port pin. The program should:

   Set up External Interrupt 0 (INT0) to trigger on a falling edge. Configure an LED on port P1.0. When an external interrupt is triggered (via a switch connected to INT0), the interrupt service routine should toggle the LED connected to P1.0. Ensure that the program returns to normal operation after handling the interrupt and continues to monitor for additional interrupts. Include a delay in the main program loop to debounce the switch and avoid false triggers.

MODEL QUESTION PAPER

QP CODE: **Pages: 5**

Reg.No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

FORTH SEMESTER B TECH DEGREE EXAMINATION, DECEMBER 2024

Course Code: B24ECM41

Course Name: Microcontrollers

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks

1. Explain the key differences between a microprocessor and a microcontroller.
2. How is external memory interfaced with the 8051 microcontroller?
3. What are bit-manipulation instructions in the 8051?
4. Write a simple assembly program to perform the addition of two 8-bit numbers using 8051 arithmetic instructions.
5. How does 8051 handle subroutine calls?
6. What is the stack in the 8051 microcontroller, and how is it used for storing data?
7. How are the 8051 Timers and Counters used to generate precise time delays?
8. List the 9 pins of the RS-232 connector and describe their functions.
9. Describe how Timer 0 can be configured to generate an interrupt periodically?
10. Explain the interfacing of a stepper motor with the 8051 microcontroller.

PART B

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

Module I

11. a) Draw and explain the pin diagram of the 8051 microcontroller. (7)

    b) Describe the functions of I/O ports and explain the internal memory organization in detail. (7)

12. Describe the architecture of the 8051 microcontroller. Explain the roles of its registers and how they contribute to its functionality. (14)

Module II

13. a) Classify the 8051 instruction set into data transfer, arithmetic, logical, branching, and bit manipulation instructions. Give two examples for each category. (7)

    b) Explain the difference between the instructions ADD A, R1 and ADDC A, R1. Write an assembly language example for each. (3)

    c) Differentiate between SJMP and LJMP instructions with an example for each. Discuss their use cases in program design. (4)

14. a) Write a program to perform bitwise AND and OR operations between two bytes stored at memory locations 30H and 31H. Store the results in 32H and 33H, respectively. Use appropriate logical instructions. (7)

    b) Explain the role of the NOP, CLR, and SWAP instructions in the 8051 instruction set with examples. (7)

Module III

15. a) Write an assembly language program to toggle an LED connected to Port 1, Pin 0 (P1.0) with a delay. Use a subroutine to generate the delay. (7)

    b) Write an assembly program to calculate the sum of the first 10 natural numbers using a loop. Store the result in the accumulator (ACC). Include a subroutine to clear the accumulator before adding. (7)

16. a) Write an assembly language program for the 8051 microcontroller to generate a square wave of 50% duty cycle on Port 2, Pin 3 (P2.3). Use a subroutine for the delay. (7)

    b) Write an 8051 assembly program to move a block of data from internal memory locations 20H-29H to 30H-39H using a loop. Include a subroutine to clear the destination memory block before copying. (7)

Module IV

17. a) Explain the difference between Timers and Counters in the 8051 microcontroller. How are they configured and used in embedded systems? (7)

    b) Describe Timer Mode 2 (8-bit auto-reload mode). Write an assembly program to generate a square wave of 1kHz on P2.3 using Timer 0 in Mode 2. (7)

18. a) Explain the role of UART in the 8051 microcontroller. What are the key registers involved in serial communication? (7)

b) How is the baud rate for serial communication determined in the 8051? If Timer 1 is set in Mode 2, calculate the TH1 value required for a baud rate of 9600 with a 12 MHz crystal frequency. (7)

Module V

19. a) Explain the interrupt structure of the 8051 microcontroller. How many interrupt sources are available, and what are their priorities? (7)

    b) How does the 8051 handle nested interrupts? Provide an example program where Timer 0 interrupt has higher priority than INT0. (7)

20. a) Write the sequence of steps required to initialize a 16x2 LCD in 8-bit mode. Include the initialization commands. (7)

    b) Design a system using the 8051 to display the temperature value read from a sensor on an LCD. Assume the temperature data is available in the accumulator. (7)

B24ECM42	DIGITAL COMMUNICATION (Minor)	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		3	1	0	3	4	2024

Preamble:
Digital communication explores the principles and technologies that enable efficient and reliable transmission of information in digital form, forming the backbone of modern connectivity and innovation.

Prerequisites:

NIL

Course Outcomes:

After the completion of the course the student will be able to:

CO 1	Develop a strong foundation in random processes (Cognitive Knowledge Level: Understand)
CO 2	To understand the Performance comparison various pulse modulation schemes (Cognitive Knowledge Level: Understand)
CO 3	To understand signal space representation of signal and to apply waveform coding techniques in digital transmission for zero ISI. (Cognitive Knowledge Level: Apply)
CO 4	Analyze and design baseband transmission systems with minimal inter-symbol interference, incorporating concepts like Nyquist criteria(Cognitive Knowledge Level: Analyze)
CO 5	Design and analyze bandpass digital modulation schemes such as ASK, FSK, PSK, and QAM (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	PO 12
CO 1	2	1	2	2	1	1	2					1
CO 2	1	2	2	1	2		2					1
CO 3	3	2	3	1	2	2	1					2
CO 4	3	2	3	2	3	3	3	1	1			2
CO 5	2	1	3	1	3	1	2	1				2

Assessment Pattern

Bloom's Category	Continuous Assessment		End Semester Examination (% Marks)
	Test 1 (% Marks)	Test 2 (% Marks)	
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	15 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-division.

SYLLABUS

MODULE 1

Random Signal Theory

Stationarity random process , WSS random process,ergodicity, mean, auto correlation, co-variance, random process transmission through linear filters, power spectral density, cross correlation functions, cross spectral densities, Gaussian process, Discrete Time Random Process, White Process

MODULE 2

Pulse Modulation schemes

Sampling and pulse modulation: Sampling theorem, Ideal sampling and reconstruction, practical sampling and Aliasing, PAM, PWM. Quantization,Quantization Noise, Companding,PCM generation and reconstruction, DPCM transmitter and receiver, Delta modulation, drawbacks of delta modulation.

MODULE 3

Signal Space representation and transmission

Signal Space Concepts, Gram- Schmidt Orthogonalization Procedure . Baseband transmission through AWGN channel.
Baseband shaping for Data Transmission : Binary signaling format, inter symbol interference, mathematical model of ISI. Nyquit criterion for zero ISI. Signal modeling for ISI,idel and practical solutions raised cosine spectrum and square-root raised cosine pulse. Eye pattern

MODULE 4

Transmission Over AWGN Channel: Conversion of continuous AWGN channel into a vector channel, likelihood function, maximum likelihood decoding, maximum likelihood receiver,Matched filter and its properties,correlation receivers, probability of error in receiver.

MODULE 5

Digital CW Modulation: ASK, BFSK, BPSK (need introduction only). BPSK transmitter and receiver. Base band QPSK transmitter and receiver with Signal constellations.Probability of error of BPSK and BFSK, Quadrature amplitude modulation and signal constellations.

Text Books

1. Simon Haykin , Introduction To Analog And Digital Communications, Wiley India Edition.
2. Simon Haykin , Digital Communications, Wiley India Edition.
3. John G. Proakis, Masoud Salehi, Digital Communication, McGraw Hill Education Edition, 2014.

