MAR ATHANASIUS COLLEGE OF ENGINEERING (Autonomous)

Kothamangalam 686 666

Affiliated to APJ Abdul Kalam Technological University

Thiruvananthapuram

Master of Technology (M. Tech.)

Structural Engineering and Construction Management

Curriculum - 2026

COLLEGE VISION AND MISSION

VISION

Excellence in education through resource integration.

MISSION

The institution is committed to transform itself into a centre of excellence in Technical Education upholding the motto "Knowledge is Power."
This is to be achieved by imparting quality education to mould technically competent professionals with moral integrity, ethical values and social commitment, and by promoting innovative activities in the thrust areas emerging from time to time.

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS)
M.TECH CURRICULUM 2026
CIVIL ENGINEERING
STRUCTURAL ENGINEERING AND CONSTRUCTION MANAGEMENT

PROGRAM OUTCOMES – PO

Outcomes are the attributes that are to be demonstrated by a graduate after completing the programme.

PO1: An ability to independently carry out research/investigation and development work in engineering and allied streams

PO2: An ability to communicate effectively, write and present technical reports on complex engineering activities by interacting with the engineering fraternity and with society at large.

PO3: An ability to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program

PO4: An ability to apply stream knowledge to design or develop solutions for real world problems by following the standards

PO5: An ability to identify, select and apply appropriate techniques, resources and state-of-the-art tool to model, analyse and solve practical engineering problems.

PO6: An ability to engage in life-long learning for the design and development of the stream related problems taking into consideration sustainability, societal, ethical and environmental aspects. Also to develop cognitive skills for project management and finance which focus on Industry and Entrepreneurship.

The departments conducting the M.Tech programme shall define their own PSOs, if required, and evaluation shall also be done for the same.

SEMESTER I

Slot	Course Code	Courses	Marks		L-T-P-S	Hours	Credit
			CIE	ESE			
A	M26CE1D101	Advanced Design of Concrete Structures	60	40	3-0-3-6	6	5
B	M26CE1D102	Construction Planning Scheduling Control	60	40	3-0-3-6	6	5
C	M26CE1T103	Structural Dynamics and Earthquake Engineering	60	40	4-0-0-5	4	4
D	M26CE1E104A	Programme Elective 1	60	40	4-0-0-5	4	4
J	M26GE1R105	Research Methodology & IPR	60	40	2-0-0-4	2	2
Total			300	200		22	20

Teaching Assistance: 8 hours/week

Self-study- 26 Hrs

PROGRAM ELECTIVE 1

Slot	Course Code	Course Name	Marks		L-T-P-S	Hours	Credit
			CIE	ESE			
D	M26CE1E104A	Maintenance and Rehabilitation of Structures	60	40	4-0-0-5	4	4
	M26CE1E104B	Construction Contracts, Methods and Equipment's	60	40	4-0-0-5	4	4
	M26CE1E104C	Bridge Engineering	60	40	4-0-0-5	4	4
	M26CE1E104D	Advanced Concrete Technology	60	40	4-0-0-5	4	4

SEMESTER II

Slot	Course Code	Courses	Marks		L-T-P-S	Hours	Credit
			CIE	ESE			
A	M26CE1D201	Advanced Design of Steel Structures	60	40	3-0-3-6	6	5
B	M26CE1D202	Advanced Structural Analysis	60	40	3-0-3-6	6	5
C	M26CE1E203A	Programme Elective 2	60	40	4-0-0-5	4	4
E	M26CE1S204	Building Information Modelling	60	40	4-0-0-5	4	4
G	M26CE1P205	Mini project	100		0-0-4-6	4	2
TOTAL			340	160		24	20

Teaching Assistance: 8 hours/week

Self-study- 28 Hrs

PROGRAM ELECTIVE 2

Slot	Course code	Course Name	Marks		L-T-P-S	Hours	Credit
			CIE	ESE			
C	M26CE1E203A	Advanced Foundation Engineering	60	40	4-0-0-5	4	4
	M26CE1E203B	Project Planning and Implementation	60	40	4-0-0-5	4	4
	M26CE1E203C	Prestressed Concrete	60	40	4-0-0-5	4	4
	M26CE1E203D	Design Tall Buildings	60	40	4-0-0-5	4	4

SEMESTER III

Slot	Course Code	Courses	Marks		L-T-P-S	Hours	Credit
			CIE	ESE			
A	M26CE1M301	*MOOC	To be completed successfully		--	--	2
K	M26CE1I302	Internship	50	50	--	--	10
P	M26CE1P303	Dissertation Phase 1	100	--	0-0-12-18	12	8
TOTAL			150	50		12	20

Teaching Assistance: 8 hours/week

*MOOC Course of minimum 8 weeks duration to be successfully completed before the end of fourth semester (starting from semester 1).

Internship - mandatory internship of minimum 16 weeks duration.

Dissertation Phase 1 may be undertaken either in college or in the industry. Dissertation Phase 1 can be linked with internship. Students are expected to have the following skills: Technical Skills, Research Skills, Communication Skills, Critical Thinking Skills, and Problem Solving Skills.

SEMESTER IV

Slot	Course Code	Courses	Marks		L-T-P-S	Hours	Credit
			CIE	ESE			
P	M26CE1PP401	Dissertation Phase II	100	100	0-0-24-26	24	20
TOTAL			100	100		24	20
Total credits in all four semesters							**80**

COURSE NUMBERING SCHEME

The course number consists of digits/alphabets. The pattern to be followed is

For General Courses - MYYBBXCSNN
For Elective Courses - MYYBBXCSNNA

- M: MASTERS
- YY: Last two digits of year of regulation
- BB: DEPARTMENT

Sl.No	Department	Course Prefix
01	Civil Engg	CE
02	Computer Science	CS
03	Electrical & Electronics	EE
04	Electronics & Communication	EC
05	Mechanical Engg	ME
06	Any	GE
07	External (Industry/NPTEL etc)	EX

- X : Specialization number
- C : Course Type

  T- Core Course

  E- Elective Course

  R- Research Methodology & IPR

  D- Lab integrated Course

  S- Industry Integrated Course

  I- Internship

  M- MOOC

  P- Project/Dissertation
- S : Semester of Study

  1. Semester 1
  2. Semester 2
  3. Semester 3
  4. Semester 4
- NN: Course sequence number
- A : Elective sequence number - A/B/C/D/E

It is illustrated below: Examples:

M26CE1T103 is a core course of first specialization offered by the Civil Department in semester 1

M26CE1D201 is a lab integrated core course of first specialization offered by the Civil Department in semester 2

M26GE1R106 is Research Methodology & IPR offered in semester 1offered by all Departments

M26EC1E104A is the first subject of Elective 1 of first specialization offered by the EC Department in semester 1.

EVALUATION PATTERN

(i) LAB INTEGRATED COURSES

Evaluation shall only be based on application, analysis or design-based questions (for both internal and end semester examinations).

Continuous Internal Evaluation (CIE) : 60 marks

Theory Evaluation **: 30 marks**

Self-study (Course based task/Seminar/ Quiz/ Micro project) :10 marks

Test paper 1 :10 marks

Test paper 2 :10 marks

Lab Evaluation **: 30 marks**

Lab work : 10 marks

Final evaluation Test : 20 marks

(Note: 50% of Module 1, 2 and 3 may be considered for each test)

End Semester Examination (ESE) **: 40marks**

The end semester examination should be conducted by the college. The time duration will be 2 Hrs and will contain 6 questions from first three modules, with minimum one question from each module of which student should answer any four. Each question can carry 10 marks and can have maximum 2 sub-divisions.

(ii) ELECTIVE COURSES/CORE COURSE

Evaluation shall only be based on application, analysis or design based questions(for both internal and end semester examinations).

Continuous Internal Evaluation **: 60 marks**

Self-study (Seminar*) : 10 marks

Course based task/Micro Project/Data collection and interpretation/Case study : 20 marks

Test paper 1 (Module 1 and Module 2) : 15 marks

Test paper 2 (Module 3 and Module 4) : 15 marks

*Seminar should be conducted in addition to the theory hours. Topics for the seminar should be from recent technologies in the respective course.

End Semester Examination (ESE) **: 40marks**

The end semester examination will be conducted by the College. Total duration of the examination will be 2 Hrs and will contain 6 questions, with minimum one question from each module of which student should answer any four. Each question can carry 10 marks and can have maximum 2 sub-divisions.

(iii) RESEARCH METHODOLOGY & IPR

Continuous Internal Evaluation: 60 marks

Self-study (Preparing a review article based on peer reviewed original publications in the relevant discipline (minimum 10 publications shall be referred))	: 10 marks
Course based task/Seminar/Quiz	: 20 marks
Test paper 1 (Module 1 and Module 2)	: 15 marks
Test paper 2 (Module 3 and Module 4)	: 15 marks
End Semester Examination	**: 40 marks**

The end semester examination should be conducted by the college. The time duration will be 2 Hrs and will contain 6 questions, with minimum one question from each module of which student should answer any four. Each question carries 10 marks.

(iv) INTERNSHIP

Internships are educational and career development opportunities, providing practical experience in a field or discipline. They are structured, short-term, supervised placements often focused around particular tasks or projects with defined time scales. An internship may be compensated or non-compensated by the organization providing the internship. The internship has to be meaningful and mutually beneficial to the intern and the organization. It is important that the objectivesand the activities of the internship program are clearly defined and understood. The internship offers the students an opportunity to gain hands-on industrial or organizational exposure; to integrate the knowledge and skills acquired through the coursework; interact with professionals and other interns; and to improve theirpresentation, writing, and communication skills. Internship often acts as a gateway for final placement for many students.

A student shall opt for carrying out the Internship at an Industry/ResearchOrganization or at another institute of higher learning and repute (Academia). The organization for Internship shall be selected/decided by the students on their own with prior approval from the faculty advisor/respective PG Programme Coordinator/Guide/Supervisor. Every student shall be assigned an internship Supervisor/Guide at the beginning of the Internship. The training shall be related to their specialization after the second semester for a minimum duration of sixteen weeks. On completion of the course, the student is expected to be able to develop skills in facing and solving the problems experiencing in the related field.

Objectives

- Exposure to the industrial environment, which cannot be simulated in theclassroom and hence creating competent professionals for the industry.
- Provide possible opportunities to learn understand and sharpen the real timetechnical / managerial skills required at the job.

- Exposure to the current technological developments relevant to the subjectarea of training.
- Create conducive conditions with quest for knowledge and its applicabilityon the job.
- Understand the social, environmental, economic and administrativeconsiderations that influence the working environment.
- Expose students to the engineer's responsibilities and ethics.

Benefits of InternshipBenefits to Students

- An opportunity to get hired by the Industry/ organization.
- Practical experience in an organizational setting & Industry environment.
- Excellent opportunity to see how the theoretical aspects learned in classes are integrated into the practical world. On-floor experience provides much more professional experience which is often worth more than classroom teaching.
- Helps them decide if the industry and the profession is the best career optionto pursue.
- Opportunity to learn new skills and supplement knowledge.
- Opportunity to practice communication and teamwork skills.
- Opportunity to learn strategies like time management, multi-tasking etc in anindustrial setup.
- Makes a valuable addition to their resume.
- Enhances their candidacy for higher education/placement.
- Creating network and social circle and developing relationships with industrypeople.
- Provides opportunity to evaluate the organization before committing to a fulltime position.

Benefits to the Institute

- Build industry academia relations.
- Makes the placement process easier.
- Improve institutional credibility & branding.
- Helps in retention of the students.
- Curriculum revision can be made based on feedback from Industry/students.
- Improvement in teaching learning process.

Benefits to the Industry

- Availability of ready to contribute candidates for employment.
- Year round source of highly motivated pre-professionals.
- Students bring new perspectives to problem solving.
- Visibility of the organization is increased on campus.
- Quality candidate's availability for temporary or seasonal positions andprojects.

- Freedom for industrial staff to pursue more creative projects.
- Availability of flexible, cost-effective workforce not requiring a long-termemployer commitment.
- Proven, cost-effective way to recruit and evaluate potential employees.
- Enhancement of employer's image in the community by contributing to theeducational enterprise.

Types of Internships

- Industry Internship with/without Stipend
- Govt / PSU Internship (BARC/Railway/ISRO etc)
- Internship with prominent education/research Institutes
- Internship with Incubation centres /Start-ups

Guidelines

- All the students need to go for internship for minimum duration of 16 weeks.
- Students can take mini projects, assignments, case studies by discussing itwith concerned authority from industry and can work on it during internship.
- All students should compulsorily follow the rules and regulations as laid by industry.
- Every student should take prior permissions from concerned industrialauthority if they want to use any drawings, photographs or any otherdocument from industry.
- Student should follow all ethical practices and SOP of industry.
- Students have to take necessary health and safety precautions as laid bythe industry.
- Student should contact his /her Guide/Supervisor from college on weeklybasis to communicate the progress.
- Each student has to maintain a diary/log book
- After completion of internship, students are required to submit
    - Report of work done
    - Internship certificate copy
    - Feedback from employer / internship mentor
    - Stipend proof (in case of paid internship).

Total Marks 100: The marks awarded for the Internship will be on the basis of (i)Evaluation done by the Industry (ii) Internal evaluation & Student's diary (iii) Internship Report and (iv) Comprehensive Viva Voce.

Continuous Internal Evaluation: 50 marks

Internal evaluation & Student's diary- 25 Marks

Evaluation done by the Industry - 25 Marks

Student's Diary/ Daily Log: The main purpose of writing daily diary is to cultivate the habit of documenting and to encourage the students to search for details. It develops the students' thought process and reasoning abilities. The students should record in the daily training diary the day to day account of the observations, impressions, information gathered and suggestions given, if any. It should contain the sketches & drawings related to the observations made by the students. The daily training diary should be signed after every day by the supervisor/ in charge of the section where the student has been working. The diary should also be shown to the Faculty Mentor visiting the industry from time to time and got ratified on the day of his visit. Student's diary will be evaluated on the basis of the following criteria:

- Regularity in maintenance of the diary
- Adequacy & quality of information recorded
- Drawings, design, sketches and data recorded
- Thought process and recording techniques used
- Organization of the information.

The format of student's diary

Name of the Organization/Section:

Name and Address of the Section Head:

Name and Address of the Supervisor:

Name and address of the student:

Internship Duration: From ..... To .....

Brief description about the nature of internship:

Day	Brief write up about the Activities carried out: Such as design, sketches, result observed, issues identified, data recorded, etc.
1	
2	
3	

Signature of Industry Supervisor *Signature of Section Head/HR Manager* *Office Seal*

Attendance Sheet

Name of the Organization/Section:

Name and Address of the Section Head:

Name and Address of the Supervisor:

Name and address of the student:

Internship Duration: From ..... To .....

Month & Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	...
Month & Year																					
Month & Year																					

Signature of Industry Supervisor *Signature of Section Head/HR Manager* *Office Seal*

Note:

- Student's Diary shall be submitted by the students along with attendance record and an evaluation sheet duly signed and stamped by the industry tothe Institute immediately after the completion of the training.
- Attendance Sheet should remain affixed in daily training diary. Do not remove or tear it off.
- Student shall sign in the attendance column. Do not mark 'P'.
- Holidays should be marked in red ink in the attendance column. Absent should be marked as 'A' in red ink.

Evaluation done by the Industry (Marks 25)

Format for Supervisor Evaluation of Intern

Student Name :_____Date:_____ Supervisor Name :_____

_____Designation:_____ Company/Organization :_____

_____

Internship Address: _____ Dates of Internship: From_____To _

_____

Please evaluate intern by indicating the frequency with which you observed thefollowing parameters:

Parameters	**Marks** Rating (0-10 mark)
Behavior	
Performs in a dependable Manner	
Cooperates with coworkers and supervisor	
Shows interest in work	
Learns quickly	
Shows initiative	
Produces high quality work	
Accepts responsibility	
Accepts criticism	
Demonstrates organizational skills	
Uses technical knowledge and expertise	
Shows good judgment	
Demonstrates creativity/originality	
Analyzes problems effectively	
Is self-reliant	
Communicates well	
Writes effectively	
Has a professional attitude	
Is punctual	
Uses time effectively	

Evaluation marks: 20 Marks

Overall performance of student: 5 Marks

Intern (Tick one) : Needs improvement (0 - 1 mark) / Satisfactory (1-2 mark) /Good (2-3 mark) / Very Good (3-4 mark) / Excellent (4-5 mark)

Signature of Industry Supervisor *Signature of Section Head/HR ManagerOffice Seal*

End Semester Evaluation (External Evaluation): 50 Marks

Internship Report - 25 Marks

Viva Voce - 25 Marks

Internship Report: After completion of the internship, the student should prepare a comprehensive report to indicate what he has observed and learnt in the training period and should be submitted to the faculty Supervisor. The student may contact Industrial Supervisor/ Faculty Mentor for assigning special topics and problems and should prepare the final report on the assigned topics. Daily diary will also help to

a great extent in writing the industrial report since much of the information has alreadybeen incorporated by the student into the daily diary. The training report should be signed by the Internship Supervisor, Programme Coordinator and Faculty Mentor.

The Internship report (25 Marks) will be evaluated on the basis of following criteria:

- Originality
- Adequacy and purposeful write-up
- Organization, format, drawings, sketches, style, language etc.
- Variety and relevance of learning experience
- Practical applications, relationships with basic theory and concepts taughtin the course

Viva Voce (25 Marks) will be done by a committee comprising Faculty Supervisor, PG Programme Coordinator and an external expert (from Industry or research/academic Institute). This committee will be evaluating the internship report also.

(v) INDUSTRY INTEGRATED COURSE

Engineering students frequently aspire to work in areas and domains that are keytopics in the industry. There are concerns by recruiters that skill sets of engineering students did not match with the Industry requirements, especially in the field of latesttopics. In response to their desires, the College has incorporated Industry integrated course in the curriculum.

The evaluation pattern for Industry based electives is as follows:

Continuous Internal Evaluation: 60 marks

Self-study (*Seminar)	:	10 marks
Course based task/Seminar/Data collection and interpretation/Case study	:	20marks
Test paper 1 (Module 1 and Module 2)	:	15 marks
Test paper 2 (Module 3 and Module 4)	:	15 marks

End Semester Examination: 40 marks

The examination will be conducted by the College with the question paper provided by the Industry. The examination will be for 2 Hrs and will contain 6 questions, with minimum one question from each module of which student should answer any four. Each question can carry 10 marks. The valuation of the answer scripts shall be done by the expert in the Industry handling the course.

(vi) MOOC COURSES

The MOOC course shall be considered only if it is conducted by the agencies namely

AICTE/NPTEL/SWAYAM or NITTTR. The MOOC course should have a minimum duration of 8 weeks and the content of the syllabus shall be enough for at least 40 hours of teaching. The course should have a proctored/offline end semester examination. The students can do the MOOC according to their convenience, but shall complete it before the end of fourth semester. The list of MOOC courses will be provided by the concerned BoS if at least 70% of the course content match with the area/stream of study. The course shall not be considered if its content has more than 50% of overlap with a core/elective course in the concerned discipline or with an open elective.

MOOC Course to be successfully completed before the end of fourth semester (starting from semester 1). A credit of 2 will be awarded to all students whoever successfully completes the MOOC course as per the evaluation pattern of the respective agency conducting the MOOC.