Reference Books

1. Simon Haykin, Communication Systems, 4/e Wiley India, 2012
2. Carlson, Crilly, Rutledge, “Communication Systems” 4th Edition, McGraw Hill

3. Sklar: Digital Communication, 2E, Pearson Education.

4. Herbert Taub, Schilling Donald L.,"Principles of Communication Systems,3rd e/d, Tata Mc Graw Hill,2007.

COURSE CONTENTS AND LECTURE SCHEDULE

No	**Topic**	**No of Lecture/Tutorial Hours**
	Module 1 (Random Signal Theory)	10 hours
1.1	Random process: stationarity random process,WSS random process, ergodicity.	1 hour
1.2	mean, auto correlation.	2 hours
1.3	cross correlation, covariance, random process transmission through linear filters.	3 hours
1.4	power spectral density, cross correlation functions, cross spectral densities.	2 hours
1.5	Gaussian process, Discrete Time Random Process, White Process.	2 hours
	Module 2 (Pulse Modulation schemes)	8 hours
2.1	Pulse Modulation Techniques: Sampling and pulse modulation: Sampling theorem, Ideal sampling and reconstruction, practical sampling and Aliasing,PCM generation and reconstruction .	3 hours
2.2	PAM, PWM, Quantizing,Quantization error, Companding.	3 hours
2.3	DPCM transmitter and receiver,Delta Modulation,Drawbacks of delta modulation,problems based on slope overload distortion.	2hour
	Module 3 (Signal Space representation and transmission)	10 hours
3.1	Signal Space Representation of Waveforms:Signal Space Concepts, Gram- Schmidt Orthogonalization Procedure with problem	3 hours
3.2	Detection and Estimation: Baseband transmission through AWGN channel. Baseband shaping for Data Transmission: Binary signaling format, inter symbol interference, mathematical model of ISI.	4 hours
3.3	Nyquit criterion for zero ISI.ideal and practical solution Signal modeling for ISI, raised cosine spectrum and	3hours
3.4	square-root raised cosine pulse and eye pattern	1 hour
	Module 4 (Detection and estimation)	9 hours
4.1	Transmission Over AWGN Channel: Conversion of the continuous AWGN channel into a vector channel, .	2 hours

4.2	Likelihood function, Maximum Likelihood Decoding,Maximum likelihood receiver	3 hours
4.3	Matched filter and correlation receivers and probability of error in optimum receiver.	4 hours
	Module 5 (Advanced Materials and Devices for Engineering Applications)	8 hours
5.1	Digital modulation schemes. Digital CW Modulation: ASK, BFSK, BPSK .	2 hours
5.2	BPSK signal representation and constellation,transmitter and receiver.	2 hours
5.3	Base band QPSK system and Signal constellations,transmitter and receiver.	2 hours
5.4	Probability of error of BPSK and BFSK.	1 hour
5.5	Quadrature amplitude modulation and signal constellation.	1 hour
	Total Hours	45 Hours

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Define stationarity and differentiate between strict-sense stationarity (SSS) and wide-sense stationarity (WSS) with examples..
2. Describe the mean, autocorrelation, and cross-correlation functions for a random process and their physical interpretations.
3. Prove that the output of a stationary random process passing through a linear filter remains stationary.
4. What are the key properties of a Gaussian random process, and why is it widely used in signal processing?

Course Outcome 2 (CO 2):

1. State and explain the Sampling Theorem. Why is it important in digital communication?
2. Describe the steps involved in the generation and reconstruction of PCM signals.
3. Analyze the drawbacks of Delta Modulation, particularly slope overload distortion, and propose solutions to overcome these issues.
4. Analyze the trade-offs between PCM, DPCM, and Delta Modulation for bandwidth and signal-to-noise ratio.

Course Outcome 3 (CO 3):

1. Define the Signal Space Concept and explain its significance in communication systems.
2. Illustrate the Gram-Schmidt orthogonalization procedure to represent a given set of waveforms using orthogonal basis.
3. Define Inter-Symbol Interference (ISI) and describe its mathematical model.
4. State and explain the Nyquist Criterion for Zero ISI.Compare and contrast the raised cosine spectrum and the square-root raised cosine spectrum.
5. Elaborate the significance of eye pattern

Course Outcome 4 (CO 4):

1. Define the likelihood function and its role in detection and decoding.
2. Explain Maximum Likelihood (ML) Decoding .
3. Analyze the performance difference between a correlation receiver and a matched filter receiver in detecting signals transmitted over an AWGN channel?

Course Outcome 5 (CO 5):

1. Define different digital modulation schemes and explain their basic principles.
2. Describe the operation of a BPSK & QPSK transmitter and receiver with a block diagram.
3. Analyze the probability of error of BFSK and compare it with BPSK.
4. Explain the relationship between the number of constellation points in a QAM system and its data rate.

MODEL QUESTION PAPER

QP CODE: **Pages: 2**

Reg.No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

FOURTH SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER2025

Course Code: B24ECM42

Course Name: DIGITAL COMMUNICATION

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks.

1. Define the Power spectral Density (PSD) of a stationary random process X(t).
2. A continuous random variable X is uniformly distributed in the interval [0,8].fiND its PDF?
3. What is Companding, and why is it used in communication systems?
4. What is slope overload distortion in Delta Modulation? How can it be mitigated?
5. Why signal-to-noise ratio (SNR) is important in an AWGN channel?
6. Explain the significance of roll-off factor in raised cosine pulse.
7. Describe the key differences between a matched filter and a correlation receiver?
8. What is the likelihood function in the context of AWGN channels?
9. What are the advantages of QPSK over BPSK?.
10. Draw the constellation plot for the BPSK system and explain.

PART B

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

1. (a) A random process $A\cos(\omega t+\phi)$ is defined, where A,ω are constants, and ϕ is uniformly distributed over [0,2]. (a) Is the process stationary in the strict sense? (b) Is it wide-sense stationary? 8

   (b) Discuss how a random process is affected when passed through a linear time-invariant (LTI) filter. Derive the expression for the output autocorrelation function. 6

OR

2. (a) A white noise process $X(t)$ has a constant power spectral density (PSD)

$$S_X(f)=\frac{N_0}{2}.$$

   (i)Derive the autocorrelation function $R_X(\tau)$. (ii) Calculate the output PSD if $X(t)$ is passed through a low-pass filter with

$$H(f)=\frac{1}{1+jf}.$$

   . 9

   (b) What is a white noise process? Discuss its autocorrelation function and power spectral density. 5

3. (a) Explain the transmitter and receiver structure of Differential Pulse Code Modulation. Discuss its advantages over standard PCM. 8

   (b) A 4 kHz message signal is sampled at 8 kHz, quantized into 8 levels, and encoded using PCM. Determine: (a) The bit rate of the PCM signal. (b) The bandwidth required to transmit this PCM signal. 6

OR

4. (a) A message signal x(t)=sin(2*pi* 100t) is to be encoded using delta modulation. The sampling rate is 10 KHz, and the step size is Δ=0.1V. (a) Determine if slope overload distortion occurs. (b) Calculate the maximum permissible step size to avoid slope overload. . 9

   (b) Explain the working of Delta Modulation and discuss its drawbacks. 5

5. (a) State and explain the Nyquist criterion for zero inter symbol interference. 8

   (b) Explain the significance of the raised cosine spectrum in minimizing inter-symbol interference. 6

OR

6. (a) Expalin the Gram-shmidt orthogonalization procedure with an example. 10

   (b) Describe how an eye pattern can be used to assess the performance of a digital communication system. 4

7. (a) What is a matched filter receiver? Derive the output of the matched filter for a signal transmitted over an AWGN channel. 9

(b) Explain the properties of Matched filter? 5

OR

8. (a) What is Maximum Likelihood (ML) Decoding? Discuss its significance in minimizing the probability of error in a communication system. 7

   (b) How is a continuous AWGN channel converted into a vector channel? 7

9. (a) Draw and explain the signal constellation diagram for QPSK modulation.Explain its transmitter and receiver. 10

   (b) What is meant by quadrature amplitude modulation? Plot diferent constellation for the same. 4

OR

10. (a) Derive the expression of probability of error for BPSK 14

B24ECM43	INTRODUCTION TO DIGITAL SIGNAL PROCESSING (Minor)	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		3	1	0	3	4	2024

Preamble: This course aims to give an introduction to digital signal processing

Prerequisite: B24ECM33 : Introduction to Signals and Systems

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

CO 1	Explain how digital signals are obtained from continuous time signals.
CO 2	Solve basic problems involving DFT using its properties and FFT algorithms
CO 3	Design and realize FIR and IIR filters for a given specification
CO 4	Understand finite precision representation of numbers in a digital system and finite world length effects
CO 5	Understand the multiprocessor architecture of the DSP processors.

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**	**PO 12**
CO 1	3	1										
CO 2	3	3	2	2	3				3			1
CO 3	3	2	3	3	3				3			
CO 4	3	1										
CO 5	3	1			1							

Assessment Pattern

Bloom's Category	Continuous Assessment		End Semester Examination
	Test 1	Test 2	
Remember	30	30	30
Understand	30	30	30
Apply	40	40	40

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	15 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-division.

SYLLABUS

MODULE 1
Discrete-time and digital signals. Basic elements of digital processing system- ADC, DAC and Nyquist rate. Frequency aliasing due to sampling. Need for anti-aliasing filters. Discrete-Time Fourier Transforms– Properties(proof not required). Computation of spectrum.

MODULE 2
Discrete Fourier transform - DFT as a linear transformation, Properties(proof not required) - circular convolution. Filtering of long data sequences - FFT-Radix-2 DIT and DIF algorithms. Computational complexity of DFT and FFT .

MODULE 3
Digital FIR Filter: Linear phase FIR filter, Design of FIR filter using windowing method (Rectangular, Hamming, Hanning), Direct form and cascade realization of FIR filters. Digital IIR Filters.IIR filter design by impulse invariance and bilinear transformation, Frequency transformations in the analog and digital domain. Design of analog Butterworth filter. Realization of IIR filter: Direct form.

MODULE 4
Fixed point arithmetic, Floating point arithmetic, Truncation and Rounding, Quantization error in ADC, Overflow error, Product round-off error, Scaling, Limit cycle oscillation.

MODULE 5
General and special purpose hardware for DSP: Computer architectures for DSP – Harvard, pipelining, MAC, special instruction, replication, on-chip cache. General-purpose digital signal processors (TMS 320 family) - Implementation of digital filtering on DSP processor. Special purpose DSP hardware

Text Books
1. Proakis, J.G. & Manolakis, D.G., “Digital Signal Processing: Principles, Algorithms,& Applications”, 3/e Prentice Hall of India, 1996
2. Ifeachor, E.C., & Jervis, B.W., “Digital Signal Processing: A Practical Approach”,2/e, Pearson Education Asia, 2002.
3. Chen, C.T., “Digital Signal Processing: Spectral Computation & Filter Design”, Oxford Univ. Press, 2001.
4. Mitra, S.K., “Digital Signal Processing: A Computer-Based Approach”, McGraw Hill, NY, 1998
5. Monson H Hayes, Schaums outline: Digital Signal Processing

COURSE CONTENTS AND LECTURE SCHEDULE

No	Topic	No of Lecture/Tutorial Hours
1	**Module 1**	**8**
1.1	Overview of signals. Frequency elements of DSP sytems.	2
1.2	Conversion of analog signals to digital signals, Sampling theorem, reconstruction ADC and DAC, spectra and antialiasing filter	3
1.3	DTFT properties(proof not required)., spectrum	3
2	**Module 2**	**9**
2.1	DFT from DTFT, DFT as a linear transformation (proof not required). W matrix. Properties of DFT, Computational challenges.	3
2.2	FFT for computational advantage, Radix -2 DIT and DIF algorithm, in place computation. Bit reversal permutation. complexity	4
2.3	Filtering of long sequences	2
3	**Module 3**	**12**
3.1	Digital FIR Filter: Linear phase FIR filter, Design of FIR filter using windowing method (Rectangular, Hamming, Hanning)Direct form and cascade realization of FIR filters. Digital IIR Filters.	5
3.2	IIR filter design by impulse invariance and bilinear transformation, Frequency transformations in the analog and digital domain.	3
3.3	Design of analog Butterworth filter. Realization of IIR filter: Direct form.	4
4	**Module 4**	**7**
4.1	Number representation Truncation - Rounding - Quantization error in ADC - Overflow error- product round off error - Scaling - Limit cycle oscillation.	2
4.2	Truncation-Rounding - Quantization error in ADC - Overflow error - product round-off error - Scaling - Limit cycle oscillation.	5
5	**Module 5**	**9**
5.1	Von Neumann and Harvard architecture, Comparison	2
5.2	Data paths of fixed and floating point DSP processors. Functions of various blocks Architecture of a typical DSP processor	5
5.3	Implementation of systems on DSP chip	2
	Total Hours	**45**

Simulation Assignments

The following simulation assignments can be done with Python/MATLAB/SCILAB/OCTAVE

1. Generate the following discrete signals
   - Impulse signal
   - Pulse signal and
   - Triangular signal
2. Write a function to compute the DFT of a discrete energy signal.Test this function on a few signals and plot their magnitude and phase spectra.
3. - Compute the linear convolution between the sequences $x = [1, 3, 5, 3]$ with $h = [2, 3, 5, 6]$. Observe the stem plot of both signals and the convolution.
   - Now let $h = [1, 2, 1]$ and $x = [2, 3, 5, 6, 7]$. Compute the convolution between h and x.
   - Flip the signal x by 180° so that it becomes $[7, 6, 5, 3, 2]$. Convolve it with h. Compare the result with the previous result.
   - Repeat the above two steps with $h = [1, 2, 3, 2, 1]$ and $h = [1, 2, 3, 4, 5, 4, 3, 2, 1]$
   - Give your inference.
4. - Compute the DFT matrix for $N = 8, 16, 64, 1024$ and 4098
   - Plot the first 10 rows in each case and appreciate these basis functions
   - Plot the real part of these matrices as images and appreciate the periodicities and half periodicities in the pattern
   - Normalize each matrix by dividing by $\sqrt{N}$. Compute the eigenvalues of every normalized matrix and observe that all eigenvalues belong to the set $\{1, j, -j, -1\}$.
5. Realize a continuous time LTI system with system response
$$H(s) = \frac{5(s+1)}{(s+2)(s+3)}$$
   One may use *scipy.signal.lti* package in Python.
   - Make it into a discrete system (possibly with *scipy.signal.cont2discrete*)
   - Observe the step response in both cases and compare.
6.
   - Download a vibration signal in *.wav* format.
   - Load this signal into an array. One may use the *scipy.io.wavfile* module in Python.
   - Understand the sampling rate of this signal.