(vii) MINIPROJECT

Total marks: 100

Mini project can help to strengthen the understanding of student's fundamentals through application of theoretical concepts and to boost their skills and widen the horizon of their thinking. The ultimate aim of an engineering student is to resolve a problem by applying theoretical knowledge. Doing more projects increases problem-solving skills. The introduction of mini projects ensures preparedness of students to undertake project. Students should identify a topic of interest in consultation with PG Programme Coordinator. Demonstrate the novelty of the project through the results and outputs. The progressof the mini project is evaluated based on three reviews, two interim reviews and a final review. A report is required at the end of the semester.

Interim evaluation: 60 (30 marks for each review), final evaluation by a Committee(will be evaluating the level of completion and demonstration of functionality/specifications, clarity of presentation, oral examination, work knowledge and involvement): 25, Report (the committee will be evaluating for the technical content, adequacy of references, templates followed and permitted plagiarism level is not more than 25%): 10, Supervisor/Guide: 5

(viii) DISSERTATION

Dissertation: All Students should carry out the main dissertation inthe college or can work either in any CSIR/Industrial R&D organization/any other reputed Institute which have facilities for dissertation work in the area proposed.

Dissertation outside the Institute: For doing dissertation outside the Institution, the following conditions are to be met:

- They have completed successfully the course work prescribed in the approved curriculum up to the second semester.

- The student has to get prior approval from the DLAC and CLAC.
- Facilities required for doing the dissertation shall be available in the Organization/Industry (A certificate stating the facilities available in the proposed organization and the time period for which the facilities shall be made available to the student, issued by a competent authority from the Organization/Industry shall be submitted by the student along with the application).
- They should have an external as well as an internal supervisor. The internal supervisor should belong to the parent institution and the external supervisor should be Scientists or Engineers from the Institution/Industry/ R&D organization with which the student is associated for doing the dissertation work. The external supervisor shall be with a minimum post graduate degree in the related area.
- The student has to furnish his /her monthly progress as well as attendance report signed by the external guide and submit the same to the concerned Internal guide.
- The external guide is to be preferably present during all the stages of evaluation of the dissertation.

Note1- Students availing this facility should continue as regular students of the College itself.

Internship leading to Dissertation: The M. Tech students who after completion of 16 weeks internship at some reputed organization are allowed to continue their work as dissertation for the third and fourth semester after getting approval from the DLAC. Such students shall make a brief presentation regarding the work they propose to carry out before the DLAC for a detailed scrutiny and to resolve its suitability for accepting it as an M.Tech dissertation. These students will be continuing as regular students of the Institute in third semester for carrying out all academic requirements as per the curriculum/regulation. However, they will be permitted to complete their dissertation in the Industry/Organization (where they have successfully completed their internship) during fourth semester.

Dissertation as part of Employment: Students may be permitted to discontinue the programme and take up a job provided they have completed all the courses till second semester (FE status students are not permitted) prescribed in the approved curriculum. The dissertation work can be done during a later period either in the organization where they work if it has R & D facility, or in the Institute. Such students should submit application with details (copy of employment offer, plan of completion of their dissertation etc.) to the Dean (PG) through HoD. When the students are planning to do the dissertation work in the organization with R & D facility where they are employed, they shall submit a separate application having following details:

- Name of R&D Organization/Industry
- Name and designation of an external supervisor from the proposed Organization/Industry (Scientists or Engineers with a minimum post graduate degree in the related area) and his/her profile with consent
- Name and designation of a faculty member of the Institute as internal supervisor with his/her consent
- Letter from the competent authority from the Organization/Industry granting permission to do the dissertation

- Details of the proposed work
- Work plan of completion of dissertation

DLAC will scrutinize the proposal and forward to the Dean (PG) through HoD for approval.

When students are doing dissertation work along with the job in the organization(with R & D facility) where they are employed, the dissertation work shall be completed in four semesters normally (two semesters of dissertation work along with the job may be considered as equivalent to one semester of dissertation work at the Institute). Extensions may be granted based on requests from the student and recommendation of the supervisors such that he/she will complete the M. Tech programme within four years from the date of admission as per the regulation. Method of evaluation and grading of the dissertation will be the same as in the case of regular students. MOOC can be completed as per the norms mentioned earlier.

Extended Submission for PG Thesis/Project: Extended submission may be permitted for students who have registered for the dissertation / thesis but require additional time for completion. The extended submission period shall be limited to a maximum of three months from the scheduled date of normal submission. Evaluation of theses submitted during the extended period shall be treated as part of the regular examination, and not as a supplementary examination. Extended submission shall be permitted only on the recommendation of the Project Supervisor. If the attendance requirements are not met, an 'FE' grade shall be awarded.

Mark Distribution:

Phase 1: Total marks: 100, only CIE
Phase 2: Total marks: 200, CIE = 100 and ESE = 100 marks

- If the student publishes the dissertation work in a recognized national/international conference or an indexed journal, 10 marks should be awarded.
- Final Evaluation (ESE) should be done by a three-member committee comprising of the Department dissertation coordinator, Guide and an External expert. The external expert shall be an academician or from industry
- If the quantum of work done by the candidate is found to be unsatisfactory, the evaluation committee may extend the duration of the dissertation up to maximum of three months, giving reasons for this in writing to the student. Normally further extension will not be granted and there shall be no provision to register again for the dissertation. A separate evaluation may be conducted for such candidates

(ix)TEACHING ASSISTANCESHIP (TA)

All M.Tech students irrespective of their category of admission, shall undertake TA duties for a minimum duration as per the curriculum. Being a TA, the student willget an excellent opportunity to improve their expertise in the technical content of thecourse, enhance communication skills, obtain a hands-on experience in handling theexperiments in the laboratory and improve peer interactions.

The possible TA responsibilities include the following: facilitate a discussion section or tutorial for a theory/ course, facilitate to assist the students for a laboratorycourse, serve as a mentor for students, and act as the course web-master. TAs maybe required to attend the instructor's lecture regularly. A TA shall not be employed as a substitute instructor, where the effect is to relieve the instructor of his or her teaching

responsibilities.

For the tutorial session:

(i) Meet the teacher and understand your responsibilities well in advance, attend the lectures of the course for which you are a tutor, work out the solutions for allthe tutorial problems yourself, approach the teacher if you find any discrepancyor if you need help in solving the tutorial problems, use reference text books, beinnovative and express everything in English only.

(ii) Try to lead the students to the correct solutions by providing appropriate hints rather than solving the entire problem yourself, encourage questions from the students, lead the group to a discussion based on their questions, plan to ask them some questions be friendly and open with the students, simultaneously being firm with them.

(iii) Keep track of the progress of each student in your group, give a periodic feedback to the student about his/her progress, issue warnings if the student is consistently under-performing, report to the faculty if you find that a particular student is consistently underperforming, pay special attention to slow-learners and be open to the feedback and comments from the students and faculty.

(iv) After the tutorial session you may be required to grade the tutorials/assignments/tests. Make sure that you work out the solutions to the questions yourself, and compare it with the answer key, think and work out possible alternate solutions to the same question, understand the marking scheme from the teacher. Consult the teacher and make sure that you are not partial to some student/students while grading. Follow basic ethics.

Handling a laboratory Session:

(i) Meet the faculty – in- charge a few days in advance of the actual lab class andget the details of the experiment, get clarifications from him/her regarding all aspects of the experiment and the expectations, prepare by reading about the theoretical background of the experiment, know the physical concepts involved in the experiment, go to the laboratory and check out the condition of the equipment/instrumentation, perform the laboratory experiment at least once oneor two days before the actual laboratory class, familiarize with safety/ security aspects of the experiment / equipment/laboratory, prepare an instruction sheetfor the experiment in consultation with the faculty, and keep sufficient copies ready for distribution to students for their reference.

(ii) Verify condition of the equipment/set up about 30 minutes before the students arrive in the class and be ready with the hand outs, make brief introductory remarks about the experiment, its importance, its relevance to the theory they have studied in the class, ask the students suitable questions to know there level of preparation for the experiment, discuss how to interpret results, ask them comment on the results.

(iii) Correct/evaluate/grade the submitted reports after receiving suitable instructions from the faculty in charge, continue to interact with students if theyhave any clarifications regarding any aspect of the laboratory session, including of course grading, Carefully observe instrument and human safety in laboratoryclass, Preparing simple questions for short oral quizzing during explanation of experiments enables active participation of students, facilitate attention, provides feedback and formative evaluation.

POINTS TO REMEMBER

1. Arrange an awareness programme to all M.Tech students on day 1 regarding the curriculum and the regulation.
2. The departments should prepare the list of MOOC courses suitable to their programmes and encourage the students to complete at the earliest.
3. Make a tie up with industries by the middle of semester for Industry Integrated Course. While choosing the course, it should be ensured that the programme is relevant and updated in that discipline. The Industry expert handling the course shall be a postgraduate degree holder. The evaluation procedure shall also be clearly explained to them.
4. Each department offering M.Tech programme should be careful in selecting the mini project in semester 2.
5. The departments should invite the Industries/research organizations during first semester and inform them about the mandatory 16 weeks internship that the students should undergo after their second semester. The possibility of doing their project at the Industry shall also be explored. They should also be made aware about the evaluation procedure of the Internships. They may also be informed that it is possible to continue internship provided if it leads to their project. Proposals may be collected from them for allotting to students according to their fields of interest.
6. Make sure that all internal evaluations and the end semester examinations to be conducted by the college are carried out as per the evaluation procedure listed in the curriculum. Any dilution from the prescribed procedure shall be viewed seriously.
7. Teaching assistance shall be assigned to all students as per the curriculum. However, a TA shall not be employed as a substitute instructor, where the effect is to relieve the instructor of his or her teaching responsibilities.
8. The possible TA responsibilities include the following: facilitate a discussion section or tutorial for a theory/ course, facilitate to assist the students for a laboratory course, serve as a mentor for students, and act as the course web-master.

SYLLABUS

Master of Technology (M. Tech.)

Structural Engineering and Construction Management

SEMESTER I

CODE	COURSE NAME	L	T	P	S	CREDIT
M26CE1D101	ADVANCED DESIGN OF CONCRETE STRUCTURES	3	0	3	6	5

Preamble:

The course is intended to build upon the principles of reinforced concrete design and extend the understanding to complex structural systems encountered in professional practice. It emphasizes analytical approaches, codal provisions, and practical design considerations for a variety of structural elements like continuous beams, slender columns under axial and bending loads, structural walls and foundations.

Prerequisites: Design of Concrete structures

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

CO 1	Explain the behavior and design principles of continuous beams and slender columns (Cognitive Knowledge Level: Apply)
CO 2	Apply yield line method for slab analysis, design grid floors and flat slabs based on codal guidelines (Cognitive Knowledge Level: Analyse)
CO 3	Analyze and design structural walls and foundation systems, including piles and pile caps (Cognitive Knowledge Level: Analyse)
CO 4	Perform static and dynamic analysis, and design and detail multi - storeyed buildings with shear walls and overhead water tanks(Cognitive Knowledge Level: Analyse)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	2	3	2	2	1	2
CO 2	2	3	2	2	1	2
CO 3	2	3	2	2	1	2
CO 4	3	3	2	2	2	2

Assessment Pattern

ADVANCED DESIGN OF CONCRETE STRUCTURES			
Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination (%)**
	Test 1 (%)	**Test 2 (%)**	
Remember			
Understand			
Apply	40	40	40
Analyse	60	60	60
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	60	40	2 hours

Continuous Internal Evaluation Pattern

Theory Evaluation	:	**30 marks**
Self-study (Course based task/Seminar/Quiz/ Micro project)	:	10 marks
Test paper 1	:	10 marks
Test paper 2	:	10 marks
	:	**30 marks**
Lab Evaluation		
Lab work	:	10 marks
Final evaluation Test	:	20 marks

(Note: 50% of Module 1, 2 and 3 may be considered for each test)

End Semester Examination Pattern

The end semester examination should be conducted by the college. The time duration will be 2 Hrs and will contain 6 questions from first three modules, with minimum one question from each module of which student should answer any four. Each question can carry 10 marks and can have maximum 2 sub-divisions.

SYLLABUS

Module 1:Design of continuous beams and slender columns (10 hours)

Introduction to continuous beams, definition and significance in structural engineering, analysis of loading conditions for maximum moment, overview of IS code provisions and design coefficients, design problems and practical applications, redistribution of moments and its implications in design.
Introduction to Slender columns, characteristics and significance in structural design, analysis of additional moments due to slenderness, behavior of columns under axial compression, uniaxial, and biaxial bending, design examples.

Module 2: Advanced design of slab systems (10 hours)

Yield line method of analysis of slabs, characteristic features of yield lines, analysis by virtual work method (concepts).
Introduction to grid floor, design example.
Introduction to flat slabs, components, IS code provisions for design, design examples of exterior and interior panel.

Module 3: Design of Structural Walls and Foundations (10 Hours)

Introduction to structural walls, classification, importance in lateral load resistance, Basic concepts and design considerations.
Foundation-classifications, Introduction to pile and pile cap, classifications, design of end-bearing piles, Design of pile cap.

Module 4: Integrated Structural Design: Bridging Theory with Laboratory Practices (30 Hours)
Using ETABS, perform static and dynamic analysis, design and detailing of:
1. A multi storeyed residential building with shear wall
2. Overhead rectangular water tank with staging

Reference Books:

1. B. C. Punmia, Ashok Kumar Jain and Arun Kumar Jain, “Reinforced Concrete Structures”, Laxmi Publications, New Delhi.
2. S. Unnikrishna Pillai and Devdas Menon, “Reinforced Concrete Design”, Tata McGraw Hill Education, New Delhi.
3. P. C. Varghese, “Advanced Reinforced Concrete Design”, Prentice Hall of India, New Delhi.
4. P. Dayaratnam, “Design of Reinforced Concrete Structures”, Oxford and IBH Publishing, New Delhi.
5. R. N. Krishna Raju, “Design of Concrete Structures”, CBS Publishers and Distributors, New Delhi.

6. B. C. Punmia, Ashok Kumar Jain and Arun Kumar Jain, “Soil Mechanics and Foundations”, Laxmi Publications, New Delhi.

COURSE CONTENTS AND LECTURE SCHEDULE

(For 5 credit courses, the content can be for 60 hrs. and for 4 credit courses, the content can be for 40 hrs.)

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	**Module 1**	**10 hours**
1.1	Introduction to continuous beams, definition and significance in structural engineering, analysis of loading conditions for maximum moment	1
1.2	Overview of IS code provisions and design coefficients, Redistribution of moments and its implications in design	1
1.3	Design problems and practical applications	2
1.4	Introduction to Slender columns, Characteristics and significance in structural design, Analysis of additional moments due to slenderness	2
1.5	Behavior of columns under axial compression-problems	1
1.6	Behavior of columns under axial compression	2
1.7	Behavior of columns under axial compression	2
2	**Module 2**	**10 hours**
2.1	Yield line method of analysis of slabs	1
2.2	Characteristic features of yield lines, analysis by virtual work method	1
2.3	Introduction to grid floor, design example	3
2.4	Introduction to flat slabs, components	1
2.5	IS code provisions for design, design examples of exterior and interior panel	4

3	**Module 3**	**10 hours**
3.1	Introduction to structural walls- Classification, importance in lateral load resistance	1
3.2	Basic concepts and design considerations	2
3.3	Introduction to pile -classifications	1
3.4	Design of end-bearing piles	2
3.5	Introduction to pile cap -classifications	1
3.6	Design of pile cap-problems	3
4	**Module 4**	**30 hours**
4.1	Perform static and dynamic analysis, design and detailing of multi - storeyed residential building with shear wall	20
4.2	Perform static and dynamic analysis, design and detailing of Overhead rectangular water tank with staging	10
Total		**60 Hours**

MODEL QUESTION PAPER

QP CODE: **Pages: 1**

Reg.No.: .....

Name: .....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

FIRST SEMESTER M TECH DEGREE EXAMINATION, DECEMBER 2026

Course Code: M26CE1D101

ADVANCED DESIGN OF CONCRETE STRUCTURES

Max. Marks: 40 Duration: 2 hours

Answer any four questions. Each question carries 10 marks.

1. Design a three span continuous beam of span 7 m each to carry a dead load of 12 kN/m and live load of 16 kN/m. Use M20 concrete and Fe 415 steel.

2. A rectangular RCC column is having the following data: Size of column: 500mm x 650mm, Unsupported length = 9m, Effective length in both the direction = 8.5m, Factored Axial Load = 1500 kN. Factored Moment about major axis, Mux = 225 kNm, Factored Moment about minor axis, Muy = 80 kNm, Grade of Concrete: M25, Grade of Steel: Fe415, Clear cover: 40mm. Design the column.

3. Explain the structural action of bar bell type (simple rectangular type) structural wall with neat sketches. Discuss the interaction between structural frame and the wall.

4. Using the yield line theory, determine the ultimate resisting moment for an isotropic reinforced two-way slab simply supported at all edges sustaining a uniformly distributed load of 9kN/m2.

5. Design an exterior and interior panel of a flat slab with panel size 5 m x 5 m and size of the floor 30m x 30m. Provide suitable drops. Take live load as 4.5 KN/m2. Use M20 grade of concrete Fe415 steel.

6. Design a pile cap for a group of two piles of 300 mm diameter spaced 1.5 m apart. The columns transmit a factored load of 700 kN and is of size 300 mm x 300 mm. Use M20 concrete and Fe 415 steel.

CODE	COURSE NAME	L	T	P	S	CREDIT
M26CE1D102	CONSTRUCTION PLANNING, SCHEDULING AND CONTROL	3	0	3	6	5

Preamble:

This course introduces the principles of construction planning, scheduling, and project control using techniques such as CPM, PERT, and resource optimization. It emphasizes integration of time and cost analysis with performance evaluation using Earned Value Management (EVM). Practical exposure using Primavera enables students to develop and manage construction schedules effectively.

Prerequisites: Construction Techonology and Management

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

CO 1	Understand construction planning concepts including activity sequencing, CPM/PERT scheduling, and project timelines. (Cognitive knowledge level: Understand)
CO 2	Analyse advanced scheduling methods with resource constraints, optimization, and cost–schedule relationships. (Cognitive knowledge level: Analyse)
CO 3	Analyse project cost management through budgeting, cash flow analysis, and project control techniques. (Cognitive knowledge level: Analyse)
CO 4	Apply Primavera tools for project scheduling, resource optimization, and EVM-based performance analysis. (Cognitive knowledge level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	1	1	2	1	2	1
CO 2	2	1	3	2	3	2
CO 3	2	1	3	2	3	3
CO 4	2	2	3	3	3	2

Assessment Pattern

CONSTRUCTION PLANNING,SCHEDULING AND CONTROL			
Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination (%)**
	Test 1 (%)	**Test 2 (%)**	
Remember			
Understand	20	20	30
Apply	40	40	30
Analyse	40	40	40
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	60	40	2 hours

Continuous Internal Evaluation Pattern

Theory Evaluation	:	**30 marks**
Self-study (Course based task/Seminar/Quiz/ Micro project)	:	10 marks
Test paper 1	:	10 marks
Test paper 2	:	10 marks
	:	**30 marks**
Lab Evaluation		
Lab work	:	10 marks
Final evaluation Test	:	20 marks

(Note: 50% of Module 1, 2 and 3 may be considered for each test)

End Semester Examination Pattern

The end semester examination should be conducted by the college. The time duration will be 2 Hrs and will contain 6 questions from first three modules, with minimum one question from each module of which student should answer any four. Each question can carry 10 marks and can have maximum 2 sub-divisions.