   - Plot and observe the vibration signal waveform.
   - Compute the absolute squared value of the FFT of the vibration signal.
   - Plot it and observe the spectral components in the discrete frequency domain.
   - Multiply prominent discrete frequencies by the sampling rate and observe and appreciate the major frequency components in Hz.

MODEL QUESTION PAPER

QP CODE: **Pages: 5**

Reg.No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

FOURTH SEMESTER B TECH DEGREE (MINOR) EXAMINATION, DECEMBER 2024

Course Code: B24ECM43

INTRODUCTION TO DIGITAL SIGNAL PROCESSING

Max. Marks: 100 Duration: 3 hours

PART A

(Answer all questions. Each question carries 3 marks.)

1. De ne frequency of a discrete signal and identify its range.
2. State Nyquist sampling theorem for low pass signals and the formula for signal reconstruction.
3. Explain why DFT operation is a linear transformation.
4. Explain how it reduces the computational complexity of DFT.
5. Write the expression for the Hamming window and plot it.
6. Give the expression for bilinear transformation and explain the term frequency warping.
7. Explain the quantization error in ADCs.
8. . Explain the 1s and 2s complement representation of numbers in DSP processor.
9. Compare floating point and fixed point data paths in a DSP processor.
10. Explain the function of a barrel shifter in a DSP processor.

PART B

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

MODULE I

11. a. Explain how analog signals are converted to digital signals. (10 marks)

    b.What digital frequencies are obtained when a 1 *kHz* signal is sampled by 4kHz and 8 *kHz* impulse trains? (4marks)

OR

12. a. Give the expression for DTFT. Compute the DTFT of the signal x[n] = [1,-1,1,-1]. (8 marks)

    b. Explain how sampling affects the spectrum of the signal and the need for an antialiasing filter. (6 marks)

MODULE II

13. a. Give the radix-2 decimation in time algorithm for 8-point FFT computation. (10 Marks)

    b. How is in-place computation applied in FFT algorithms? (4 Marks)

OR

14. a. Find the DFT of the sequence *x(n)* = {1,2,3,4,4,3,2,1} using radix-2 DIF algorithm (10 marks)

    b. How is bit reverse addressing used in FFT computations? (4 marks)

MODULE III

15. a. Write the difference equation representation of the IIR filter and explain how its impulse response is infinite in duration (7 marks)

    b. Convert the analog filter $H(s)$ into digital filter using impulse invariance method. (7 marks)

$$H(s) = \frac{1}{(s+1)(s+2)}$$

OR

16. a. Implement the FIR filter *h[n]* = [1,2,4,6,4,2,1] with minimum multipliers in direct form (6 marks)

    b. Design an IIR Butterworth filter for passband frequency 5 *kHz* and stopband frequency 10 *kHz*. The stop band and pass band attenuations are 0.1 respectively. (8 marks).

MODULE IV

17. a. Explain the limit cycle oscillations in IIR filters (6 marks)

    b. Derive the quantization noise power in an ADC (8 marks)

OR

18. a. Find the output noise variance of a first-order system with transfer function $H(z)$ that is driven by a zero mean white Gaussian noise of variance σ_N^2, where $H(z)$ is given by (8 marks)

$$H(z) = \frac{1}{1 - \alpha z^{-1}}$$

    b. Explain the fixed and floating point arithmetic used in DSP processors. (6 marks)

MODULE V

19. Draw and explain the functional blocks in a floating point DSP processor. (14 marks)

OR

20. a. Compare Von Neumann architecture with Harvard architecture (7marks)

    b.Explain the significance and operation of the MAC unit in a DSP processor (7 marks)

B24ECH41	NANO ELECTRONICS (Honors)	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		3	1	0	3	4	2024

Preamble

This course aims to understand the physics behind mesoscopic systems and working of nanoelectronic devices.

Prerequisites

B24PH1T01A : Engineering Physics
B24EC2T04 : Solid State Devices.

Course Outcomes

After the completion of the course the student will be able to:

CO 1	Explain Quantum mechanical effects of low dimensional semiconductors and solve numericals to find nanomaterial [Remember].
CO 2	Understand the fabrication process of nanoparticles and nanolayers. [Understand]
CO 3	Explain the different techniques for characterizing nano-layers and particles.[Understand]
CO 4	Understand the different transport mechanisms in nano structures.[Remember, Understand]
CO 5	Illustrate the operating principle of nanoscale electronic devices like SET, Resonant tunneling devices, Quantum lasers etc.[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**	**PO 12**
CO 1	3	3	2	1								2
CO 2	3	2	1	1								2
CO 3	2	2	1	2								2
CO 4	3	2	1	1								2
CO 5	3	3	2	1								2

Assessment Pattern

Bloom's Category	Continuous Assessment		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/Class work	15 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-division.

Course Level Assessment Questions

Course Outcome 1 (CO1):

1. Derive the expression for density of states in a 1D nanomaterial.

2. Compare and contrast triangular, square and parabolic quantum wells.

3. Solve numerical problems to find whether the given material is a nanometric one.

Course Outcome 2 (CO2) :

1. Explain Sol-Gel process for synthesis of nanoparticles.

2. Explain the different steps involved in CVD process for fabricating nanolayers.

3. DC sputtering cannot be used for the coating of non- conducting materials. Justify.

Course Outcome 3 (CO3):

1. Illustrate the working principle of an AFM.

2. Explain the different emission and interactions between electron beam and the specimen.

3. Explain the principle of operation of an XRD.

Course Outcome 4 (CO4):

1. Explain Kronig Penney model of a super lattice.

2. Explain modulation doping with an example.

3. Explain the different scattering events encountered by a carrier during parallel transport under the influence of electric field.

Course Outcome 5 (CO5):

1. Explain Coulomb blockade effect. Illustrate the working of a single electron transistor.

2. Draw the schematic representation of the conduction band of a resonant tunnel diode for (a) no voltage applied (b) increasing applied voltages. Explain its I-V characteristics.

3. MODFETS are high electron mobility transistors. Justify.

SYLLABUS

MODULE I

Introduction to nanotechnology, characteristic lengths in mesoscopic systems, Quantum mechanical coherence Classification of Nano structures, Low dimensional structures Quantum wells, wires and dots, Density of states and dimensionality. Basic properties of two dimensional semiconductor nanostructures, square quantum wells of finite depth, parabolic and triangular quantum wells, Quantum wires and quantum dots, carbon nanotubes.

MODULE II

Introduction to methods of fabrication of nano-layers, different approaches, physical vapour deposition, chemical vapour deposition. Molecular Beam Epitaxy, Ion Implantation, Formation of Silicon Dioxide- dry and wet oxidation methods. Fabrication of nano particle-grinding with iron balls, laser ablation, reduction methods, sol gel, self assembly, precipitation of quantum dots.