SYLLABUS

Module 1: (12 hours)

Construction Planning Fundamentals : Fundamental principles in construction planning choice of technology and construction methods, Defining work tasks and establishing precedence relationships among activities, Estimating activity duration and resource requirements, Importance of construction schedules and project timelines, Critical Path Method (CPM) for scheduling project activities, Activity-on-Node diagrams for visualizing project schedules, Understanding leads, lags, and activity floats, Handling uncertain duration in project scheduling, Advanced scheduling techniques including Program Evaluation and Review Technique (PERT).

Module 2: (9 hours)

Advanced Scheduling Methods: Resource-oriented scheduling and managing resource constraints, Handling scheduling in poorly structured scenarios, Optimization approaches in the scheduling process, Establishing the project budget and forecasting for activity cost control, Integration of financial accounting systems and cost accounts, Managing project cash flows and controlling expenditures, Techniques for schedule control and updating project schedules and budgets, Project delay management, Analysis of the relationship between project cost and schedule information.

Module 3: (9 Hours)

Cost Control and Budget Management: Establishing the project budget and forecasting for activity cost control, Integration of financial accounting systems and cost accounts, Managing project cash flows and controlling expenditures, Techniques for schedule control and updating project schedules and budgets, Project delay management, Analysis of the relationship between project cost and schedule information.

Module 4: (30 Hours)

Students are required to perform any three experiments out of the six listed experiments.

List of Experiments:

Experiment 1: To develop a Level 3 (L3) project schedule in Primavera by defining activities, establishing logical sequencing, and identifying and analyzing the critical path using CPM techniques.

Experiment 2: To define activity relationships and develop an Activity-on-Node (AON) network diagram in Primavera and analyze logical dependencies and constraints for efficient workflow planning.

Experiment 3: To assign and manage resources and costs for project activities in Primavera and analyze resource utilization for effective planning and optimization.

Experiment 4: To apply crashing techniques, implement PERT using three-time estimates, and analyze time–cost trade-off for optimal project duration under uncertainty.

Experiment 5: To set the project baseline, track and update project progress in Primavera, perform Earned Value Management (EVM) analysis, and interpret performance indicators (SPI, CPI, EAC) for informed decision-making.

Experiment 6: To generate cash flow forecasts and S-curves in Primavera and analyze project performance trends for effective monitoring and control.

Reference Books:

1. Chitkara, K.K. (2014), *Construction Project Management: Planning, Scheduling and Controlling*, Tata McGraw Hill.
2. Hendrickson, C. and Au, T. (2000), *Project Management for Construction*, Prentice Hall.
3. Kerzner, H. (2017), *Project Management: A Systems Approach to Planning, Scheduling, and Controlling*, John Wiley & Sons.
4. Harris, E. (2015), *Planning and Control Using Oracle Primavera P6*, Eastwood Harris Pty Ltd.
5. Harris, P.E. (2010), *Project Planning and Control Using Primavera P6 for All Industries*, Eastwood Harris Pty Ltd.
6. Hardin, B. and McCool, D. (2015), *BIM and Construction Management*, John Wiley & Sons.

COURSE CONTENTS AND LECTURE SCHEDULE

(For 5 credit courses, the content can be for 60 hrs. and for 4 credit courses, the content can be for 40 hrs.)

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	**Module 1: Construction Planning Fundamentals**	**12 hours**
1.1	Fundamental principles in construction planning; choice of technology and construction methods	2
1.2	Defining work tasks and establishing precedence relationships among activities	2
1.3	Estimating activity duration and resource requirements; importance of construction schedules and project timelines	4
1.4	Critical Path Method (CPM) for scheduling project activities; Activity-on-Node diagrams	2
1.5	Leads, lags, activity floats; uncertain duration; PERT	2
2	**Module 2: Advanced Scheduling Methods**	**9 hours**
2.1	Resource-oriented scheduling and managing resource constraints	2
2.2	Handling scheduling in poorly structured scenarios; optimization approaches in scheduling	2
2.3	Establishing project budget; forecasting for activity cost control	2
2.4	Integration of financial accounting systems and cost accounts; managing project cash flows	2
2.5	Schedule control, updating schedules and budgets; delay management; cost–schedule relationship analysis	1
3	**Module 3: Cost Control and Budget Management**	**9 hours**
3.1	Establishing project budget and forecasting for activity cost control	2

3.2	Integration of financial accounting systems and cost accounts	2
3.3	Managing project cash flows and controlling expenditures	2
3.4	Schedule control and updating project schedules and budgets; project delay management	2
3.5	Analysis of relationship between project cost and schedule information	1
4	**Module 4: Software-Based Construction Planning and Analytics**	**30 hours**
4.1	Experiment 1: To develop a Level 3 (L3) project schedule in Primavera by defining activities, establishing logical sequencing, and identifying and analyzing the critical path using CPM techniques. Experiment 2: To define activity relationships and develop an Activity-on-Node (AON) network diagram in Primavera and analyze logical dependencies and constraints for efficient workflow planning.	10
4.2	Experiment 3: To assign and manage resources and costs for project activities in Primavera and analyze resource utilization for effective planning and optimization. Experiment 4: To apply crashing techniques, implement PERT using three-time estimates, and analyze time–cost trade-off for optimal project duration under uncertainty.	10
4.3	Experiment 5: To set the project baseline, track and update project progress in Primavera, perform Earned Value Management (EVM) analysis, and interpret performance indicators (SPI, CPI, EAC) for informed decision-making. Experiment 6: To generate cash flow forecasts and S-curves in Primavera and analyze project performance trends for effective monitoring and control.	10
Total		**60 Hours**

MODEL QUESTION PAPER

QP CODE: **Pages: xx**

Reg.No.: .....

Name: .....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

FIRST SEMESTER B TECH DEGREE EXAMINATION, DECEMBER 2026

Course Code: M26CE1D102

CONSTRUCTION PLANNING, SCHEDULING AND CONTROL

Max. Marks: 40 Duration: 2 hours

Answer any four questions. Each question carries 10 marks.

1. a) Illustrate the process of defining activities and establishing precedence relationships in construction planning. (5)
   b) Explain the significance of CPM in identifying the critical path in project scheduling. (5)
2. a) Illustrate the development of an Activity-on-Node (AON) network diagram for a construction project. (5)
   b) Explain the concepts of leads, lags, and floats in project scheduling. (5)
3. a) Explain how uncertainty in activity duration is handled using PERT. (5)
   b) Explain the importance of construction schedules and project timelines in project management. (5)
4. a) Analyse how resource-oriented scheduling and the management of resource constraints in construction projects. (5)
   b) Explain optimization approaches used in project scheduling. (5)
5. a) Analyse the process of project budgeting and cash flow management in construction projects. (5)
   b) Explain the relationship between project cost and schedule information. (5)
6. a) Explain how Earned Value Management (EVM) is used for project performance evaluation. (5)
   b) Explain the role of Primavera in project scheduling and monitoring. (5)

CODE	COURSE NAME	L	T	P	S	CREDIT
M26CE1T103	STRUCTURAL DYNAMICS AND EARTHQUAKE RESISTANT DESIGN	4	0	0	5	4

Preamble: To introduce the basic principles of structural dynamics and their application in earthquake resistant design of structures. The course enables students to understand the dynamic behavior of structures subjected to various types of loading, particularly seismic loads, and to apply codal provisions for safe and ductile design. It also familiarizes students with seismic response analysis, behavior of masonry and reinforced concrete structures during earthquakes, and design concepts of ductile detailing and base isolation.

Prerequisites: Strength of Materials, Structural Analysis, Reinforced Concrete Design

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

CO 1	Apply fundamentals of structural dynamics to analyze single degree of freedom (SDOF) systems under free and forced vibrations. (Cognitive knowledge Level: Apply)
CO 2	Analyze multi-degree of freedom (MDOF) systems using modal analysis and evaluate structural response using modal superposition methods.(Cognitive knowledge Level: Apply)
CO 3	Explain earthquake characteristics and assess seismic performance of masonry structures, incorporating concepts of response spectrum and earthquake-resistant design philosophy. (Cognitive knowledge Level: Apply)
CO 4	Perform seismic analysis and design of reinforced concrete structures as per IS 1893 and IS 13920, including ductile detailing and shear wall design. (Cognitive knowledge Level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	2	2	2	1	2	1
CO 2	2	2	2	1	2	1
CO 3	2	2	2	1	2	1
CO 4	1	2	1	1	2	1

Assessment Pattern

STRUCTURAL DYNAMICS AND EARTHQUAKE RESISTANT DESIGN			
Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination (%)**
	Test 1 (%)	**Test 2 (%)**	
Remember			
Understand	40	40	40
Apply	60	60	60
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	60	40	2 hours

Continuous Internal Evaluation Pattern

Self-study (Seminar*) : 10 marks
Course based task/Micro Project/ Data collection and interpretation/-Case study : 20 marks
Test paper 1 (Module 1 and Module 2) : 15 marks
Test paper 2 (Module 3 and Module 4) : 15 marks

*Seminar should be conducted in addition to the theory hours. Topics for the seminar should be from recent technologies in the respective course.

End Semester Examination Pattern

The end semester examination will be conducted by the College. Total duration of the

examination will be 2 Hrs and will contain 6 questions, with minimum one question from each module of which student should answer any four. Each question can carry 10 marks and can have maximum 2 sub-divisions.

SYLLABUS

Module 1: Introduction to Structural Dynamics and Single Degree of Freedom (SDOF) Systems (8 hours)

Fundamentals of vibration: degrees of freedom, types of dynamic loads, undamped and damped free vibration.Equation of motion for SDOF systems; D'Alembert's principle, damped free vibration (viscous damping), logarithmic decrement.Forced vibration under harmonic excitation: resonance, magnification factor.General dynamic loading (Duhamel integral – conceptual only); support motion, vibration isolation, transmissibility of force and transmissibility of displacement.

Module 2: Multi-Degree of Freedom (MDOF) Systems and Modal Analysis (10 hours)

Free vibration analysis: eigenvalue problem, natural frequencies, mode shapes, and orthogonality principles. Formulation of equations of motion for MDOF systems (mass, stiffness, and damping matrices).Modal superposition method for forced vibration (harmonic and general loads).Introduction to numerical integration schemes (Newmark-beta method – basic steps only).

Module 3: Introduction to Earthquakes resistant design and Seismic performance of masonry structures (10 Hours)

Characteristics of earthquakes: seismic waves, magnitude, intensity, and ground motion parameters, measurement of earthquakes.Introduction to response spectrum, design spectrum, construction of tripartite response spectrum.Concept of capacity design, Strong Column and weak beam, Philosophy of earthquake resistant construction. Performance of masonry structures during earthquakes, box action, influence of openings, role of horizontal and vertical bands, rocking of masonry piers. Repair and retrofitting of masonry structures

Module 4: Seismic Analysis and Design of RC Structures as per IS 1893 (12 Hours)

Seismic force computation using IS code provisions. Static method of analysis, Response spectrum analysis, brief introduction to time-history analysis – theoretical aspects. Performance of RC structures during EQ, base shear calculation as per IS 1893 (Part 1):2016,Codal provisions for seismic zoning: zone factor, importance factor, response reduction factor, fundamental time-period estimation, distribution of lateral forces over height. (as per IS 1893).Design of Shear wall. Ductile detailing considerations as per IS:13920: Detailing of structural members joints, Introduction to response reduction techniques-Base isolation.

Text Books:

1. Anil K. Chopra – Dynamics of Structures: Theory and Applications to Earthquake Engineering (Pearson Education / Prentice Hall, latest edition) – The standard reference that seamlessly combines structural dynamics with earthquake applications.

2. Mario Paz – Structural Dynamics: Theory and Computation (Springer or CBS Pub-

lishers) – Excellent for numerical examples on SDOF/MDOF and modal analysis.

3. Pankaj Agarwal Manish Shrikhande – Earthquake Resistant Design of Structures (Oxford University Press) – Focuses on practical IS code-based design with clear explanations suitable for medium-level study.

Reference Books:

1. R.W. Clough J. Penzien – Dynamics of Structures (McGraw Hill) – For deeper insight into MDOF and numerical methods.
2. T.K. Datta – Seismic Analysis of Structures (John Wiley) – Good for earthquake-specific response analysis.
3. S.K. Duggal – Earthquake Resistant Design of Structures (Oxford University Press) – Indian-context examples and IS code applications.

Relevant Indian Standards (Codes)

1. IS 1893 (Part 1): 2016 – Criteria for Earthquake Resistant Design of Structures (General Provisions and Buildings) – Core code for zoning, spectra, and analysis methods.
2. IS 13920: 2016 – Ductile Design and Detailing of Reinforced Concrete Structures Subjected to Seismic Forces.
3. IS 4326 – Code of Practice for Earthquake Resistant Design and Construction of Buildings (supplementary guidance).

COURSE CONTENTS AND LECTURE SCHEDULE

(For 5 credit courses, the content can be for 60 hrs. and for 4 credit courses, the content can be for 40 hrs.)

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	**Module 1**	**8 hours**
1.1	Fundamentals of vibration: degrees of freedom, types of dynamic loads, undamped and damped free vibration.	1
1.2	Equation of motion for SDOF systems; D'Alembert's principle, damped free vibration (viscous damping), logarithmic decrement.	2
1.3	Forced vibration under harmonic excitation: resonance, magnification factor.	2
1.4	General dynamic loading (Duhamel integral – conceptual only); support motion, vibration isolation, transmissibility of force and transmissibility of displacement.	3
2	**Module 2**	**10 hours**
2.1	Free vibration analysis: eigenvalue problem, natural frequencies, mode shapes, and orthogonality principles.	2
2.2	Formulation of equations of motion for MDOF systems (mass, stiffness, and damping matrices).	2
2.3	Modal superposition method for forced vibration (harmonic and general loads).	3
2.4	Introduction to numerical integration schemes (Newmark-beta method – basic steps only).	3
3	**Module 3**	**10 hours**
3.1	Characteristics of earthquakes: seismic waves, magnitude, intensity, and ground motion parameters, measurement of earthquakes.	2
3.2	Introduction to response spectrum, design spectrum, construction of tripartite response spectrum.	2

3.3	Concept of capacity design, Strong Column and weak beam, Philosophy of earthquake resistant construction.	3
3.4	Performance of masonry structures during earthquakes, box action, influence of openings, role of horizontal and vertical bands, rocking of masonry piers. Repair and retrofitting of masonry structures	3
4	**Module 4**	**12 hours**
4.1	Seismic force computation using IS code provisions. Static method of analysis, Response spectrum analysis, brief introduction to time-history analysis – theoretical aspects.	2
4.2	Performance of RC structures during EQ, base shear calculation as per IS 1893 (Part 1):2016	2
4.3	Codal provisions for seismic zoning: zone factor, importance factor, response reduction factor, fundamental time-period estimation, distribution of lateral forces over height. (as per IS 1893).	2
4.4	Design of Shear wall.	3
4.5	Ductile detailing considerations as per IS:13920: Detailing of structural members and joints, Introduction to response reduction techniques-Base isolation.	3
Total		**40 Hours**

MODEL QUESTION PAPER

QP CODE: **Pages:3**

Reg.No.: .....

Name: .....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

FIRST SEMESTER M TECH DEGREE EXAMINATION, DECEMBER 2026

Course Code: M26CE1T103

STRUCTURAL DYNAMICS AND EARTHQUAKE RESISTANT DESIGN

Max. Marks: 40 Duration: 2 hours

Answer any four questions. Each question carries 10 marks.

1. a) Derive the equation of motion for a single degree of freedom system using D'Alembert's principle. (5)
   b) Explain logarithmic decrement and its use in determining damping in a system. (5)
2. a) Explain the concept of natural frequencies and mode shapes in multi-degree of freedom systems. (5)
   b) Discuss the orthogonality principle of mode shapes with suitable expressions. (5)
3. a) Define earthquake magnitude and intensity. Explain different types of seismic waves. (5)
   b) Explain the concept of response spectrum and its significance in structural design. (5)
4. a) Explain the concept of response spectrum and describe the construction of a tripartite response spectrum. (5)
   b) Discuss the behavior of masonry structures during earthquakes, highlighting the role of box action and the influence of openings. (5)
5. a) Explain the procedure for calculation of base shear as per IS 1893 (Part 1):2016. (5)
   b) Discuss the importance of ductile detailing as per IS 13920 in earthquake-resistant design. (5)
6. Explain the design procedure of a reinforced concrete shear wall subjected to seismic forces as per IS 1893 (Part 1):2016 and IS 13920, including load calculation, analysis, stability checks, and reinforcement detailing. (10)

CODE	COURSE NAME	L	T	P	S	CREDIT
M26CE1E104A	Maintenance and Rehabilitation of Structures	4	0	0	5	4

Preamble: This course introduces postgraduate students to the principles, practice, and management of maintenance, repair, rehabilitation, and strengthening of concrete and masonry structures. It emphasizes deterioration mechanisms, inspection and condition assessment, maintenance planning, repair materials, and rehabilitation strategies for extending service life and improving the performance of existing structures.

Prerequisite: Design of Reinforced Concrete Structures and Concrete Technology

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

CO 1	Understand deterioration mechanisms, categories of maintenance, and distress in concrete and masonry structures. (Cognitive knowledge Level: Understand)
CO 2	Apply appropriate inspection, condition assessment, and non-destructive/semi-destructive evaluation techniques for existing structures. (Cognitive knowledge Level: Apply)
CO 3	Analyse repair materials, surface preparation requirements, corrosion mitigation measures, and crack repair methods for damaged structural components. (Cognitive knowledge Level: Analyse)
CO 4	Evaluate and recommend suitable rehabilitation, strengthening, and retrofit strategies for extending service life of structures. (Cognitive knowledge Level: Evaluate)

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	2	1	3	1	2	1
CO 2	2	2	3	2	3	2
CO 3	2	2	3	3	3	2
CO 4	3	2	3	3	2	3

Assessment Pattern

Bloom's Category	Maintenance and Rehabilitation of Structures		
	Continuous Internal Evaluation Tests		End Semester Examination (%Marks)
	Test 1 (%Marks)	Test 2 (%Marks)	
Remember			
Understand	20	20	20
Apply	40	40	40
Analyse	40	40	40
Evaluate			
Create			

Mark distribution

Total Marks	CIE marks	ESE marks	ESE Duration
100	60	40	2 Hours

Continuous Internal Evaluation Pattern:

Self-study (Seminar*) : 10 marks

Course based task/Micro Project/

Data collection and interpretation/Case study: 20 marks

Test paper 1 (Module 1 and Module 2) : 15 marks

Test paper 2 (Module 3 and Module 4) : 15 marks

*Seminar should be conducted in addition to the theory hours. Topics for the seminar should be from recent technologies in the respective course.

End Semester Examination Pattern:

The end semester examination will be conducted by the College. Total duration of the examination will be 2 Hrs and will contain 6 questions, with minimum one question from each module of which student should answer any four. Each question can carry 10 marks and can have maximum 2 sub-divisions.