MODULE III

Introduction to characterization of nanostructures, tools used for of nano materials characterization, microscope-optical, electron, and electron microscope. Principle of operation of Scanning Tunnelling Microscope, Atomic Force Microscope, Scanning Electron microscope, Specimen interaction. Transmission Electron Microscope. X-Ray Diffraction analysis, PL and UV Spectroscopy, Particle size analyser.

MODULE IV

Two dimensional electronic system, two dimensional behaviour, MOSFET structures, Heterojunctions. Quantum wells, modulation doped quantum wells, The concept of super lattices Kronig - Penney model of super lattice.

MODULE V

Nanoelectonic devices - MODFETS, Single Electron Transistor, CNT transistors – Properties of graphene Resonant tunnel effect, RTD, RTT, Hot electron transistors. Quantum well laser, quantum dot LED, quantum dot laser. Quantum well optical modulator, quantum well sub band photo detectors, principle of NEMS.

Text Books

1.J.M. Martinez-Duart, R.J. Martin Palma, F. Agulle Rueda Nanotechnology for Microelectronics and optoelectronics , Elsevier, 2006

2. W.R. Fahrner, Nanotechnology and Nanoelectronics, Springer, 2005.

Reference Books

1. Chattopadhyay, Banerjee, Introduction to Nanoscience & Technology, PHI 2012

2. Poole, Introduction to Nanotechnology, John Wiley 2006.

3. George W. Hanson, Fundamentals of Nanoelectronics, Pearson Education, 2009.

4. K. Goser, P. Glosekotter, J. Dienstuhl, Nanoelectronics and nanosystems, Springer 2004.

5. Supriyo Dutta, Quantum Transport- Atom to transistor, Cambridge, 2013.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Topic	No of Lecture/Tutorial Hours
	Module 1	**10**
1.1	Introduction to nanotechnology, characteristic lengths in mesoscopic systems, Quantum mechanical coherence .	2
1.2	Classification of Nano structures, Low dimensional structures Quantum wells, wires and dots.	2
1.3	Density of states and dimensionality.	1
1.4	Basic properties of two dimensional semiconductor nanostructures.	1
1.5	Square quantum wells of finite depth, parabolic and triangular quantum wells.	1
1.6	Quantum wires and quantum dots.	1
1.7	carbon nanotubes.	1
1.8	TUTORIAL.	1
	Module 2	**9**
2.1	Introduction to methods of fabrication of nano-layers, different approaches, physical vapour deposition.	2
2.2	Chemical vapour deposition.	1
2.3	Molecular Beam Epitaxy, Ion Implantation.	1
2.4	Formation of Silicon Dioxide- dry and wet oxidation methods.	1
2.5	Fabrication of nano particle- grinding with iron balls, laser ablation, reduction methods	2
2.6	sol gel, self assembly, precipitation of quantum dots.	2
	Module 3	**12**
3.1	Introduction to characterization of nanostructures	2
3.2	tools used for of nano materials characterization, microscope-optical, electron, and electron microscope.	2
3.3	Principle of operation of Scanning Tunnelling Microscope, Atomic Force Microscope, Scanning Electron microscope, Specimen interaction	3
3.4	Transmission Electron Microscope. X-Ray Diffraction analysis	2
3.5	PL and UV Spectroscopy, Particle size analyser.	2
3.6	TUTORIAL	1
	Module 4	**9**
4.1	Two dimensional electronic system, two dimensional behaviour.	2
4.2	MOSFET structures, Heterojunctions.	2
4.3	Quantum wells, modulation doped quantum wells	2
4.4	The concept of super lattices Kronig - Penney model of super lattice.	2

4.5	TUTORIAL	1
	Module 5	**8**
5.1	Nanoelectonic devices - MODFETS.	1
5.2	Single Electron Transistor, CNT transistors	1
5.3	Properties of graphene, Resonant tunnel effect	1
5.4	RTD, RTT, Hot electron transistors.	1
5.5	Quantum well laser, quantum dot LED, quantum dot laser.	1
5.6	Quantum well optical modulator, quantum well sub band photo detectors.	2
5.7	Principle of NEMS.	1
	Total Hours	**48 Hours**

MODEL QUESTION PAPER

QP CODE: **Pages: 5**

Reg.No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

FOURTH SEMESTER B TECH DEGREE EXAMINATION (HONOURS), DECEMBER 2024

Course Code: B24ECH41

Course Name: NANOELECTRONICS

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks

1. Explain any three characteristic lengths in mesoscopic systems.
2. Explain the terms (i) coherence length (ii) phase coherence.
3. Differentiate dry and wet oxidation.
4. DC sputtering cannot be used for coating of non-conducting materials. Justify.
5. Explain two different modes of operation of a STM.
6. Explain XRD method for characterizing nano materials.
7. Differentiate between the two types of multiple quantum wells.
8. Explain Aharonov-Bohm effect.
9. Explain why MODFETs are called high electron mobility transistors.
10. List any six properties of graphene.

PART B

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

Module I

11. a) Show that DOS in a 2D material is independent of energy. (8)

 b) Explain any three physical limitations in reducing the size of devices in Nano metric scale. (6)

12. Compare and contrast square, parabolic and triangular quantum wells (14)

Module II

13. a) Illustrate the process of Molecular Beam Epitaxi for fabricating nano layers. (8)

 b) Differentiate between dry oxidation and wet oxidation techniques (6)

14. a) Sketch and label a CVD reactor and explain the different steps involved in the CVD process. (8)

 b) Explain the reduction method for nano particle fabrication (6)

Module III

15. Explain the different specimen interactions of an electron beam and illustrate the working of a SEM (14)

16. Explain the principle of operation of an AFM. Explain the different modes of operation. . (14)

Module IV

17. a) Explain Kronig–Penney model of a super lattice. What is meant by Zone folding? (10)

 b) Explain the concept of hot electrons in parallel transport (4)

18. a) Explain Coulomb Blockade effect. (8)

 b) Explain the concept of hot electrons in parallel transport (6)

Module V

19. a) Draw the schematic and explain the working of a single electron transistor. (8)

 b) Explain working of resonant tunneling diodes (6)

20. a) Illustrate the working of a quantum well laser (6)

 b) Explain the different types of Carbon Nanotube transistors (8)

B24ECH42	STOCHASTIC PROCESSES FOR COMMUNICATION (Honors)	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		3	1	0	3	4	2024

Preamble

This course aims to apply the concepts of probability and random processes in communication systems.

Prerequisites : None

Course Outcomes:

After the completion of the course the student will be able to

CO 1	Explain the concepts of probability, random variables and stochastic processes[Remember]
CO 2	Apply the knowledge in probability to statistically characterize communication channels.[Understand, Apply]
CO 3	Apply probability to find the information and entropy[Understand, Apply]
CO 4	Explain source coding and channel coding theorem. [Remember]
CO 5	Apply stochastic processes in data transmission.[Understand, 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**	**PO 12**
CO 1	3	3										
CO 2	3	3		3	2							
CO 3	3	3		3	2							2
CO 4	3	3										
CO 5	3	3		3	2							

Assessment Pattern

Bloom's Category	Continuous Assessment		End Semester Examination (% Marks)
	Test 1 (%Marks)	Test 2 (%Marks)	
Remember	30	30	30
Understand	40	40	40
Apply	30	30	30

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/Class work	15 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-division.