SYLLABUS

MODULE 1: Deterioration, Distress, and Maintenance Fundamentals (12 hours)

Concept of maintenance, repair, rehabilitation, retrofit, and strengthening; service life of structures. Categories of maintenance: routine, preventive, predictive, condition-based, and special maintenance. Deterioration mechanisms in reinforced concrete and masonry structures; cracking in buildings, causes and effects; common defects due to moisture, thermal actions, construction deficiencies, chemical attack, and ageing. Distress in masonry and building components; importance of maintenance planning, inspection records, and facility management.

MODULE 2: Inspection, Condition Assessment, and Damage Diagnosis (8 hours)

Inspection strategy for existing structures; preliminary appraisal, detailed investigation, documentation, and condition rating. Visual inspection and distress mapping. Non-destructive and semi-destructive techniques: rebound hammer, ultrasonic pulse velocity, carbonation depth, chloride ingress, half-cell potential, cover measurement, core test, pull-out/probe tests, and load testing.

MODULE 3: Repair Materials, Surface Preparation, and Repair Techniques (12 hours)

Strength, durability, permeability, and thermal considerations for repair design. Surface and substrate preparation; cleaning of concrete and reinforcing steel; bond requirements. Selection criteria for repair materials; polymer-modified mortars, micro-concrete, non-shrink grouts, bonding agents, corrosion inhibitors, protective coatings, waterproofing materials, shotcrete/gunite, fibre-reinforced and high-performance repair materials. Crack repair techniques: routing and sealing, epoxy injection, stitching, dry packing, overlays, grouting.

MODULE 4: Rehabilitation and Strengthening (8 hours)

Rehabilitation of structural elements affected by corrosion, fire, leakage, settlement, and seismic action. Strengthening methods: RC jacketing, steel jacketing, FRP wrapping, plate bonding, section enlargement, shoring, underpinning, and retrofit of beam-column joints.

Textbooks (Primary)

1. **Peter H. Emmons**, Concrete Repair and Maintenance Illustrated, Galgotia Publications.
2. **Noel P. Mailvaganam**, Repair and Protection of Concrete Structures, CRC Press.
3. **Denison Campbell, Allen Harold Roper**, Concrete Structures: Materials, Maintenance and Repair, Longman Scientific and Technical.
4. **R.N. Raikar**, Diagnosis and Treatment of Structures in Distress.

Reference

1. Handbook on Repair and Rehabilitation of RCC Buildings, CPWD, Government of India.
2. ET-523 C: Repair and Maintenance of Buildings, SWAYAM/IGNOU, coordinated by Dr. Munish Kumar Bhardwaj.

COURSE CONTENTS AND LECTURE SCHEDULE

(For 5 credit courses, the content can be for 60 hrs. and for 4 credit courses, the content can be for 40 hrs.)

No	Topic	No. of Lecture/ Tutorial hours
	MODULE 1: Deterioration, Distress, and Maintenance Fundamentals	**(12 hours)**
1.1	Concept of maintenance, repair, rehabilitation, retrofit, strengthening, and service life of structures.	2
1.2	Categories of maintenance: routine, preventive, predictive, condition-based, and special maintenance; maintenance planning and records.	3
1.3	Distress and cracking in reinforced concrete buildings; causes and effects of defects due to moisture, temperature, shrinkage, corrosion, and construction deficiencies.	4
1.4	Damages to masonry structures and building components; ageing, chemical attack, and need for facility management-oriented maintenance.	3
	MODULE 2: Inspection, Condition Assessment, and Damage Diagnosis	**(8 hours)**
2.1	Inspection strategy, preliminary appraisal, detailed investigation, distress documentation, and condition rating of existing structures.	2
2.2	Visual inspection and distress mapping; assessment procedure for evaluating damaged structures.	2
2.3	Non-destructive and semi-destructive tests: rebound hammer, ultrasonic pulse velocity, carbonation depth, chloride ingress, cover measurement, and half-cell potential.	2
2.4	Core test, pull-out/probe tests, load test, interpretation of results, residual performance, and maintenance prioritisation.	2
	MODULE 3: Repair Materials, Surface Preparation, and Repair Techniques	**(12 hours)**
3.1	Repair design considerations: strength, durability, permeability, thermal effects, and bond requirements.	3
3.2	Surface and substrate preparation; cleaning of concrete and reinforcing steel; importance of proper surface preparation.	3

3.3	Repair materials: polymer-modified mortars, micro-concrete, grouts, bonding agents, corrosion inhibitors, protective coatings, waterproofing systems, and shotcrete/gunite.	3
3.4	Crack and corrosion repair techniques: routing and sealing, epoxy injection, stitching, dry packing, overlays, grouting, repair of active and dormant cracks, and cathodic protection.	3
	MODULE 4: Rehabilitation and Strengthening	**(8 hours)**
4.1	Rehabilitation of structures affected by corrosion, fire, leakage, settlement, and seismic action.	3
4.2	Strengthening methods: RC jacketing, steel jacketing, FRP wrapping, plate bonding, section enlargement, shoring, and underpinning.	4
4.4	Decision framework for repair and retrofit	1
	TOTAL	**40 HRS**

Model Question Paper

QP CODE: Pages:

Reg No.:_____

Name:_____

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

FIRST SEMESTER M. TECH DEGREE EXAMINATION, DECEMBER 2026

Course Code: M26CE1E104A

Course Name: Maintenance and Rehabilitation of Structures

Max. Marks:40 Duration: 2 hours

Answer any four questions. Each question carries 10 marks.

1. Explain the different categories of structural maintenance and discuss the major causes of deterioration and cracking in reinforced concrete and masonry buildings. *(10 marks)*
2. Describe a systematic procedure for inspection and condition assessment of an existing damaged structure. Include visual inspection, documentation, and condition rating. *(10 marks)*
3. Compare rebound hammer, ultrasonic pulse velocity, carbonation depth, and core testing with respect to principle, field application, and limitations in condition assessment. *(10 marks)*
4. Discuss the criteria for selection of repair materials for concrete structures and explain the importance of substrate preparation before repair. (10 marks)
5. Explain suitable methods for repair of active and dormant cracks and discuss the role of corrosion control measures including protective coatings and cathodic protection. (10 marks)
6. A multistorey reinforced concrete building shows beam-column joint distress, leakage, and corrosion damage. Recommend an integrated rehabilitation and maintenance strategy, including strengthening options and the decision process for repair versus demolition. (10 marks)*)*

CODE	COURSE NAME	L	T	P	S	CREDIT
M26CE1E104B	CONSTRUCTION CONTRACTS, METHODS AND EQUIPMENTS	4	0	0	5	4

Preamble: This course provides an overview of construction management, contracts, and related legal aspects essential for successful project execution. It covers contract types, tendering processes, planning and scheduling techniques, construction methods, and equipment management. The subject also introduces modern construction practices, quality and safety management, and sustainable approaches. It aims to equip students with the knowledge and skills required to effectively manage construction projects within legal and professional frameworks.

Prerequisites: NIL

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

CO 1	Apply different types of construction contracts and contract documents in real-world project scenarios. (Cognitive knowledge level: Apply)
CO 2	Apply project planning and scheduling techniques such as CPM, PERT, and WBS for construction projects.(Cognitive knowledge level: Apply)
CO 3	Apply appropriate construction equipment selection and management techniques based on project requirements.(Cognitive knowledge level: Apply)
CO 4	Apply modern construction practices, quality control measures, and contract management principles in project execution. (Cognitive knowledge level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	2	2	2	1	2	1
CO 2	2	2	2	1	2	1
CO 3	2	2	2	1	2	1
CO 4	1	2	1	1	2	1

Assessment Pattern

STRUCTURAL DYNAMICS AND EARTHQUAKE RESISTANT DESIGN			
Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination (%)**
	Test 1 (%)	**Test 2 (%)**	
Remember			
Understand	40	40	40
Apply	60	60	60
Analyse			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	60	40	2 hours

Continuous Internal Evaluation Pattern

Self-study (Seminar*) : 10 marks
Course based task/Micro Project/ Data collection and interpretation/-Case study : 20 marks
Test paper 1 (Module 1 and Module 2) : 15 marks
Test paper 2 (Module 3 and Module 4) : 15 marks

*Seminar should be conducted in addition to the theory hours. Topics for the seminar should be from recent technologies in the respective course.

End Semester Examination Pattern

The end semester examination will be conducted by the College. Total duration of the

examination will be 2 Hrs and will contain 6 questions, with minimum one question from each module of which student should answer any four. Each question can carry 10 marks and can have maximum 2 sub-divisions.

SYLLABUS

Module 1: Construction Contracts and Legal Framework (8 hours)

Types of construction contracts: lump sum, item rate, percentage rate, cost-plus, EPC, turnkey contracts. Contract documents: agreement, conditions of contract, specifications, drawings, bill of quantities. Tendering process: prequalification, bidding procedures, evaluation of bids, award of contract. Legal aspects: contract law basics, roles and responsibilities of parties, dispute resolution methods (arbitration, mediation, adjudication). Standard contract forms: FIDIC, government and private sector contracts.

Module 2: Construction Planning and Methods (10 hours)

Construction project planning and scheduling techniques: bar charts, CPM, PERT. Work breakdown structure (WBS) and resource allocation. Construction methods for major structural works: foundations (shallow and deep), formwork systems, concreting techniques, steel erection methods. Prefabrication and modular construction methods. Temporary structures and site layout planning.

Module 3: Construction Equipment and Management (10 Hours)

Classification and selection of construction equipment. Earthmoving equipment: excavators, loaders, bulldozers. Material handling equipment: cranes, hoists, conveyors. Concrete equipment: batching plants, mixers, pumps, vibrators. Equipment productivity, maintenance, and cost analysis. Equipment management: planning, scheduling, and optimization.

Module 4: Advanced Practices in Construction and Contract Management (12 Hours)

Modern construction technologies: automation, robotics, and BIM integration in construction. Quality control and safety management in construction projects. Contract management: claims, variations, escalation, and risk allocation. Delay analysis and mitigation techniques. Sustainability in construction: green materials, waste management, and energy-efficient practices.

Text Books:

1. R.L. Peurifoy, W.B. Ledbetter, C. Schexnayder – 1. Construction Planning, Equipment and Methods (o Publisher: McGraw-Hill)
2. Construction Management and Machinery (Standard Publishers)
3. John Schaufelberger, Giovanni Migliaccio – 3. Construction Equipment Management (Routledge)

Reference Books:

1. K. K. Chitkara-Construction Equipment and Management
2. Mahesh Varma – Construction Equipment and its Planning and Application
3. Jha and Sinha – Construction and Foundation Engineering

COURSE CONTENTS AND LECTURE SCHEDULE

(For 5 credit courses, the content can be for 60 hrs. and for 4 credit courses, the content can be for 40 hrs.)

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	**Module 1**	**8 hours**
1.1	Types of construction contracts: lump sum, item rate, percentage rate, cost-plus, EPC, turnkey contracts.	1
1.2	Contract documents: agreement, conditions of contract, specifications, drawings, bill of quantities. Tendering process: prequalification, bidding procedures, evaluation of bids, award of contract	2
1.3	Legal aspects: contract law basics, roles and responsibilities of parties, dispute resolution methods (arbitration, mediation, adjudication).	3
1.4	Standard contract forms: FIDIC, government and private sector contracts.	2
2	**Module 2**	**10 hours**
2.1	Construction project planning and scheduling techniques: bar charts, CPM, PERT	2
2.2	Work breakdown structure (WBS) and resource allocation.	2
2.3	Construction methods for major structural works: foundations (shallow and deep), formwork systems, concreting techniques, steel erection methods.	3
2.4	Prefabrication and modular construction methods. Temporary structures and site layout planning.	3
3	**Module 3**	**10 hours**
3.1	Classification and selection of construction equipment. Earthmoving equipment: excavators, loaders, bulldozers	3
3.2	Material handling equipment: cranes, hoists, conveyors. Concrete equipment: batching plants, mixers, pumps, vibrators.	3

3.3	Equipment productivity, maintenance, and cost analysis.	2
3.4	Equipment management: planning, scheduling, and optimization.	2
4	**Module 4**	**12 hours**
4.1	Modern construction technologies: automation, robotics, and BIM integration in construction.	3
4.2	Quality control and safety management in construction projects.	3
4.3	Contract management: claims, variations, escalation, and risk allocation.	2
4.4	Delay analysis and mitigation techniques. Sustainability in construction: green materials, waste management, and energy-efficient practices.	3
Total		**40 Hours**

MODEL QUESTION PAPER

QP CODE: **Pages:1**

Reg.No.: .....

Name: .....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

FIRST SEMESTER M TECH DEGREE EXAMINATION, DECEMBER 2026

Course Code: M26CE1E104B

CONSTRUCTION CONTRACTS, METHODS AND EQUIPMENTS

Max. Marks: 40 Duration: 2 hours

Answer any four questions. Each question carries 10 marks.

1. a) Explain the different types of construction contracts such as lump sum, item rate, and cost-plus contracts with suitable examples. (5)
   b) Describe the key components of contract documents and their significance in construction projects. (5)
2. a) Outline the tendering process including prequalification, bidding, and evaluation of bids. (5)
   b) Discuss dispute resolution methods in construction contracts, highlighting arbitration and mediation. (5)
3. a) Compare CPM and PERT techniques used in construction project scheduling. (5)
   b) Explain Work Breakdown Structure (WBS) and its role in resource allocation. (5)
4. a) Describe construction methods for shallow and deep foundations. (5)
   b) Explain prefabrication and modular construction methods and their advantages. (5)
5. a) Classify construction equipment and explain the selection criteria for choosing appropriate equipment. (5)
   b) Discuss the productivity and cost analysis of construction equipment. (5)
6. a) Explain modern construction technologies such as BIM, automation, and robotics in construction. (5)
   b) Discuss delay analysis and mitigation techniques along with the importance of risk allocation in contracts. (5)

CODE	COURSE NAME	L	T	P	S	CREDIT
M26CE1E104C	BRIDGE ENGINEERING	4	0	0	5	4

Preamble:

The course covers the concept and design of concrete bridges as per the Indian Road Congress (IRC) specifications. The student will be exposed to real-life bridge design and construction practices enabling them to independently plan, analyse, design, and detail various types and components of bridges.

Prerequisites: Structural Analysis

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

CO 1	Understand bridge types, components, and investigation requirements, and design RC slab bridges and box culverts using IRC loading standards. (Cognitive Knowledge Level: Apply)
CO 2	Design various components of the T beam bridges. (Cognitive Knowledge Level: Apply)
CO 3	Understand the structural systems and components of long span bridges such as cable-stayed and suspension bridges. (Cognitive Knowledge Level: Understand)
CO 4	Apply design principles for elastomeric bearings and analyze the stability of abutments and piers under various loading conditions. (Cognitive Knowledge Level: Analyse)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	1	1	2	2	2	1
CO 2	1	1	2	2	2	1
CO 3	1	1	2	2	2	1
CO 4	1	1	2	2	2	1

Assessment Pattern

BRIDGE ENGINEERING			
Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination (%)**
	Test 1 (%)	**Test 2 (%)**	
Remember			
Understand	20	20	20
Apply	50	50	60
Analyse	30	30	20
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	60	40	2 hours

Continuous Internal Evaluation Pattern

Self-study (Seminar*) : 10 marks
Course based task/Micro Project/ Data collection and interpretation/- Case study : 20 marks
Test paper 1 (Module 1 and Module 2) : 15 marks
Test paper 2 (Module 3 and Module 4) : 15 marks

*Seminar should be conducted in addition to the theory hours. Topics for the seminar should be from recent technologies in the respective course.

End Semester Examination Pattern

The end semester examination will be conducted by the College. Total duration of the examination will be 2 Hrs and will contain 6 questions, with minimum one question from each module of which student should answer any four. Each question can carry 10 marks and can have maximum 2 sub-divisions.

SYLLABUS

Module 1: Bridge Engineering Fundamentals and Design of Small Bridges (12 hours)

Classification and components of bridges - Investigation for bridges– need for investigation– selection of site– economical span– subsoil exploration– investigation report– importance for proper investigation— Structural forms of bridge decks. Standard specifications for bridges: IRC loadings for road bridges: IRC class AA, class A, class 70R and class B. Design of RC slab bridge and box culvert.

Module 2: Analysis and Design of T-Beam Bridges(12 hours)

T-beam bridges– Analysis and design of interior slab and cantilever slab, longitudinal girders and cross girders–Pigeaud's method– Courbon's method– prestressed concrete bridges-Introduction, Concepts, advantages, and applications.

Module 3: Analysis and Design of T-Beam Bridges(7 Hours)

Introduction to long span bridges: cable stayed bridges and suspension bridges: Structural system and components – instability: Buckling of bridge components, Measures to prevent instability.

Module 4: Design of Bridge Bearings and Substructures(9 Hours)

Design of elastomeric bearings, Abutments – General features, Loads on abutments, Stability analysis of abutments, Piers – Types, Loads on Piers, Stability analysis of Piers.

Reference Books:

1. E.C. Hambly, Bridge deck behaviour, Taylor Francis, London, 1991.
2. P. Nagarajan, Design of Concrete Bridges, Wiley Publications, 2020.
3. E J O'Brien an D L Keo h, Bri e eck analysis, E FN pon, New York , 1999
4. D.Johnson Victor, Essentials of bridge engineering, Oxford IBH publishing Co. Ltd., New Delhi, 2017.
5. N.Krishna Raju, Design of bridges, Oxford IBH publishing Co. Ltd., New Delhi, 2009.
6. Jaikrishna and O.P Jain, Plain and reinforced concrete-Vol.II, Nemchand Bros,Roorkee, 2007.
7. Relevant IRC and IRS codes.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	**Module 1**	**12 hours**
1.1	Classification and components of bridges - Investigation for bridges– need for investigation– selection of site– economical span– subsoil exploration– investigation report– importance for proper investigation	2
1.2	Structural forms of bridge decks. Standard specifications for bridges: IRC loadings for road bridges: IRC class AA, class A, class 70R and class B.	3
1.3	Design of RC slab bridge	3
1.4	Design of box culverts.	4
2	**Module 2**	**12 hours**
2.1	T-beam bridges– Analysis and design of interior slab and cantilever slab	3
2.2	Analysis and design of cantilever slab	2
2.3	Longitudinal girders and cross girders– Courbon's method	3
2.4	Analysis and design of cross girders	2
2.5	Prestressed concrete bridges - Introduction, Concepts, advantages, and applications.	2
3	**Module 3**	**7 hours**
3.1	Introduction to long span bridges: cable stayed bridges and suspension bridges	2
3.2	Introduction to long span bridges: cable stayed bridges and suspension bridges	3
3.3	Measures to prevent instability.	2
4	**Module 4**	**9 hours**

4.1	Design of elastomeric bearings	2
4.2	Abutments – General features, Loads on abutments, Stability analysis of abutments	4
4.3	Piers – Types, Loads on Piers, Stability analysis of Piers.	3
Total		**40 Hours**

MODEL QUESTION PAPER

QP CODE: **Pages: 02**

Reg.No.: .....

Name: .....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

FIRST SEMESTER B TECH DEGREE EXAMINATION, DECEMBER 2026

Course Code: M26CE1E104C

BRIDGE ENGINEERING

Max. Marks: 40 Duration: 2 hours

Answer any four questions. Each question carries 10 marks.

1. a) How the bridges can be classified in accordance with IS code. (5)
   b) Discuss the importance of site investigation in bridge engineering. (5)

2. Design an RCC slab culvert for a state highway the following data.(Design of kerb is not expected), Clear span = 7m, Width of carriageway = 7.5m, Thickness of wearing coat = 80mm, Kerbs 600 mm wide are provided on either side. Loading: IRC Class A, Materials: M25 concrete and Fe 415 steel. Sketch the reinforcement details. (10)

3. Design an interior cross girder for a T beam bridge for the following data: Effective span = 16 m, Live load – IRC Class 70R tracked; Materials – M25 concrete and Fe 415 steel; spacing of cross girders 5 m c/c; width of carriage way 7.5m; thickness of wearing coat = 80 mm; kerbs on either side = 600 mm wide × 300 mm deep; width of main girder = 300 mm; width of cross girder = 300 mm; spacing of main girders = 2.5 m c/c. Sketch reinforcement details. (10)

4. Design the longitudinal girders and interior panel of a T-beam and slab bridge for the following data:(shear calculations are not expected) Effective span = 12m, Carriage way width = 7.8m, Cross beams are spaced at 4m c/c, Kerbs 600 mm wide are provided on either side. Loading: IRC Class AA tracked vehicle Materials: M25 concrete and Fe 415 steel. Sketch the reinforcement details. (10)

5. Sketch and explain various parts and their functions of suspension bridge and cable stayed bridge. (10)

6. Design an elastomeric bearing as per IRC 83 Part 2:2018 with the following data. Maximum vertical design force = 1009 kN, Minimum vertical design force = 666 kN Horizontal force along span direction = 10.39 kN Horizontal force along width direction = 41.56 kN Resultant of all horizontal forces = 42.84 kN Relative displacement in the direction of dimension 'a' = 3.77 mm Relative displacement in the direction of dimension 'b' = 1.88 mm Angle of rotation across the width 'a' of bearing = 0.00381 Angle of rotation across the length 'b' of bearing = 0.001 Adopt an elastomeric bearing (based on International Standards) of dimension 250 mm(a) × 400 mm(b) Yield strength of steel laminate = 500 MPa. (10)

CODE	COURSE NAME	L	T	P	S	CREDIT
M24CE1E203B	ADVANCED CONCRETE TECHNOLOGY	4	0	0	5	4

Preamble:

The course covers the properties of the constituents of concrete and its influence on the performance of concrete. The course also focus to develop a strong understanding about the latest developments in the area of concrete technology with a clear knowledge about the fundamental mechanisms.

Prerequisites: Basics of Civil Engineering and Concrete Technology

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

CO 1	Explain the properties and behaviour of constituent materials of concrete including cement, aggregates, admixtures. (Cognitive knowledge level: Understand)
CO 2	Design concrete mixes as per Bureau of Indian Standards IS 10262:2019 and evaluate fresh and hardened concrete properties using standard methods and rheology of fresh concrete. (Cognitive knowledge level: Apply)
CO 3	Analyze creep, shrinkage, durability issues, and non-destructive testing methods for performance assessment of concrete structures. (Cognitive knowledge level: Analyze)
CO 4	Evaluate the suitability of special concretes and advanced concreting technologies for specific structural, durability, and construction requirements. (Cognitive knowledge level: Evaluate)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	1	1	3	2	2	1
CO 2	2	1	3	3	3	1
CO 3	3	2	3	2	3	2
CO 4	2	2	3	3	3	3

Assessment Pattern

Advanced Concrete Technology			
Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination (%)**
	Test 1 (%)	**Test 2 (%)**	
Remember			
Understand	40	20	30
Apply	40	40	30
Analyse	20	40	20
Evaluate			20
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	60	40	2 hours

Continuous Internal Evaluation Pattern

Self-study (Seminar*) : 10 marks
Course based task/Micro Project/ Data collection and interpretation/- Case study : 20 marks
Test paper 1 (Module 1 and Module 2) : 15 marks
Test paper 2 (Module 3 and Module 4) : 15 marks

*Seminar should be conducted in addition to the theory hours. Topics for the seminar should be from recent technologies in the respective course.

End Semester Examination Pattern

The end semester examination will be conducted by the College. Total duration of the examination will be 2 Hrs and will contain 6 questions, with minimum one question from each module of which student should answer any four. Each question can carry 10 marks and can have maximum 2 sub-divisions.

SYLLABUS

Module 1: (10 hours)

Cement -Review of manufacturing process- chemical composition, Bogue's compounds, mechanism of hydration-heat of hydration-Aggregate-Review of types, sampling and testing, artificial aggregates – Chemical Admixtures- types, uses, mechanism of action - effects on properties of concrete - Mineral admixtures- types, chemical composition - physical characteristics - effects on properties of concrete

Module 2: (12 hours)

Mix design as per IS 10262-2019, Importance of particle packing, Statistical quality control of concrete – acceptance criteria. Rheology – basic concepts – Bingham model; Properties of fresh concrete- workability-factors affecting workability - slump test- compaction factor test- Vee Bee consistometer test- Properties of hardened concrete - modulus of elasticity, compressive strength, split tensile strength, flexural strength- effect of water cement ratio – maturity concept- Creep - factors affecting creep - effect of creep- Shrinkage- factors affecting shrinkage - plastic shrinkage, drying shrinkage, autogenous shrinkage, carbonation shrinkage and temperature shrinkage.

Module 3: (10 Hours)

Durability of concrete- Factors affecting durability - permeability- cracking-reinforcement corrosion; carbonation, chloride penetration, sulphate attack, acid attack, fire resistance; frost damage, alkali silica reaction, concrete in sea water - Non-destructive testing of concrete- surface hardness test- ultrasonic pulse velocity method - penetration resistance- pull-out test- core cutting - measuring reinforcement cover.

Module 4: (8 Hours)

Special concretes - lightweight concrete-heavy weight concrete - high strength concrete – high performance concrete - self compacting concrete -roller compacted concrete– fibre reinforced concrete - polymer concrete-pumped concrete - ready mix concrete - green concrete. Special processes and technology - sprayed concrete; underwater concrete, mass concrete; slip form construction, prefabrication technology- 3D concrete printing.

Reference Books:

1. Neville A.M., Properties of Concrete , Trans-Atlantic Publications, Inc.; 5e, 2016
2. R. Santhakumar „ Concrete Technology , Oxford Universities Press, 2018
3. Shetty M. S., Concrete Technology , S. Chand and Co., 2018
4. Mehta and Monteiro, Concrete-Micro structure, Properties and Materials , McGraw Hill Professional 2017
5. Neville A. M. and Brooks J. J., Concrete Technology, Pearson Education, 2019
6. Lea, Chemistry of Cement and Concrete , Butterworth-Heinemann Ltd, 5e, 2017

7. Gambhir, M. L. (2013). Concrete Technology: Theory and Practice (5th ed.). McGraw-Hill Education.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	**Module 1**	**10 hours**
1.1	Cement -Review of manufacturing process- chemical composition, Bogue's compounds, mechanism of hydration-heat of hydration	3
1.2	Aggregate-Review of types, sampling and testing, artificial aggregates	2
1.3	Chemical Admixtures- types, uses, mechanism of action - effects on properties of concrete	2
1.4	Mineral admixtures- types, chemical composition - physical characteristics - effects on properties of concrete	3
2	**Module 2**	**12 hours**
2.1	Mix design as per IS 10262-2019, Importance of particle packing, Statistical quality control of concrete – acceptance criteria.	3
2.2	Rheology – basic concepts – Bingham model; Properties of fresh concrete- workability-factors affecting workability - slump test- compaction factor test- Vee Bee consistometer test	3
2.3	Properties of hardened concrete - modulus of elasticity, compressive strength, split tensile strength, flexural strength-effect of water cement ratio – maturity concept	3
2.4	Creep - factors affecting creep - effect of creep- Shrinkage-factors affecting shrinkage - plastic shrinkage, drying shrinkage, autogenous shrinkage, carbonation shrinkage and temperature shrinkage.	3
3	**Module 3**	**10 hours**

3.1	Durability of concrete- Factors affecting durability - permeability- cracking-reinforcement corrosion; carbonation, chloride penetration, sulphate attack, acid attack	4
3.2	Fire resistance; frost damage, alkali silica reaction, concrete in sea water	2
3.3	Non-destructive testing of concrete- surface hardness test- ultrasonic pulse velocity method	2
3.4	Penetration resistance- pull-out test- core cutting - measuring reinforcement cover.	2
4	**Module 4**	**8 hours**
4.1	Special concretes - lightweight concrete-heavy weight concrete - high strength concrete – high performance concrete - self compacting concrete	3
4.2	Roller compacted concrete– fibre reinforced concrete - polymer concrete-pumped concrete - ready mix concrete - green concrete.	2
4.3	Special processes and technology - sprayed concrete; underwater concrete, mass concrete; slip form construction, prefabrication technology- 3D concrete printing.	3
Total		**40 Hours**

MODEL QUESTION PAPER

QP CODE: **Pages: xx**

Reg.No.: .....

Name: .....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

FIRST SEMESTER M.TECH DEGREE EXAMINATION, DECEMBER 2026

Course Code: M24CE1E203B

ADVANCED CONCRETE TECHNOLOGY

Max. Marks: 40 Duration: 2 hours

Answer any four questions. Each question carries 10 marks.

1. a) State the major Bogue's compounds present in ordinary Portland cement. (3)
   b) Explain the mechanism of hydration of cement and discuss the significance of heat of hydration in concrete. (7)

2. a) Explain the properties of aggregtes. (3)
   b) Classify chemical and mineral admixtures used in concrete and explain their effects on fresh and hardened properties. (7)

3. a) What is meant by characteristic compressive strength of concrete? (3)
   b) Explain the concrete mix design procedure as per Bureau of Indian Standards IS 10262:2019. (7)

4. a) Define creep in concrete. (3)
   b) Explain various types of shrinkage in concrete and discuss factors affecting shrinkage. (7)

5. a) What is carbonation in concrete? (3)
   b) Discuss the durability problems caused by chloride attack, sulphate attack, and reinforcement corrosion in concrete. (7)

6. a) Define self-compacting concrete. (3)
   b) Explain any four special concretes with their properties and engineering applications. (7)

M26GE1R105	RESEARCH METHODOLOGY & IPR	L	T	P	S	CREDIT	YEAR OF INTRODUCTION
		2	0	0	4	2	2026

Preamble

Research methodology and intellectual property rights form an essential foundation for postgraduate students and research scholars engaged in advanced engineering studies. This course introduces the principles of scientific research, problem identification, experimental and analytical methods, and effective technical communication. It also emphasizes ethical research practices, scholarly publication processes, and the protection of intellectual property arising from research and innovation. The course aims to equip M Tech students and research scholars with the skills required to conduct systematic research, communicate findings effectively, and understand the legal and ethical frameworks governing intellectual property and technology development.

Pre-requisite Nil

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

CO 1	Explain the principles, processes, and characteristics of scientific research and apply creative and logical thinking approaches for identifying research directions. (Cognitive Knowledge Level: Understand).
CO 2	Apply literature survey techniques and analytical reasoning to identify research gaps and formulate well-defined research problems. (Cognitive Knowledge Level: Apply).
CO 3	Analyze experimental data and develop appropriate experimental or modelling approaches for solving engineering research problems. (Cognitive Knowledge Level: Analyze)
CO 4	Demonstrate effective technical communication while adhering to research ethics and intellectual property regulations. (Cognitive Knowledge Level: Apply)

Mapping of Course Outcomes with Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	2		2		1	1
CO 2	3	1	2	1	2	1
CO 3	3		2	2	3	1
CO 4	1	3	2		1	3

Assessment Pattern

Course Name	Research Methodology & IPR		
Bloom's Category	Continuous Assessment Tests		End Semester Examination (%Marks)
	Test 1 (% Marks)	Test 2 (% Marks)	
Remember	20		
Understand	40	40	40
Apply	40	40	40
Analyse		20	20
Evaluate			
Create			

Mark Distribution

Total Marks	CIE marks	ESE marks	ESE Duration
100	60	40	2 Hours

Continuous Internal Evaluation Pattern

Self-study (Preparing a review article based on peer reviewed original publications in the relevant discipline (minimum 10 publications shall be referred)) : 10 marks

Course based task/Seminar/Quiz : 20 marks

Test paper 1 (Module 1 and Module 2) : 15 marks

Test paper 2 (Module 3 and Module 4) : 15 marks

End Semester Examination Pattern

The end semester examination will be conducted by the college. The time duration will be 2 hours and will contain 6 questions, with minimum one question from each module of which student should answer any four. Each question carries 10 marks.

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SYLLABUS

MODULE 1: Foundations of Research and Creative Thinking (6 Hours)

Meaning, objectives and significance of research – types of research, basic, applied and interdisciplinary research – characteristics of good research and stages in the research process – skills, habits and attitudes required for researchers – motivation for research with discussion of Richard Hamming's lecture *"You and Your Research"* – thinking skills in research, levels and styles of thinking, common sense versus scientific thinking, logical reasoning and decomposition of complex problems – creativity in research, definitions and characteristics, intelligence versus creativity, creative thinking process and requirements for innovation.

MODULE 2: Literature Survey and Research Problem Formulation (5 Hours)

Importance of literature survey in research – sources of scientific information, journals, conference papers, patents and technical reports – techniques for information search using digital databases – reading, documentation and referencing practices – integration of research literature and identification of research gaps – attributes and sources of research problems – problem formulation and research questions – multiple approaches to solving research problems – techniques for problem representation, graphical methods and reasoning – analytical and analogical reasoning – creative problem solving approaches including TRIZ.

MODULE 3: Experimental Design, Modelling and Data Analysis (8 Hours)

Scientific method and hypothesis formulation – experimental variables, dependent and independent variables, control and reproducibility in experiments – precision, accuracy and measurement errors – random and systematic errors, detection and reduction – statistical treatment and interpretation of experimental data – principles of design of experiments and experimental documentation – modelling in engineering research, types of models and stages in modelling – curve fitting and approximations – mathematical representation and logical reasoning in models – continuum, meso and micro scale modelling approaches – introduction to numerical simulation methods with illustrative case studies.

MODULE 4: Technical Communication, Research Ethics and Intellectual Property Rights (6 Hours)

Importance of effective communication in research – communication process and barriers – oral

communication skills for seminars, conferences and project presentations – preparation and delivery of technical presentations – guidelines for effective presentation slides – principles of scientific writing – structure of technical papers, theses and reports – language, layout, typography, tables and figures – referencing and citation styles – tools for document preparation including LaTeX – scholarly publications including journals and conferences – journal selection and peer review process – research metrics – plagiarism, research integrity and ethical publication practices- Introduction to Intellectual Property Rights – types of IPR: patents, copyrights, trademarks and industrial designs – patent concepts, objectives and patentability criteria – patent application procedures and documentation – technology transfer and IPR agreements.

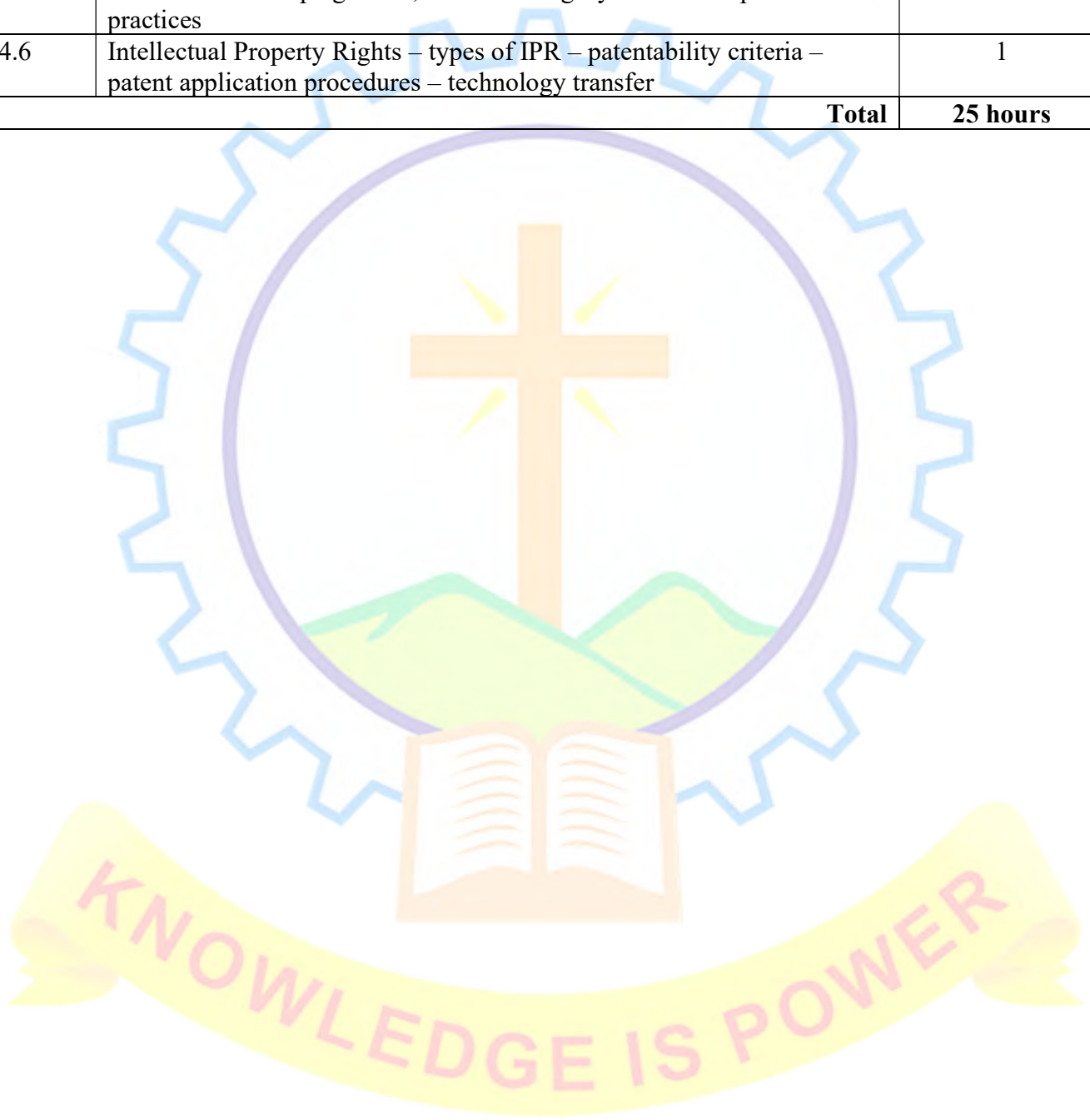
References

1. Panneerselvam, R., *Research Methodology*, PHI Learning, New Delhi.
2. Kothari, C. R. and Garg, G., *Research Methodology: Methods and Techniques*, New Age International.
3. Phillips, E. M. and Pugh, D. S., *How to Get a PhD*, Viva Books.
4. Leedy, P. D. and Ormrod, J. E., *Practical Research: Planning and Design*, Pearson.
5. Day, R. A. and Gastel, B., *How to Write and Publish a Scientific Paper*, Cambridge University Press.
6. Thiel, D. V., *Research Methods for Engineers*, Cambridge University Press.
7. Bouchoux, D. E., *Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets*.
8. Resnik, D. B., *The Ethics of Science: An Introduction*, Routledge.
9. Medawar, P., *Advice to a Young Scientist*.
10. Wilson, E. O., *Letters to a Young Scientist*.
11. Hamming, R., *You and Your Research*, Bell Labs Lecture.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Topic	No. of Lecture/ Tutorial hours
Module 1		**(6 Hours)**
1.1	Meaning, objectives and significance of research – types of research: basic, applied and interdisciplinary	1
1.2	Characteristics of good research – stages in the research process	1
1.3	Skills, habits and attitudes required for researchers – motivation for research – discussion of Richard Hamming's lecture "You and Your Research"	1
1.4	Thinking skills in research – levels and styles of thinking – common sense versus scientific thinking	1
1.5	Logical reasoning and decomposition of complex problems	1
1.6	Creativity in research – intelligence versus creativity – creative thinking process and requirements for innovation	1
Module 2		**(5 Hours)**
2.1	Importance of literature survey – sources of scientific information: journals, conference papers, patents and technical reports	1
2.2	Techniques for information search using digital databases	1
2.3	Reading, documentation and referencing practices	1
2.4	Integration of research literature and identification of research gaps	1
2.5	Research problem formulation – attributes and sources of research problems – research questions – introduction to problem representation and TRIZ	1
Module 3		**(8 Hours)**
3.1	Scientific method and hypothesis formulation	1
3.2	Experimental variables – dependent and independent variables – control and reproducibility in experiments	1
3.3	Precision, accuracy and measurement errors – random and systematic errors	1
3.4	Detection and reduction of experimental errors – statistical treatment and interpretation of experimental data	1
3.5	Principles of design of experiments – experimental documentation	1
3.6	Modelling in engineering research – types of models and stages in modelling	1
3.7	Curve fitting, approximations and mathematical representation of models	1
3.8	Continuum, meso and micro scale modelling approaches – introduction to numerical simulation methods with examples	1
Module 4		**(6 Hours)**
4.1	Importance of communication in research – communication process and barriers	1
4.2	Oral communication skills – preparation and delivery of technical presentations – presentation slide design	1

4.3	Scientific writing – structure of technical papers, theses and reports – referencing and citation styles	1
4.4	Scholarly publications – journal selection – peer review process – research metrics	1
4.5	Research ethics – plagiarism, research integrity and ethical publication practices	1
4.6	Intellectual Property Rights – types of IPR – patentability criteria – patent application procedures – technology transfer	1
	Total	**25 hours**



MODEL QUESTION PAPER

QP CODE: Pages: 1

Reg. No.: .....