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1): Concepts in probability

1. Give frequentist and axiomatic definitions of probability. State the demerits of frequentist definition.
2. What is a random variable? Illustrate with an example how it becomes useful in studying engineering problems?
3. A six faced die with P(1)=P(3)=1/3, P(4)=P(5)=1/4 is thrown in a game with outcomes listed in the table.

Face	1	2	3	4	5	6
Payoff (Rs)	50	-40	60	-60	-20	100

The + and - signs indicate gain and loss for the player, respectively.

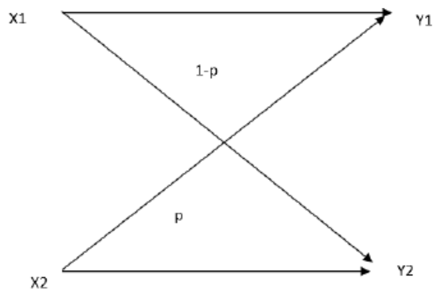
1. Draw the CDF and PDF
2. Compute the expected value of gain/loss. Is it worthwhile to play the game?
3. Compute the entropy of the random variable.

Course Outcome 2 (CO 2): Review of random processes

1. Give the conditions for WSS and SSS.
2. Test if the sinusoid X(t)=Acos(2π ft+θ) with θ variying uniformly in the interval [-π,π] is WSS.
3. Define white Gaussian noise.
4. State central limit theorem. Why is the Gaussian model suitable in additive noise channels?

Course Outcome 3 (CO 3):Entropy and Information

1. Define discrete memoryless source and discrete memoryless channel.
2. Define entropy and conditional entropy.
3. See the binary symmetric channel in the figure below.
   Let p(x1)=1/3 and p =1/4. Compute the mutual information between X and Y.



Course Outcome 4 (CO 4): Source coding and Channel Coding

1. State the source coding theorem.
2. Compute the mutual information between the input and output of an AWGN channel. What is its capacity?
3. Find the capacity of an AWGN channel with 4kHz bandwidth and the noise power spectral density 10^{-12}W/Hz. The signal power at the receiver is 0.1mW.

Course Outcome 5 (CO 5): Stochastic processes in data transmission

1. Derive Chapman – Kolmogorov equation.
2. Explain the need for spectrum estimation.
3. Explain the packet transmission in a slotted ALOHA network.
4. Consider a Markov chain with three possible states 1,2,3 with transition probability matrix

$$\begin{vmatrix} \frac{1}{4} & \frac{1}{2} & \frac{1}{4} \\ \frac{1}{3} & 0 & \frac{2}{3} \\ \frac{1}{2} & 0 & \frac{1}{2} \end{vmatrix}$$

   (a) Draw the state transition diagram.
   (b) Find P(X4=3|X3=2)
   (c) If P(X0=1)=1/3 Find P(X0=1,X1=2)

SYLLABUS

Module 1 :

Review of probability. Relative frequency and Axiomatic definitions of probability, Significance of axiomatic definition. Bayes theorem and conditional probability. Independence. Discrete random variables. The cumulative distribution and density functions for discrete random variables. Joint distribution and conditional distribution. Statistical averages. Mean, Variance and standard deviation, Gaussian density function, Pdf of envelop of two gaussian variables.

Module 2 :

Stochastic Processes. Stationarity and ergodicity. WSS and SSS processes. Gaussian Random process, Mean and autocorrelation and power spectral density functions. Weiner Kinchine theorem, Bandwidth of a random process, PSD of a Pulse Amplitude Modulated wave. White noise, Filtering of discrete WSS process by LTI systems. Noise-equivalent bandwidth, Signal to Noise Ratio, Matched Filter, Bandlimited and narrowband random process.

Sum of random variables, The central limit theorem (statement only). Gaussianity of thermal noise.

Module 3:

Basics of discrete communication system, Sources, channels and receivers. Discrete memoryless sources. Entropy. Source coding theorem (statement only). Mutual Information. Discrete memoryless channels. Matrix of channel transmission probabilities. Noiseless and noisy channels, binary symmetry channels. Channel coding theorem (statement only) Channel capacity for BSC (derivation required), Differential entropy, Channel capacity of AWGN channel (statement only).

Module 4 :

Markov process. Definition and model. Markov chain. Transition probability matrix. State diagram and characteristics of a Markov chain. Chapman Kolmogorov equation. Poisson process.

Module 5 :

Overview of queuing theory. M/M/1, M/M/∞, Application to packet transmission in a slotted ALOHA computer communication network.

Text Books

1. Papaulis and Unnikrishna Pillai, *"Probability, Random Variables and Stochastic Processes"*, MH.
2. *Analog and Digital Communication Systems*, Hsu, Schaum Outline Series, MGH.
3. *Digital Communication*, John G Proakis, John Wiley.
4. *Probability and Random Processes*, Miiller and Childers, Ed. 2, Academic Press.
5. *Data Networks*, Bertsekas and Gallager, Ed. 2, PHI.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Topic	No of Lecture
1	**Module 1**	**12**
1.1	Review of probability. Relative frequency and Axiomatic definitions of probability, Significance of axiomatic definition.	2
1.2	Conditional probability, Bayes theorem, Meaning and significance of prior. Random variable. Definition. Random variable as a function and its domain. Comparison with probability function.	2
1.3	Examples of RV. Discrete and continuous RV. CDF and PDF of RV(both discrete and continuous) Examples. Relation between the two and properties	1
1.4	The cumulative distribution and density functions for discrete random variables. Joint distribution and conditional distribution.	3
1.5	Statistical averages. Mean, Variance and standard deviation	2
1.6	Gaussian density function, Pdf of envelop of two gaussian variables	2
2	**Module 2**	**8**
2.1	Stochastic Processes. Stationarity and ergodicity. WSS and SSS processes. Gaussian Random process	2
2.2	Mean and autocorrelation and power spectral density functions. Weiner Kinchine theorem, Bandwidth of a random process, PSD of a Pulse Amplitude Modulated wave.	2

2.3	White noise, Filtering of discrete WSS process by LTI systems. Noise- equivalent bandwidth, Signal to Noise Ratio, Matched Filter, Bandlimited and narrowband random process.	3
2.4	Sum of random variables, The central limit theorem (statement only). Gaussianity of thermal noise.	1
3	**Module 3**	**9**
3.1	Basics of discrete communication system, Sources, channels and receivers.	1
3.2	Discrete memoryless sources. Entropy. Source coding theorem (statement only).	1
3.3	Mutual Information. Discrete memoryless channels. Matrix of channel transmission probabilities. Noiseless and noisy channels, binary symmetry channels.	2
3.4	Channel coding theorem (statement only) Channel capacity for BSC (derivation required),	3
3.5	Differential entropy, Channel capacity of AWGN channel (statement only).	2
4	**Module 4**	**8**
4.1	Markov process. Definition and model.	1
4.2	Markov chain. Transition probability matrix. State diagram and characteristics of a Markov chain. Chapman Kolmogorov equation.	4
4.4	Poisson process	3
5	**Module 5**	**8**
5.1	Overview of queuing theory.	2
5.2	M/M/1, M/M/∞ systems.	3
5.3	Application to packet transmission in a slotted ALOHA computer communication network.	3
	Total Hours	**45**

Simulation Assignments

The following simulations can be done in Python/R/MATLAB/SCILAB.