Name : .....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS)
KOTHAMANGALAM

FIRST SEMESTER M TECH DEGREE EXAMINATION, DECEMBER 2026

Course Code: **M26GE1R105**
Course Name: **RESEARCH METHODOLOGY & IPR**

Max. Marks: 40 Duration: 2 hours

*Answer any **four** questions. Each question carries 10 marks.*

1	a.	Explain the stages in the research process and the characteristics of good research.	(5 marks)
	b.	Discuss the role of creative and logical thinking in research with suitable examples from engineering research.	(5 marks)
2	a.	Describe the methods used for conducting an effective literature survey and the different sources of research information.	(5 marks)
	b.	A researcher intends to study energy efficiency improvement in electric vehicles. Explain how the researcher can identify research gaps and formulate a research problem based on literature survey.	(5 marks)
3	a.	Explain the scientific method and hypothesis formulation in experimental research.	(5 marks)
	b.	An experiment measures the temperature of a furnace multiple times giving the following readings (°C): 650, 652, 648, 651, 649. Calculate the mean temperature and comment on the precision of the measurements.	(5 marks)
4	a.	Explain the concept and stages of modelling in engineering research.	(6 marks)
	b.	Discuss the importance of approximations and curve fitting in engineering models with examples.	(4 marks)
5	a.	Explain the structure of a scientific research paper and the important rules of scientific writing.	(5 marks)
	b.	Discuss the principles for preparing effective technical presentation slides for conferences or seminars.	(5 marks)
6	a.	Explain the peer review process and discuss the criteria used for selecting a suitable journal for publication.	(5 marks)
	b.	Explain the concept of patents, the criteria for patentability, and the steps involved in the patent filing process.	(5 marks)

KNOWLEDGE IS POWER

SEMESTER II

CODE	COURSE NAME	L	T	P	S	CREDIT
M26CE1D201	ADVANCED DESIGN OF STEEL STRUCTURE	3	0	3	6	5

Preamble: The course provides an in-depth study of limit state design, encompassing tension and compression members, welded and bolted connections, industrial buildings, light gauge structures, and structures resistant to blast, impact, snow, and fire loads, emphasizing practical design principles and analysis methods for various structural components and systems.

Prerequisites: Mechanics of Solids, Design of Steel Structures

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

CO 1	Comprehend the principles of limit state design to various structural members and to design them (Cognitive Knowledge Level: Apply)
CO 2	Analyze beam-to-beam and beam-to-column connections for strength and serviceability.(Cognitive Knowledge Level: Analyse)
CO 3	Apply design concepts to plate girders, considering shear buckling, tension field action, and stiffener requirements. (Cognitive Knowledge Level: Apply)
CO 4	Analyze and design steel Structures using software tools. (Cognitive Knowledge Level: Analyze)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	2	2	1	1	2	1
CO 2	2	2	2	2	2	2
CO 3	2	2	2	2	3	2
CO 4	2	1	2	3	2	

Assessment Pattern

ADVANCED DESIGN OF STEEL STRUCTURE			
Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination (%)**
	Test 1 (%)	**Test 2 (%)**	
Remember			
Understand	10	10	10
Apply	50	50	50
Analyse	40	40	40
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	60	40	2 hours

Continuous Internal Evaluation Pattern

Theory Evaluation	:	**30 marks**
Self-study (Course based task/Seminar/Quiz/ Micro project)	:	10 marks
Test paper 1	:	10 marks
Test paper 2	:	10 marks
	:	**30 marks**
Lab Evaluation		
Lab work	:	10 marks
Final evaluation Test	:	20 marks

(Note: 50% of Module 1, 2 and 3 may be considered for each test)

End Semester Examination Pattern

The end semester examination should be conducted by the college. The time duration will be 2 Hrs and will contain 6 questions from first three modules, with minimum one question from each module of which student should answer any four. Each question can carry 10 marks and can have maximum 2 sub-divisions.

SYLLABUS

Module 1: Fundamentals of Steel Design (IS 800:2007) (10 Hours)

Review of steel properties and stress–strain behaviour, Limit State Design philosophy (IS 800:2007 – brief review)
Design of compression members and laterally supported and unsupported beams
Design of Beam-columns (concepts only)- Moment Amplification factor- Equivalent uniform factor

Module 2: Steel Connections and Seismic Detailing (10 Hours)

Connections- bolted and welded- bolted and welded connections subjected to in-plane and out of plane loading - Beam to beam connections- Beam to column connections- Bolted Seating Angle Connection, Bolted Web Cleats Connection, Bolted End Plate Connection - Beam and column splices

Ductile detailing principles – introduction to seismics design code- Preparation of basic steel design drawings.

Learning from failures- case studies of steel structures.

Module 3: Advanced Steel Structures and Modern Applications(10 Hours)

Plate girders: components, Shear Buckling, Tension Field Action, stiffeners- design of plate girder. Gantry girders – loading and design procedure.

Multi storied steel buildings and steel trusses– overview on design and basic concepts.

Composite and Cold-Formed Steel Structures: Introduction to steel–concrete composite construction, Composite beams and shear connectors (design concepts), Cold-formed steel sections – characteristics and design concepts-Effective width method and direct strength method.

Introduction to Pre-Engineered buildings concepts only.

Module 4: Analysis and design of steel structures - Practical sessions (30 Hours)

List of experiments

1. Analysis and design of a multi storeyed steel building with detailing
2. Analysis and design of a steel roof truss
3. Preparation of drawings as per seismic design codes

* All experiments are mandatory

Reference Books:

1. Punmia B. C., Jain A. K. and Jain A. K., “Design of Steel Structures”, Laxmi Publications (P)
2. S. K. Duggal, Design of Steel Structures.

3. Bhavikatti S. S., "Design of Steel Structures: By Limit State Method as Per IS: 800-2007".

4. Srinivasan Chandrasekaran, "Advanced Design of Steel Structures".

5. Ramchandra S and Virendra Gehlot, "Design of Steel Structures Vol. II", Standard Book

6. N.Subramanian, "Steel Structures", Oxford Publication

7. P. Dayaratnam., "Design of Steel Structures", Wheeler Publishing, 2003

8. IS 800 – 2007, "Code of practice for Structural steel design", BIS

9. IS:875-Part 3-2015 "Design loads for buildings Part 3: Wind loads", BIS

COURSE CONTENTS AND LECTURE SCHEDULE

(For 5 credit courses, the content can be for 60 hrs. and for 4 credit courses, the content can be for 40 hrs.)

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	**Module 1**	**10 Hours**
1.1	Review of steel properties and stress–strain behaviour, Limit State Design philosophy (IS 800:2007 – brief review)	2
1.2	Design of Tension members, compression members and laterally supported and unsupported beams	5
1.3	Design of Beam-columns (concepts only)- Moment Amplification factor- Equivalent uniform factor;	3
2	**Module 2**	**10 Hours**
2.1	Connections- bolted and welded- bolted and welded connections subjected to in-plane and out of plane loading - Beam to beam connections- Beam to column connections- Bolted Seating Angle Connection, Bolted Web Cleats Connection, Bolted End Plate Connection - Beam and column splices	6
2.2	Ductile detailing principles – introduction to seismics design code- Preparation of basic steel design drawings.	2
2.3	Learning from failures- case studies of steel structures.	2
3	**Module 3**	**10 Hours**
3.1	Plate girders: components, Shear Buckling, Tension Field Action, stiffeners- design of plate girder. Gantry girders – loading and design procedure.	3
3.2	Multi storied steel buildings and steel trusses– overview on design and basic concepts.	2
3.3	Composite and Cold-Formed Steel Structures: Introduction to steel–concrete composite construction, Composite beams and shear connectors (design concepts), Cold-formed steel sections – characteristics and design concepts-Effective width method and direct strength method.	3

3.4	Introduction to Pre-Engineered buildings concepts only.	2
4	**Module 4**	**30 Hours**
4.1	List of experiments : 1. Analysis and design of a multi storeyed steel building with detailing	15
4.2	2. Analysis and design of a steel roof truss	9
4.3	3. Preparation of drawings as per seismic design codes	6
Total		**60 Hours**

MODEL QUESTION PAPER

QP CODE: **Pages: xx**

Reg.No.: .....

Name: .....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

SECOND SEMESTER M. TECH DEGREE EXAMINATION, MAY 2027

Course Code: M26CE1D201

ADVANCED DESIGN OF STEEL STRUCTURE

Max. Marks: 40 Duration: 2 hours

Answer any four questions. Each question carries 10 marks.

1. a) Design a built-up column consisting of two channels placed back-to-back to carry an axial factored load of 1000KN. Length of the column is 5m and the column is restrained in position and but not in direction at both ends. Use steel of grade Fe410. Design the lacing system and required connections. (10)

2. a) Design a laterally supported beam of effective span 6m for the following data : Grade of steel: Fe410,Maximum factored bending moment; M = 150kN, Maximum factored shear force; V = 250kN. (10)

3. a) Outline the design considerations for designing cold form steel structures. (5)
   b) Explain the components of a plate girder and discuss web buckling. (5)

4. a) Design a bolted beam-to-column end-plate connection for a steel frame. The beam is an ISMB 400 and the column is an ISHB 450. The connection must resist a moment of 50 kNm and a shear force of 80 kN. Use M20 bolts of grade 8.8. Provide a detailed design, including bolt arrangement, end-plate thickness, and a sketch of the connection with dimensions. (10)

5. a) Design a welded beam-to-column connection for a steel frame structure. The beam carries an end moment of 40 kNm and a shear force of 60 kN. Use E70 electrodes and assume the column is an ISHB 300 section. Provide a detailed design of the weld size and length, including necessary calculations and a sketch of the connection. (10)

6. a) Design a welded beam-to-column connection for a steel frame structure. The beam carries an end moment of 40 kNm and a shear force of 60 kN. Use E70 electrodes and assume the column is an ISHB 300 section. Provide a detailed design of the weld size and length, including necessary calculations and a sketch of the connection. (10)

CODE	COURSE NAME	L	T	P	S	CREDIT
M26CE1D202	Advanced Structural Analysis	3	0	3	6	5

Preamble:

Advanced Structural Analysis introduces the theoretical and computational principles used for the analysis of complex structural systems. The course covers matrix methods, numerical procedures, and finite element techniques for trusses, beams, frames, and two-dimensional structures, with emphasis on practical implementation using MATLAB/Python and advanced modelling through ABAQUS/ANSYS for real structural engineering applications.

Prerequisites: Engineering Mechanics, Strength of Materials, Structural Analysis.

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

CO 1	Apply the direct stiffness method to analyze trusses, beams, and plane frames by determining nodal displacements, support reactions, and member forces. **(Coginitive Knowledge Level:Apply)**
CO 2	Analyze structural engineering problems using numerical methods such as Gaussian elimination, Newton–Raphson method, eigenvalue solution, and Newmark's method.**(Coginitive Knowledge Level:Analyze)**
CO 3	Explain the basic concepts of the finite element method, including discretization, shape functions, element formulation, assembly procedure, and application to structural systems.**(Coginitive Knowledge Level:Understand)**
CO 4	Develop computational and finite element models using MATLAB/Python and ABAQUS/ANSYS for solving and interpreting structural analysis problems.**(Coginitive Knowledge Level:Create)**

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	2	1	1	2	1
CO 2	3	3	2	2	2	2
CO 3	3	3	2	2	3	2
CO 4	3	3	2	3	2	3

Assessment Pattern

M26CE1D202 Advanced Structural Analysis			
Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination (%)**
	Test 1 (%)	**Test 2 (%)**	
Remember			
Understand	20	20	20
Apply	40	40	40
Analyse	40	40	40
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	60	40	2 hours

Continuous Internal Evaluation Pattern

Theory Evaluation : **30 marks**
Self-study (Course based task/Seminar/Quiz/ Micro project) : 10 marks
Test paper 1 : 10 marks
Test paper 2 : 10 marks
Lab Evaluation : **30 marks**
Lab work : 10 marks
Final evaluation Test : 20 marks

(Note: 50% of Module 1, 2 and 3 may be considered for each test)

End Semester Examination Pattern

The end semester examination should be conducted by the college. The time duration will be 2 Hrs and will contain 6 questions from first three modules, with minimum one question from each module of which student should answer any four. Each question can carry 10 marks and can have maximum 2 sub-divisions.

SYLLABUS

Module 1: Structural Idealization and Matrix Analysis (10 Hours)

Structural idealization, degrees of freedom, coordinate systems, load representation, and boundary conditions. Stiffness concept, force–displacement relationships, and assembly of stiffness matrices. Direct stiffness method for trusses including element formulation, transformation, and axial force evaluation. Direct stiffness method for beams and continuous structures covering reactions, SFD, BMD, and deflections. Direct stiffness method for plane frames including global stiffness formulation, internal forces, and nodal displacements.

Module 2: Numerical Methods in Structural Engineering(10 Hours)

Solution of linear systems using Gaussian elimination method. Solution of nonlinear equations using Newton–Raphson method for single and multi-variable systems including limitations and modified methods. Introduction to eigenvalue problems in structural engineering and solution using characteristic polynomial method. Newmark's method including concept of equivalent loads and computational procedure. Application of Newmark's method for determining slope and deflection of beams under various loading conditions and varying flexural rigidity.

Module 3: Finite Element Method in Structural Engineering (10 Hours)

Introduction to finite element method (FEM), basic concepts, applications, and steps in finite element analysis including structural idealization and discretization. Interpolation functions and element formulation using natural and generalized coordinate systems, shape functions, Lagrangian interpolation, and convergence requirements. Finite element formulation of bar and beam elements including element stiffness matrices, assembly of global stiffness matrix, and application of boundary conditions. Solution of nodal displacements and element forces in structural systems. Introduction to two-dimensional elements (CST, LST, and quadrilateral).

Module 4: Experiments (30 Hours)

1. Development of a computational program using MATLAB/ PYTHON to solve simultaneous linear equations using the Gaussian elimination method.
2. Implementation of the Newton–Raphson method using MATLAB/ PYTHON to determine the roots of nonlinear equations for single and multi-variable.
3. Computation of eigenvalues of structural matrices using MATLAB/ PYTHON through the characteristic polynomial method.
4. Finite element modelling and analysis of continuous beam elements using ABAQUS/ ANSYS to determine deflection, slope and bending moment under different loading conditions.
5. Modelling and static analysis of two-dimensional frame structures using ABAQUS/ ANSYS to determine nodal displacements, bending moments and axial forces.
6. Analysis of structural components using 2D finite elements (CST/ LST/ quadrilateral elements) in ABAQUS/ ANSYS to evaluate stress and displacement distribution.

Note: Any four experiments shall be carried out, with at least two experiments from numerical methods and two from finite element.

Software / Tools

- MATLAB/ PYTHON
- ABAQUS/ ANSYS

Reference Books:

1. Devdas Menon,"Advanced StructuralAnalysis", Narosa Publishing House, 2009.
2. Devdas Menon,"StructuralAnalysis", Narosa Publishing House, 2008.
3. Basic Structural Analysis: Wilbur and Norris, first edition, 1971.
4. Basic Structural Analysis by C S Reddy, first edition, 2004.
5. Matrix Methods for structural engineering.by Gere, Weaver.
6. Structural Analysis by R.C. Hibbeler, 10th edition, 2016.
7. Advanced Structural Analysis by Praveen Nagarajan, first edition, 2010.
8. Rajasekaran S., "Numerical Methods in Science and Engineering, A practical approach", A H Wheeler Co., first edition, 2003.
9. Krishna Raju N. and Muthu K.U, "Numerical Methods for Engineering Problems", Macmillan India Limited, first edition, 1990.
10. J. H. Mathews and K.D. Fink, "Numerical Methods using MATLAB", Pearson Education,2004.
11. J.N. Reddy, An Introduction to Finite Element Method, Tata McGraw Hill Publishing Company Ltd, New Delhi, fourth edition 2019.
12. Y. M. Desai, T. I. Eldho, A. H. Shah, Finite Element Method with Applications in Engineering,Pearson Education India, second edition 2018.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	**Module 1**	**10hours**
1.1	Structural idealization, degrees of freedom, coordinate systems	1
1.2	Load representation and boundary conditions	1
1.3	Stiffness concept and force–displacement relationships and Assembly of stiffness matrices	2
1.4	Direct stiffness method for trusses including element formulation	2
1.5	Transformation and axial force evaluation in trusses	2
1.6	Direct stiffness method for beams and continuous structures, Reactions, SFD, BMD, and deflections in continuous beams	1
1.7	Direct stiffness method for plane frames including global stiffness formulation, Internal forces and nodal displacements in plane frames	1
2	**Module 2**	**10 hours**
2.1	Solution of linear systems using Gaussian elimination method	1
2.2	Solution of nonlinear equations using Newton–Raphson method (single variable)	2
2.3	Newton–Raphson method for multi-variable systems, Limitations and modified Newton–Raphson methods	2
2.4	Introduction to eigenvalue problems in structural engineering, Solution using characteristic polynomial method	2
2.5	Newmark's method – concept of equivalent loads, Computational procedure of Newmark's method	1

2.6	Application of Newmark's method for determining slope and deflection of beams under various loading conditions and varying flexural rigidity.	2
3	**Module 3**	**10 hours**
3.1	Introduction to finite element method (FEM), basic concepts, applications, and steps in finite element analysis including structural idealization and discretization	2
3.2	Interpolation functions and element formulation using natural and generalized coordinate systems, shape functions, Lagrangian interpolation, and convergence requirements	2
3.3	Finite element formulation of bar elements	2
3.4	Finite element formulation of beam elements	1
3.5	Assembly of global stiffness matrix and application of boundary conditions. Solution of nodal displacements and element forces in structural systems.	2
3.6	Introduction to two-dimensional elements (CST, LST, and quadrilateral).	1
4	**Module 4**	**30 hours**
4.1	Any four Experiments	
Total		**60 Hours**

MODEL QUESTION PAPER

QP CODE: **Pages: 3**

Reg.No.: .....

Name: .....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

SECOND SEMESTER M TECH DEGREE EXAMINATION, April 2027

Course Code: M26CE1D202

Advanced Structural Analysis

Max. Marks: 40 Duration: 2 hours

Answer any four questions. Each question carries 10 marks.

1. a) Structures may be solved by either stiffness matrix method or flexibility method. Generally stiffness matrix is preferred. Explain. (3)

   b) Analyse the continuous beam shown in Figure 1 using Direct stiffness method. (7)

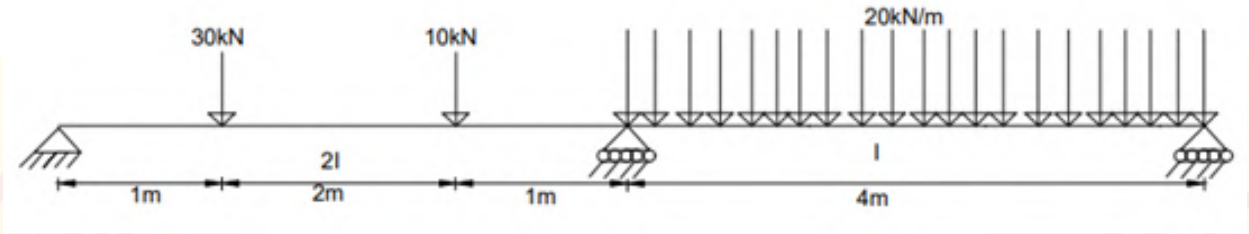


Figure 1:

2. a) How would you explain the concept of equivalent joint load and its significance in structural analysis. (3)

   b) Analyse the Truss shown in Figure 2 using Direct stiffness method. (7)

3. a) A cantilever of length L and uniform flexural rigidity EI supports a uniformly distributed load of intensity w kN/m over its entire span length. Evaluate the maximum slope and deflection at the free end using Newmark's method. (5)

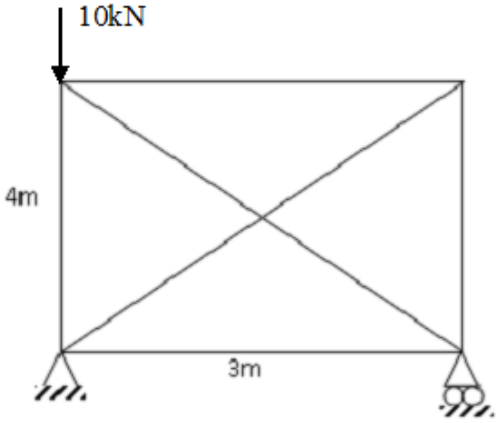


Figure 2:

b) Solve the system of equations using Gaussian Elimination:

$$\begin{aligned} 5x_1 + x_2 + x_3 &= 10 \\ x_1 + 5x_2 + 2x_3 &= -20 \\ x_1 + 2x_2 + 3x_3 &= -40 \end{aligned}$$

(5)

4. a) Determine the roots of the following pairs of simultaneous non-linear equations by modified N-R method:

$$\begin{aligned} x^2 - 2y^2 + 4.82 &= 0 \\ 2x + 4y^2 - 16.74 &= 0 \end{aligned}$$

Starting values may be assumed as $x_0 = 1.30$ and $y_0 = 1.70$. (5)

b) Find the eigenvalues and eigenvectors for the given matrix

$$A = \begin{bmatrix} 8 & -4 \\ 2 & 2 \end{bmatrix}$$

(5)

5. a) Discuss the importance of assumptions and simplifications in mathematical modeling for finite element analysis. (3)

b) The thin plate of uniform thickness 20 mm is as shown in Figure. 3. In addition to the self weight, the plate is subjected to a point load of 400 N at mid-depth. The Young's modulus is $E = 2 \times 10^5\,\mathrm{N/mm^2}$ and the unit weight is $\rho = 0.8 \times 10^{-4}\,\mathrm{N/mm^2}$. Analyse the plate after modeling it with two elements and find the stresses in each element. (7)

6. a) Outline the general steps involved in the finite element method for solving engineering problems. (3)

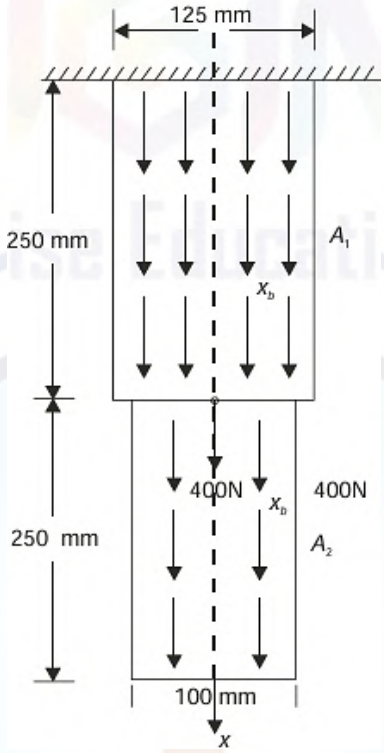


Figure 3:

b) Analyse the beam shown in Figure. 4 by finite element method and determine the end reactions. Also determine the deflections at mid spans given

$$E = 2 \times 10^5 \, \text{N/mm}^2 \quad \text{and} \quad I = 5 \times 10^6 \, \text{mm}^4 \tag{7}$$

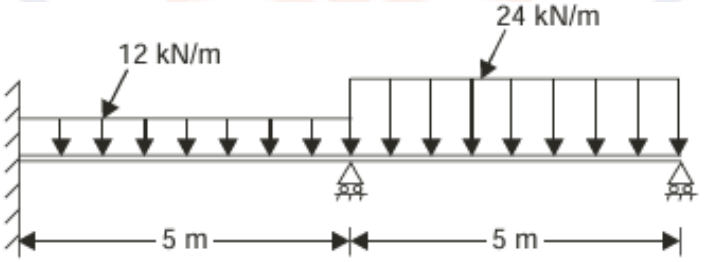


Figure 4:

CODE	COURSE NAME	CATEGORY	L	T	P	S	CREDIT
M26CE1E203A	ADVANCED FOUNDATION ENGINEERING	Elective	4	0	0	5	4

Preamble: This course provides advanced knowledge in the analysis and structural design of foundation systems and retaining structures, emphasizing soil–structure interaction and codal compliance. It encompasses shallow and deep foundations, including footings, rafts, and pile systems, along with earth-retaining and excavation support structures. The course aims to develop the ability to design safe, serviceable, and economical solutions for complex geotechnical engineering problems.

Prerequisite: Fundamental knowledge of Soil Mechanics and Foundation Engineering, including shear strength, consolidation, and bearing capacity concepts, along with basic understanding of Structural Analysis and Reinforced Concrete Design. Familiarity with relevant Indian Standard (IS) codes is desirable.

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

CO 1	Analyse bearing capacity and soil–structure interaction to determine contact pressure distribution and design various shallow foundation systems. (Cognitive knowledge level: Apply)
CO 2	Evaluate the behaviour of raft (mat) foundations using rigid and flexible approaches and perform their structural design using appropriate analytical methods. (Cognitive knowledge level: Analyse)
CO 3	Assess load transfer mechanisms and carry out the design of deep foundations, including piles and pile caps, in accordance with relevant codes and detailing practices. (Cognitive knowledge level: Analyse)
CO 4	Analyse earth pressure theories and design retaining structures and excavation support systems, ensuring stability against sliding, overturning, and bearing failure. (Cognitive knowledge level: Apply)

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	1	0	3	3	2	0
CO 2	1	0	3	3	3	0
CO 3	2	0	3	3	3	0
CO 4	1	1	3	3	2	1

Assessment Pattern

	ADVANCED FOUNDATION ENGINEERING		
Bloom's Category	**Continuous Internal Evaluation Tests**		**End Semester Examination (%Marks)**
	Test 1 (%Marks)	**Test 2 (%Marks)**	
Remember			
Understand	20	15	15
Apply	30	25	25
Analyse	30	35	30
Evaluate	10	15	15
Create	10	10	15

Mark distribution

Total Marks	**CIE marks**	**ESE marks**	**ESE Duration**
100	60	40	2 Hours

Continuous Internal Evaluation Pattern:

Self-study (Seminar*) : 10 marks

Course based task/Micro Project/

Data collection and interpretation/Case study: 20 marks

Test paper 1 (Module 1 and Module 2) : 15 marks

Test paper 2 (Module 3 and Module 4) : 15 marks

*Seminar should be conducted in addition to the theory hours. Topics for the seminar should be from recent technologies in the respective course.

End Semester Examination Pattern:

The end semester examination will be conducted by the College. Total duration of the examination will be 2 Hrs and will contain 6 questions, with minimum one question from each module of which student should answer any four. Each question can carry 10 marks and can have maximum 2 sub-divisions.

SYLLABUS

MODULE 1: Design of Shallow Foundations (10 hours)

Introduction to the Bearing capacity of Shallow Foundations
Soil pressure for structural design:
Contact pressure distribution for structural design
Structural design of:

- Isolated column footings
- Combined footings (rectangular & trapezoidal)
- Strap (cantilever) footings
- Strip footings under multiple columns

MODULE 2: Raft & Flexible Foundation Systems (10 hours)

Introduction- Application and types of Raft
Analysis approaches:
Rigid vs flexible raft behavior
Beams on elastic foundation (Winkler approach).
Design methods for Raft Foundations-Rigid beam method, Elastic plate method
Structural design of mat (raft) foundations
Types: flat plate raft, beam-and-slab raft
Circular and annular rafts (water tanks, silos)

MODULE 3: Deep Foundations (10 hours)

Pile foundations: Load carrying capacity of individual pile–Load transfer mechanism
Structural design of RC piles (as per IS 2911 & IS 456)
Under-reamed pile foundations
Structural design of pile caps (truss analogy, strut-and-tie concepts)
Load transfer mechanisms and detailing practices

MODULE 4: Retaining Structures & Temporary Works (10 hours)

Earth pressure theories (practical application in design)
Stability analysis of retaining structures: sliding, overturning, bearing
Structural design of:

- Cantilever retaining walls
- Counterfort retaining walls
- Gravity retaining walls

Introduction to deep excavation support systems
Sheet pile walls-Types of sheet pile structures-
Design of cantilever Sheet pile wall in clay and sand -
Numerical problems-
Anchored bulk heads –fixed earth and free earth support
Anchored systems:
Tie rods and anchor design (conceptual)

Reference Books

1. P.C.Varghese, “Design of Reinforced Concrete Foundations”, PHI – LTD – New Delhi, 1998
2. Kurien N.P., “Design of foundation systems – Principles and Practices” ,Narora Publishing house New Delhi (third edition),1992 33
3. Bowles J.E., “Foundation Analysis and Design” (4Ed.), Mc.Graw Hill, NY, 1996
4. Shamsher prakash, Gopal Ranjan, & Swami Saran, “Analysis and design of foundations and retaining structures”, Sarita Prakashan, New Delhi , 1979

COURSE CONTENTS AND LECTURE SCHEDULE

(For 5 credit courses, the content can be for 60 hrs. and for 4 credit courses, the content can be for 40 hrs.)

No	Topic	No. of Lecture/ Tutorial hours
	Module 1	**10**
1.1	Bearing capacity of shallow foundations	3
1.2	Soil pressure & contact pressure distribution for structural design	3
1.3	Structural design of isolated, combined, strap and strip footings	4
	Module 2	**10**
2.1	Applications, types and behavior of raft (rigid vs flexible)	3
2.2	Analysis methods: Winkler approach, rigid beam and elastic plate methods	3
2.3	Structural design of raft foundations (flat plate, beam-slab, circular/annular rafts)	4
	Module 3	**10**
3.1	Load carrying capacity and load transfer mechanism of piles	3
3.2	Structural design of RC piles (IS 2911 & IS 456), under-reamed piles	3
3.3	Design of pile caps (truss analogy, strut-and-tie) and detailing practices	4
	Module 4	**10**
4.1	Earth pressure theories and stability analysis	3
4.2	Design of retaining walls (cantilever, counterfort, gravity)	3
4.3	Sheet pile walls and anchored systems (cantilever & anchored, concepts)	4
	Total	**40 Hours**

Model Question Paper

QP CODE: Pages: X

Reg No.:_____

Name:_____

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

SECOND SEMESTER M. TECH DEGREE EXAMINATION, MAY 2027

Course Code: M26CE1E203A

Course Name: ADVANCED FOUNDATION ENGINEERING

Max. Marks:40 Duration: 2 hours

Answer any four questions. Each question carries 10 marks.

1. a. Explain the concept of **bearing capacity** and factors affecting it. *(5 marks)*

   b. square footing of size 2 m × 2 m is placed at a depth of 1.5 m in sand having:

$\gamma = 18$ kN/m³, $\varphi = 30°$, $c = 0$

The water table is at foundation level

Using Terzaghi's equation ($N_c = 30$, $N_q = 18.4$, $N\gamma = 15.7$):

Determine the ultimate bearing capacity

Calculate the safe bearing capacity (FoS = 3) (5 marks)

2. a. Discuss the need and types of combined footings. (5 marks)

   b. Two columns spaced 4 m apart carry loads of 1000 kN and 1500 kN.

Allowable soil pressure = 200 kN/m².

Design a rectangular combined footing:

i) Required area and dimensions

ii) Location of resultant load

iii) Sketch pressure distribution. (5 marks)

3. a. Differentiate between rigid and flexible raft foundations. (5 marks)

b. A raft strip is modeled as a beam subjected to column loads of 300 kN at 3 m spacing.

$k = 20000$ kN/m³.

Using Winkler approach:

i) Determine soil reaction

ii) Estimate maximum bending moment. (5 marks)

4. a. Explain the beam-and-slab raft system and its advantages. (5 marks)

b. A raft supports 9 columns in a 3 × 3 grid at 4 m spacing, each 800 kN.

Allowable soil pressure = 150 kN/m².

Determine:

i) Size of raft

ii) Average soil pressure

iii) Bending moment using $M = qL^2/10$. (5 marks)

5. a. Explain the load transfer mechanism in piles. (5 marks)

b. A 300 mm diameter pile, 12 m depth in clay:

$Cu = 50$ kN/m², $\alpha = 0.7$.

Determine:

i) Skin friction

ii) End bearing

iii) Ultimate capacity. (5 marks)

6. a. Explain earth pressure theories and applications. (5 marks)

b. Design a cantilever retaining wall for 4 m sand:

$\gamma = 18$ kN/m³, $\varphi = 30°$.

Determine:

i) Active earth pressure

ii) Overturning moment

iii) Factor of safety against sliding ($\mu = 0.5$). (5 marks)

CODE	COURSE NAME	L	T	P	S	CREDIT
M26CE1E203B	PROJECT PLANNING AND IMPLEMENTATION	4	0	0	5	4

Preamble:

This course covers project planning, productivity, quality, and safety in construction. It equips students with essential skills to manage projects efficiently while ensuring quality standards and safe practices.

Prerequisites: NIL

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

CO 1	Understand project planning processes, stakeholder roles, and execution stages in construction projects. (Coginitive knowledge level: Understsand)
CO 2	Apply productivity analysis techniques to evaluate and improve construction work performance. (Coginitive knowledge level: Apply)
CO 3	Apply quality management principles to ensure and maintain construction quality standards. (Coginitive knowledge level: Apply)
CO 4	Analyse construction safety practices to identify risks and improve safety performance (Coginitive knowledge level: Analyse)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	1	2	1	1	2	3
CO 2	1	3	2	2	1	2
CO 3	1	3	2	1	3	2
CO 4	2	3	2	1	2	3

Assessment Pattern

xxxx			
Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination (%)**
	Test 1 (%)	**Test 2 (%)**	
Remember			
Understand	30		20
Apply	50	60	60
Analyse	20	40	20
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	60	40	2 hours

Continuous Internal Evaluation Pattern

Self-study (Seminar*) : 10 marks
Course based task/Micro Project/ Data collection and interpretation/- Case study : 20 marks
Test paper 1 (Module 1 and Module 2) : 15 marks
Test paper 2 (Module 3 and Module 4) : 15 marks

*Seminar should be conducted in addition to the theory hours. Topics for the seminar should be from recent technologies in the respective course.

End Semester Examination Pattern

The end semester examination will be conducted by the College. Total duration of the examination will be 2 Hrs and will contain 6 questions, with minimum one question from each module of which student should answer any four. Each question can carry 10 marks and can have maximum 2 sub-divisions.

SYLLABUS

Module 1: (10 hours)

Project Planning: Objectives of planning, role of project manager and stakeholders; Stages of planning by different agencies; Sanctions; Tendering; Contracts; Execution of works; Project risk management plan; Work measurements, disputes, settlement of disputes and modes of settlement.

Module 2: (10 hours)

Work and Productivity Analysis: Work study and difficulties involved; Factors influencing productivity, productivity indices, measurement of productivity and productivity improvement techniques. Human relations in productivity, motivation, leadership and communication.

Module 3: (12 Hours)

Elements of quality and factors affecting construction quality-Quality control: methods and field of application in construction-Quality assurance system, quality manuals, and quality audit-ISO standards in construction quality management-Total Quality Management (TQM): principles and elements-Implementation and models of TQM in the construction industry.

Module 4: (8 Hours)

Safety in Construction: Importance of safety, causes of accidents and human factors in construction safety management; Safety codes, safety committee and inspection, measuring of safety and approaches to improve safety in construction; Safety in various construction operations.

Reference Books:

1. Sengupta and H. Guha (1995), "Construction Management and Planning", Tata McGrew Hill Publishing Company Pvt. Ltd., New Delhi.
2. Clarkson Oglesby, Henry Parker (1989), Grogory Howell, "Productivity Improvement in Construction", McGrew Hill Book Company, Inc.
3. R.P. Mohanty and R.R. Lakhe, "Total Quality Mangement", Jaico Publishing House.
4. S. Seetharaman, "Construction Engineering and Management", Umesh Publications
5. K. N. Vaid, "Construction Safety Management", National Institute of Construction Management and Research
6. Kerzner, H. (2017), "Project Management: A Systems Approach to Planning, Scheduling, and Controlling", John Wiley Sons, Hoboken, NJ.
7. Lewis, J.P. (2001), "Project Planning, Scheduling Control: A Hands-on Guide to Bringing Projects in on Time and on Budget", McGraw-Hill, New York.