Generation of Discrete Stochastic Signals

1. Simulate stochastic signals of
   - Uniform
   - Binomial
   - Gaussian
   - Rayleigh
   - Ricean

   probability density functions and test their histograms.
2. Compute the statistical averages such as mean, variance, standard deviation etc.

3. Compute the autocorrelation matrix for each signal. Compare the autocorrelation of Gaussian signal with others.

4. Observe the spectrum of the signal and relate it with the autocorrelation function.

Central Limit Theorem—Gaussianity of Channels

- Simulate a coin toss experiment that generates a string of length N of 0s and 1s that are uniformly distributed.
- Toss the coin M times and sum up the string in every toss.
- Plot the normalized histogram of the sum values for $M = 100, 1000, 5000$. Observe that it is a Binomial distribution.
- Plot the function $q = \binom{M}{r} p^r (1-p)^{M-r}$ and compare with the histogram.
- Make M very large and observe that the histogram tends to become Gaussian, justifying the central limit theorem.

Frequency of Characters in English Text and the Entropy

1. Understand the probabilities of occurrence of characters in English text, say an English novel with more than 300 pages (that contains text only) in `.txt` format. (Students may download one such file.)

2. Read the novel in `.txt` format into a single string or array, identify the unique symbols (all letters, numbers, punctuation marks, etc.), and plot their frequencies of occurrence.

3. Appreciate the probabilities of occurrences of all symbols.

4. Compute the entropy and the information content in the book.

Simulation of a Point Process

1. It is required to simulate a point Poisson process, say the arrival of packets in a queue.

2. Let the rate of arrival of packets be say 100 per second.

3. Simulate the Poisson process using small time bins of say 1 millisecond.

4. Since Poisson process has no memory, the occurrence of an event is independent from one bin to another.

5. Binary random signals can be used to represent success or failure.

6. Simulate and display each event with a vertical line using say *matplotlib*.

7. Generate the counting process $N(t)$, which is the sum of the events until time t.

8. Plot $N(t)$ against t and appreciate it.

Simulation of a Discrete Markov Chain

1. It is required to simulate a birth-death process as a discrete Markov chain.
2. Let us consider that the total population cannot exceed 1000 and the initial population is 100.
3. Set equal birth and death rates.
4. Iterate for say 10,000 steps and plot the population against the iteration number.
5. Repeat the simulation for different rates and different population and iteration sizes and appreciate the results.

MODEL QUESTION PAPER

QP CODE: **Pages: 5**

Reg.No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

FOURTH SEMESTER B TECH DEGREE (HONOURS) EXAMINATION

Course Code: B24ECH42

STOCHASTIC PROCESSES FOR COMMUNICATION

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks

1. Give the three definitions of probability
2. In the toss of an unnfair coin, the probability of head is 1 3.Write the conditions for strict sense and wide sense stationarity
3. State central limit theorem. Give its significance.
4. Explain the Gaussian statistics of communication channels
5. State the two source coding theorems
6. Give channel matrix of a noiseless binary channel
7. With mathematical model, explain Markov process
8. Give an example of a Markov chain with its transition probabib- lity matrix
9. Explain an M/M/1 queue system in packet transmission
10. Explain the statistics of packet arrival in M/M/1 queue system

PART B

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

Module I

11. a) Derive mean and variance of a Gaussian distribution with parameters μ and σ^2 (8)

    b) A random variable X has the following pdf. (6)

$$f_X(\lambda) = \begin{cases} \frac{|4|}{|8|}, & -3 \leq \lambda \leq 3, \\ 0, & \text{else} \end{cases}$$

Find the probability $P(|\lambda| < 1.5)$
Find the probability $P(1.2 \leq \lambda \leq 2.3)$
Find $E[X]$

OR

12. a) A six faced die with P(1) = P(5) = 1/6 , P(4) = P(3) = 1/8,P(2) = 1/12 is thrown in a game with outcomes listed in the table. (14)

Face	1	2	3	4	5	6
Payoff (Rs)	50	-40	60	-60	-20	100

The + and- signs indicate gain and loss for the player respectively.
(i) Draw the CDF and PDF of the Payoff random variable.
(ii) Compute the expected value of gain/loss. Is it worthwhile to play the game?
(iii) What is the variance of Payoff?

Module II

13. a) Test if the random process

$$X(t) = Acos(2\ fct+\theta)$$

is WSS with A a random variable in the interval [-π ,π]. (7)

   b) If a random signal is applied as input to an LTI system, how is the power spectral density of the output related to that of the input? Explain. (7)

OR

14. (a) State and prove Wiener Kinchine theorem . (8)

    (b) Justify the suitability of using white Gaussian model for noise in a communication system. (6)

Module III

15. a) State source coding theorem for a discrete memoryless source.(6)

b) Show that mutual information is always positive. (3)

c) What is channel capacity in terms of the conditional entropy? Write down the capacity of an AWGN channel. (5)

OR

16. (a) Define entropy of a discrete memoryless source. If the alphabet is finite with size K, show that H(X) $\leq log_2K$ (6)

    (b) For the binary channel below, compute the channel transition matrix and P(Y0) and P(Y1), given that P(X0) = P(X1) = 0.5 (8)

Module IV

17. (a) Explain a Poisson random process. Give two practical examples of a Poisson process (7)

    (b) Derive Chapman – Kolmogorov equation. (7)

OR

18. Consider a Markov chain with three possible states 1,2,3 with transition probability matrix

    (a) Draw the state transition diagram. (4)

    (b) Find P(X4 = 3|X3 = 2) (5)

    (c) If P(X0 = 1) = 1 3 , find P(X0 = 1, X1 = 2) (5)

Module V

19. Explain the packet transmission in a slotted ALOHA network (14)

OR

20. Explain the M/M/1 queue system pertaining to packet trans- mission (14)

B24ECH43	STOCHASTIC SIGNAL PROCESSING (Honors)	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		3	1	0	3	4	2024

Preamble

This course aims to study stochastic signals and their interactions with LTI systems

Prerequisites

Nil

Course Outcomes

After the completion of the course the student will be able to:

CO 1	Explain the concepts of probability, random variables and stochastic processes [Understand]
CO 2	Apply the knowledge in probability to statistically characterize communication channels [Apply]
CO 3	Use the properties of WSS for finding the LTI system response [Remember,Apply]
CO 4	Model discrete signals using various methods [Understand]
CO 5	Estimate the spectra of signals using various methods [Understand, 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	PO 12
CO 1	3	3										
CO 2	3	3		3	2							
CO 3	3	3		3	2							
CO 4	3	3										
CO 5	3	3		3	2							

Assessment Pattern

Bloom's Category	**Continuous Assessment**		**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/Class work	15 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-division.

SYLLABUS

MODULE 1

Review of Probability and Random Variables: Review of probability, Relative frequency and Axiomatic definitions of probability, Significance of axiomatic definition. Bayes theorem and conditional probability. Independence. Discrete random variables. The cumulative distribution and density functions for random variables. Joint distribution and conditional distribution. Statistical averages. Mean, Variance and standard deviation, Functions of random variables. Multivariate Gaussian density function.

MODULE 2

Review of Random Processes : Stochastic Processes, Stationarity and ergodicity, WSS and SSS processes, Discrete Gaussian, Rayleigh and Ricean processes, Sums of random variables, Convergence, Markov and Chebyshev inequality, The central limit theorem (statement only).

MODULE 3

The Autocorrelation Matrix and its Significance: Statistical averages of discrete stationary stochastic processes, Mean and autocorrelation and power spectral density functions, Weiner Kinchine theorem, Filtering of discrete WSS process by LTI systems, The auotocorrelation matrix and the significance of its eigen vectors, Whitening, Properties of autocorrelation matrix, its inversion, Wiener-Hopf equation, Brownian motion, its mathematical model and its autocorrelation and power spectral density.

MODULE 4

Signal Modeling – Deterministic and Stochastic: The least squares method of signal modeling, The Pade approximation. Prony's method, Stochastic models, AR, MA and ARMA models

MODULE 5

Spectrum Estimation : Periodogram method of spectrum estimation, Parametric methods AR, MA and ARMA methods

Text Books

1. Monson Hayes, “Statistical Digital Signal Processing”, Wiley

2. A. Papaulis and Unnikrishna Pillai, “Probability, Random Variables and Stochastic Processes”, McGraw Hill

References

1. Peyton Z. Peebles, ”Probability, Random Variables & Random Signal Principles ”, MC GRAW HILL EDUCATION, 4th Edition, 2001

COURSE CONTENTS AND LECTURE SCHEDULE

No	Topic	No of Lecture/Tutorial Hours
	Module 1	**10**
1.1	The three definitions. Critique to classical definition. Probability as a function. The domain of probability function. Event and probability space	2
1.2	Conditional probability, Bayes theorem, Meaning and significance of prior. Random variable. Definition. Random variable as a function and its domain. Comparison with probability function.	2
1.3	Examples of RV. Discrete and continuous RV. CDF and PDF of RV(both discrete and continuous) Examples. Relation between the two and properties	1
1.4	Uniform and Gaussian Pdf and correspoding CDF. Properties, Expectation, variance and standard deviation, Examples	3
1.5	Functions of random variables.	2
	Module 2	**9**
2.1	Stochastic process, Definition. Stationarity and ergodicity	2
2.2	WSS and SSS conditions. Example problems	2
2.3	Sums of random variables, Convergence, Markov and Chebyshev inequality	2
2.4	Gaussian Process. Envelope of Gaussian process. Rayleigh pdf. Example	2
2.5	Central limit theorem. Application in AWGN channel	1
	Module 3	**12**
3.1	Expectation, variance, autocorrelation and power spectral density	2
3.2	Autocorrelation matrix, properties eigen values	2
3.3	Filtering of WSS, output auotocorrelation and PSD	2
3.4	Inversion of autocorrelation matrix. LD recursion	2
3.5	Whitening	1
3.6	Wiener Hopf equation, Brownian motion. Model and spectral density	3
	Module 4	**8**
4.1	Least squares method	2
4.2	Pade method, Prony method	3
4.3	Stochastic models	3
	Module 5	**7**
5.1	Periodogram	3
5.2	Parametric methods	4
	Total Hours	**46 Hours**

CO ASSESSMENT QUESTIONS

Course Outcome 1 (CO 1):

1. Give frequentist and axiomatic definitions of probability. State the demerits of frequentist definition.
2. What is a random variable? With an example, illustrate how it finds application in defining engineering problems?

Course Outcome 2 (CO 2):

1. State central limit theorem. Explain the validity of using Gaussian model for additive communication channels.
2. Give the conditions for WSS and SSS.

Course Outcome 3 (CO 3):

1. Derive Wiener Hopf equations.
2. Solve Wiener-Hopf equation to get a third order discrete system for a an RV X whose autocorrelation is Rx=[0.89,0.75,0.7,0.6]

Course Outcome 4 (CO 4):

1. Use Prony method to model a unit pulse x[n]=U[n]-U[n-N] as a system with one pole and one zero.
2. Use Pade apprimation to model the signal x whose fisrt six values are [1,1.2,0.9,0.5,0.6,0.25] using a second order all pole model (p=2 and q=0)

Course Outcome 5 (CO 5):

1. Explain the periodogram method of spectrum estimation
2. Explain the need pf spectrum estimation

MODEL QUESTION PAPER

QP CODE: **Pages: 3**

Reg.No.: ....

Name: ....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

FOURTH SEMESTER B TECH DEGREE (HONOURS) EXAMINATION

Course Code: B24ECH43

Course Name: STOCHASTIC SIGNAL PROCESSING

Max. Marks: 100 Duration: 3 hours

PART A

Answer all questions. Each question carries 3 marks

1. State the three axioms of probability.
2. You throw a coin and if head turns up you get Rs. 100 and loses Rs. 40 if tails turns up. The probability of a head is 0:2. Draw the CDF and PDF of the random variable representing gain/loss.
3. State central limit theorem. Give its significance.
4. Draw the pdf of Rayleigh density function.
5. Write and explain the differential equation for Brownian motion.
6. Give the output mean and autocorrelation of a an LTI system that is driven by a WSS process.
7. Explain the term signal modeling.
8. Explain ARMA model of a signal.
9. Explain the need for power spectrum estimation.
10. List the various parametric spectrum estimation methods.

PART B

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

Module I

11. a) Derive mean and variance of a Gaussian distribution with parameters μ and σ^2 . (8)

    b) Write down the probability density of a bivariate Gaussian random variable. What is the significance of the correlation coefficient? (6)

or

12. A six faced die with P(1) = P(5) = $\frac{1}{6}$, P(4) = P(3) = $\frac{1}{8}$,P(2) = $\frac{1}{12}$ is thrown in a game with outcomes listed in the table.

Face	1	2	3	4	5	6
Payoff	50	-40	60	-60	-20	100

The + and - signs indicates gain and loss for the the player respectively.

a) Draw the CDF and PDF of Payoff random variable. (6)

b) Compute the expected value of gain/loss. Is it worthwhile to play the game?What is the variance of Payoff? (8)

Module II

13. a) Test if the random process (7)
    X(t)= Acos(2 π $f_c t+\theta$)
    is WSS with A a random variable in the interval[-π ,π]

    b) If X and Y are zero mean Gaussian RVs, compute the pdf of Z = $\sqrt{X^2 + Y^2}$ (7)

or

14. a) Express a Binomial random variable X as a sum of many Bernoulli random variables. Derive the mean of X using this connection.List the conditions for a stochastic process to be WSS. (8)

    b) Derive Chebyshev inequality.
    How is it helpful in estimating tail probabilities? (6)

Module III

15. a) State and prove three properties of autocorrelation matrix. (8)

    b) Prove that the power spectrum of a real process X(t) is real. (6)

or

16. Give the mathematical model and compute the autocorrelation of the Brownian motion. (14)

Module IV

17. Use Pade approximation to model the signal x whose first six values are [1, 1.6, 0.7, 0.4, 0.6, 0.25] using a second order all pole model (p = 2 and q = 0) and a second order MA model (p = 0 and q = 2). (14)

or

18. Use Prony method to model a unit pulse x[n] = U[n]-U[n-N] as a system with one pole and one zero. (14)

Module V

19. Explain the periodogram method of spectrum estimation. (14)

or

20. Explain the three nonparametric methods of spectrum estimation. (14)