COURSE CONTENTS AND LECTURE SCHEDULE

(For 5 credit courses, the content can be for 60 hrs. and for 4 credit courses, the content can be for 40 hrs.)

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	**Module 1**	**10 hours**
1.1	Project Planning: Objectives of planning, role of project manager and stakeholders;	2
1.2	Stages of planning by different agencies	2
1.3	Sanctions; Tendering; Contracts; Execution of works;	2
1.4	Project risk management plan; Work measurements	2
1.5	Disputes, settlement of disputes and modes of settlement.	2
2	**Module 2**	**10 hours**
2.1	Work and Productivity Analysis: Work study and difficulties involved	2
2.2	Factors influencing productivity, productivity indices	2
2.3	Measurement of productivity and productivity improvement techniques	3
2.4	Human relations in productivity, motivation, leadership and communication.	3
3	**Module 3**	**12 hours**
3.1	Elements of quality and factors affecting construction quality	2
3.2	Quality control: methods and field of application in construction	2
3.3	Quality assurance system, quality manuals, and quality audit	2
3.4	ISO standards in construction quality management	2
3.5	Total Quality Management (TQM): principles and elements	2

3.6	Implementation and models of TQM in the construction industry	2
4	**Module 4**	**8 hours**
4.1	Safety in Construction: Importance of safety, causes of accidents and human factors in construction safety management	2
4.2	Safety committee and inspection	2
4.3	Measuring of safety and approaches to improve safety in construction	2
4.4	Safety in various construction operations	2
Total		**40 Hours**

MODEL QUESTION PAPER

QP CODE: **Pages: xx**

Reg.No.: .....

Name: .....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

FIRST SEMESTER M TECH DEGREE EXAMINATION, DECEMBER 2026

Course Code: M26CE1E203B

PROJECT PLANNING AND IMPLEMENTATION

Max. Marks: 40 Duration: 2 hours

Answer any four questions. Each question carries 10 marks.

1. a) Explain the objectives of project planning and the role of a project manager. (5)
   b) Describe dispute resolution methods in construction projects. (5)

2. a) Explain methods used for measuring productivity in construction. (5)
   b) Discuss the role of motivation, leadership, and communication in improving productivity. (5)

3. a) Demonstrate the preparation of a basic quality assurance plan for a project (5)
   b) Illustrate the implementation of TQM principles in a construction project. (5)

4. a) Describe the principles and elements of Total Quality Management (TQM). (5)
   b) Illustrate the implementation of TQM principles in a construction project. (5)

5. a) Demonstrate the role of safety inspections in improving site safety. (5)
   b) Explain the importance of safety in construction and common causes of accidents. (5)

6. a) Apply suitable contract types for different construction scenarios (5)
   b) Demonstrate the steps involved in preparing a simple project plan. (5)

CODE	COURSE NAME	L	T	P	S	CREDIT
M26CE1E203C	Prestressed Concrete	4	0	0	5	4

Preamble: The course equips students with the knowledge and skills needed to design various types of prestressed concrete elements, including flexural, compression, and tension members. Additionally, the inclusion of composite member design broadens students' perspectives, highlighting the versatility of prestressed concrete in combination with other materials.

Prerequisites: Nil

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

CO 1	Understand the basic aspects of prestressed concrete structures and to compute the losses in prestressing. (Cognitive knowledge level: Apply)
CO 2	CO 2 Analyze and design prestressed concrete structural members and sections subjected to flexure and shear (Cognitive knowledge level: Analyze)
CO 3	CO 3 Analyze and design statically indeterminate prestressed concrete beams adopting suitable cable profiles. (Cognitive knowledge level: Analyze)
CO 4	CO 4 Analyse composite prestressed concrete structural members. (Cognitive knowledge level: Analyze)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	2	1	1	2	1
CO 2	3	3	2		2	2
CO 3	2	3		2	3	1
CO 4	2	2	2	3	2	

Assessment Pattern

Prestressed Concrete			
Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination (%)**
	Test 1 (%)	**Test 2 (%)**	
Remember			
Understand	20	20	20
Apply	30	30	30
Analyse	40	40	40
Evaluate	10	10	10
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	60	40	2 hours

Continuous Internal Evaluation Pattern

Self-study (Seminar*) : 10 marks
Course based task/Micro Project/ Data collection and interpretation/- Case study : 20 marks
Test paper 1 (Module 1 and Module 2) : 15 marks
Test paper 2 (Module 3 and Module 4) : 15 marks

*Seminar should be conducted in addition to the theory hours. Topics for the seminar should be from recent technologies in the respective course.

End Semester Examination Pattern

The end semester examination will be conducted by the College. Total duration of the examination will be 2 Hrs and will contain 6 questions, with minimum one question from each module of which student should answer any four. Each question can carry 10 marks and can have maximum 2 sub-divisions.

SYLLABUS

Module 1: Fundamentals of Prestressing (10 Hours)

Basic Concept of prestressing -Advantages and disadvantages – Materials– Systems and methods of prestressing

Analysis of sections: Stress concept – Strength concept – Load balancing concept

Effect of tendon profile on deflections – Factors influencing deflections – Calculation of deflections – Short term and long-term deflections (Concepts only).

Losses of prestress- Immediate and long term (Concept only) types.

Module 2: Flexural and Shear Design of Prestressed Members (10 Hours)

Basic assumptions of flexural design – Permissible stresses in steel and concrete as per I.S.1343 Code – Different types of sections - Design of sections- post-tensioned and pre tensioned beams – Check for flexural capacity based on I.S. 1343 Code –

Influence of Layout of cables in post-tensioned beams – Location of wires in pre-tensioned beams – Design for shear based on I.S. 1343 Code.

Anchorage zone reinforcement- Design based on IS Code.

Module 3:Prestressed Continuous Beams (10 Hours)

Prestressed continuous beams: Classifications - Methods of achieving continuity- Analysis and design of continuous beams, Concept of linear transformations, concordant cable profile.

Module 4: Composite and Special Prestressed Structures (10 Hours)

Composite Sections: Types – Advantages – applications- Analysis of stresses for composite sections -Composite beams Analysis and design of Flexural and shear strength - Differential Shrinkage Partial prestressing: its advantages and applications.

Design of Tanks, pipes and poles (concepts only). – Design of prestressed concrete slab (concepts only).

Reference Books:

1. Krishna Raju N., “Prestressed concrete”, 5th Edition, Tata McGraw Hill Company New Delhi, 2012
2. Pandit.G.S. and Gupta.S.P., “Prestressed Concrete”, CBS Publishers and Distributers Pvt. Ltd, 2012
3. Rajagopalan.N, “Prestressed Concrete”, Narosa Publishing House, 2002.
4. Nagarajan, P., Prestressed Concrete Design, Pearson 2013
5. IS 1343:2012, Code of Practice for Prestressed Concrete, Bureau of Indian Standards, New Delhi, 2012

6. IS 3370- Part 3 (1967) (Reaffirmed – 2008) Indian standard Code of practice for concrete structures for the storage of liquids, Bureau of Indian Standards, New Delhi, 2008

7. IS 3370- Part 4 (2008) Indian standard Code of practice for concrete structures for the storage of liquid- Design tables, Bureau of Indian standards, New Delhi

8. Dayaratnam.P., "Prestressed Concrete Structures", Oxford and IBH, 2013

9. Lin T.Y. and Ned.H.Burns, "Design of prestressed Concrete Structures", Third Edition, Wiley India Pvt. Ltd., New Delhi, 2013

COURSE CONTENTS AND LECTURE SCHEDULE

(For 5 credit courses, the content can be for 60 hrs. and for 4 credit courses, the content can be for 40 hrs.)

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	**Module 1**	**10 Hours**
1.1	Basic Concept of prestressing -Advantages and disadvantages – Materials– Systems and methods of prestressing	2
1.2	Analysis of sections: Stress concept – Strength concept – Load balancing concept	3
1.3	Effect of tendon profile on deflections – Factors influencing deflections – Calculation of deflections – Short term and long-term deflections (Concepts only).	2
1.4	Losses of prestress- Immediate and long term (Concept only) types.	3
2	**Module 2**	**10 Hours**
2.1	Basic assumptions of flexural design – Permissible stresses in steel and concrete as per I.S.1343 Code – Different types of sections - Design of sections- post-tensioned and pre tensioned beams – Check for flexural capacity based on I.S. 1343 Code –	3
2.2	Influence of Layout of cables in post-tensioned beams – Location of wires in pre-tensioned beams – Design for shear based on I.S. 1343 Code.	4
2.3	Anchorage zone reinforcement- Design based on IS Code.	3
3	**Module 3**	**10 Hours**
3.1	Prestressed continuous beams: Classifications - Methods of achieving continuity	2
3.2	Analysis and design of continuous beams.	5
3.3	Concept of linear transformations, concordant cable profile.	3

4	**Module 4**	**10 Hours**
4.1	Composite Sections: Types – Advantages – applications- Analysis of stresses for composite sections -Composite beams Analysis and design of Flexural and shear strength - Differential Shrinkage	5
4.2	Partial prestressing: its advantages and applications.	2
4.3	Design of Tanks, pipes and poles (concepts only). – Design of prestressed concrete slab (concepts only).	3
Total		**40 Hours**

MODEL QUESTION PAPER

QP CODE: **Pages: 2**

Reg.No.: .....

Name: .....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

SECOND SEMESTER M TECH DEGREE EXAMINATION, MAY 2027

Course Code: M24CE1E203C

Prestressed concrete

Max. Marks: 40 Duration: 2 hours

Answer any four questions. Each question carries 10 marks.

1. a) Answer to the questions in few sentences. Give a brief justification in maximum of five sentences for full credit: Two beams having same properties are prestressed with straight tendon having same force and steel area. The first one is concentric and the second one is eccentric with a positive eccentricity. Which beam carry more external load and why? (3)

   b) A prestressed concrete beam 250mm wide and 400mm deep is prestressed by an eccentric tendon. The span of the beam is 7m and the beam has to support an imposed load of 4.5kN/m. Find the prestressing force necessary so that the tension is just avoided at the soffit of the mid section if the eccentricity is 60mm. Concrete weight is 25kN/m^3. (7)

2. a) The support section of a prestressed concrete beam 100mm wide and 250mm deep is required to support an ultimate shear force of 60kN. The compressive prestress at the centroidal axis is fcp=5N/mm^2. fck=40N/mm^2 and cover to the tension reinforcement is 50mm. if the characteristic tensile strength of steel in stirrups is 250N/mm^2. Design suitable shear reinforcement at the section using IS code recommendations. (7)

   b) Consideration of transmission length and development length in post tensioned member is meaningless. Justify. Also explain the nature of stresses developed in anchorage of post tensioned member. (3)

3. a) A two span continuous beam ABC (AB = BC = 10m) has a uniform cross-section with a width of 100mm and depth of 300mm. A cable carrying an effective prestressing force of 360 kN is parallel to the axis of the beam and located at 100mm from the soffit. Determine the secondary and resultant moment at the center support B. Also locate resultant line of thrust. (10)

4. a) The mid span section of a composite beam consist of a precast web 300mm x 920mm, post tensioned with an initial force of 2450kN with tendons located at 200mm from the soffit of the beam. The effective prestress is estimated as 2150kN. Moment due to the selfweight of precast web is 270kNm at mid span. After the web is erected in place, the top slab of 150mm thickness and 920 mm width is casted (unpropped) producing a moment of 135kNm. After the slab concrete has hardened, the composite section is to carry a maximum live load of 720kNm. Compute stresses in section. (10)

5. a) A rectangular pre-tensioned concrete beam has a breadth of 100mm and depth of 230mm, and the prestress after all losses have occurred is $12N/mm^2$ at the soffit and zero at the top. The beam is incorporated in a composite T-beam by casting a top flange of breadth 300mm and depth 50mm.Calculate the maximum uniformly distributed live load that can be supported on a simply supported span of 4.5m without tensile stresses occurring, if the slab is externally supported while casting. (7)

   b) Justify the statement "Composite prestressed concrete member is superior when compared with prestressed concrete members" with proper reasoning. (3)

6. a) Explain the methods of achieving continuity in prestressed concrete members.(6)

   b) Explain the concept of linear transformation.(5 marks) (4)

CODE	COURSE NAME	L	T	P	S	CREDIT
M26CE1E203D	Design of Tall buildings	4	0	0	5	4

Preamble:

This course introduces the principles governing the design and analysis of tall buildings, with emphasis on structural systems, loading effects, dynamic behavior, stability, and computational modelling. It enables students to understand the response of tall building structures under wind and earthquake actions and to apply appropriate analytical and design concepts in modern high-rise construction.

Prerequisites: Knowledge of Structural Analysis, Reinforced Concrete Design, Steel Structures, Structural Dynamics, Design of Concrete Structures, Design of Steel Structures, and basic familiarity with structural modelling software is desirable.

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

CO 1	Explain the design philosophy, material characteristics, structural loading, and load combinations relevant to tall buildings. **(Coginitive Knowledge Level:Understand)**
CO 2	Apply the concepts of structural systems and tall building behavior to identify suitable lateral load resisting systems and preliminary member configurations.**(Coginitive Knowledge Level:Apply)**
CO 3	Analyze tall building response using approximate methods and computational modelling techniques, and interpret key outputs such as storey displacement, drift, and torsional response.**(Coginitive Knowledge Level:Analyze)**
CO 4	Evaluate the dynamic behavior, stability, serviceability, and foundation interaction of tall buildings under wind and earthquake effects.**(Coginitive Knowledge Level:Evaluate)**

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	1	1	1	1		1
CO 2	2	1	1	1		1
CO 3	2	1	2	2	1	2
CO 4	2	1	2	2	2	1

Assessment Pattern

M26CE1E203D Design of Tall Buildings			
Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination (%)**
	Test 1 (%)	**Test 2 (%)**	
Remember			
Understand	30	30	30
Apply	40	40	40
Analyse	20	20	20
Evaluate	10	10	10
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	60	40	2 hours

Continuous Internal Evaluation Pattern

Self-study (Seminar*) : 10 marks
Course based task/Micro Project/ Data collection and interpretation/- Case study : 20 marks
Test paper 1 (Module 1 and Module 2) : 15 marks
Test paper 2 (Module 3 and Module 4) : 15 marks

*Seminar should be conducted in addition to the theory hours. Topics for the seminar should be from recent technologies in the respective course.

End Semester Examination Pattern

The end semester examination will be conducted by the College. Total duration of the examination will be 2 Hrs and will contain 6 questions, with minimum one question from each module of which student should answer any four. Each question can carry 10 marks and can have maximum 2 sub-divisions.

SYLLABUS

Module 1:Design Philosophy, Materials and Structural Loading (10 hours)

Design philosophy – limit state design – performance-based design – serviceability criteria – robustness and progressive collapse. Load path– gravity load transfer mechanism. Materials for tall buildings – high-performance concrete – composite construction - time-dependent and durability effects (overview). Structural loading – gravity loads – construction sequence effects. Comparison of wind load (IS 875 Part 3) and seismic load (IS 1893) in tall buildings. Load combinations and design scenarios. Case studies

Module 2:Structural Systems and Behaviour of Tall Buildings (10 hours)

Structural systems – rigid frames – lateral load resisting systems – shear walls, core and outrigger systems – tubular and diagrid systems. Behaviour of tall buildings – load path – lateral load resistance – overturning behaviour – core–frame interaction. Structural efficiency – stiffness, strength and material efficiency – influence of slenderness and aspect ratio. Plan and vertical irregularities – torsion – symmetry – setbacks and openings. Preliminary member sizing – conceptual guidelines based on system and height. Case studies.

Module 3:Analysis and Computational Modelling (10 Hours)

Approximate analysis methods – portal method and cantilever method (concept and application). Introduction to 3D analysis of tall buildings – modelling assumptions and idealization. Computational modelling using ETABS (overview). Linear static and dynamic analysis – basic concepts of modal and response spectrum analysis. P–Delta effects and their significance in tall buildings. Interpretation of analysis results – storey displacement, drift and torsional response. Model validation and common modelling errors. Analysis report preparation (overview)

Module 4:Dynamic Behavior, Stability and Foundation Interaction (10 Hours)

Dynamic behavior of tall buildings – response to wind and earthquake (conceptual understanding). Wind effects – along-wind behavior – serviceability considerations and human comfort criteria. Seismic behavior – response characteristics of tall buildings (qualitative understanding). Stability considerations – concept of second-order effects and overall stability in tall buildings. Drift control and serviceability limits in design. Foundation systems – types and role in tall buildings (overview). Introduction to vibration control systems – tuned mass dampers and base isolation (Concept). Case studies.

Reference Books:

1. Smith, B. S., and Coull, A., Tall Building Structures: Analysis and Design, John Wiley and Sons, New York.
2. Taranath, B. S., Structural Analysis and Design of Tall Buildings: Steel and Composite Construction, CRC Press, Boca Raton.
3. Paulay, T., and Priestley, M. J. N., Seismic Design of Reinforced Concrete and Masonry Buildings, John Wiley , Sons, New York.

4. Moon, K. S., and Connor, J. J., Tall Building Structures: Systems and Concepts, Elsevier, Oxford.

5. Anil K. Chopra, Dynamics of Structures: Theory and Applications to Earthquake Engineering, Pearson Education / Prentice Hall.

COURSE CONTENTS AND LECTURE SCHEDULE

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	**Module 1**	**10 hours**
1.1	Design philosophy – limit state design	1
1.2	Performance-based design – serviceability criteria – robustness and progressive collapse.	1
1.3	Load path– gravity load transfer mechanism. Materials for tall buildings – high-performance concrete – composite construction - time-dependent and durability effects (overview).	3
1.4	Structural loading – gravity loads – construction sequence effects. Comparison of wind load (IS 875 Part 3) and seismic load (IS 1893) in tall buildings. Load combinations and design scenarios.	3
1.5	Case studies	2
2	**Module 2**	**10 hours**
2.1	Structural systems – rigid frames – lateral load resisting systems – shear walls, core and outrigger systems – tubular and diagrid systems.	4
2.2	Behaviour of tall buildings – load path – lateral load resistance – overturning behaviour – core–frame interaction.	2
2.3	Structural efficiency – stiffness, strength and material efficiency – influence of slenderness and aspect ratio.	1
2.4	Plan and vertical irregularities – torsion – symmetry – setbacks and openings. Preliminary member sizing – conceptual guidelines based on system and height.	2

2.5	Case studies.	1
3	**Module 3**	**10 hours**
3.1	Approximate analysis methods – portal method and cantilever method (concept and application)	2
3.2	Introduction to 3D analysis of tall buildings – modelling assumptions and idealization.	1
3.3	Computational modelling using ETABS (overview). Linear static and dynamic analysis – basic concepts of modal and response spectrum analysis.	3
3.4	P–Delta effects and their significance in tall buildings. Interpretation of analysis results – storey displacement, drift and torsional response	2
3.5	Model validation and common modelling errors. Analysis report preparation (overview)	2
4	**Module 4**	**10 hours**
4.1	Dynamic behavior of tall buildings – response to wind and earthquake (conceptual understanding). Wind effects – along-wind behavior – serviceability considerations and human comfort criteria.	2
4.2	Seismic behavior – response characteristics of tall buildings (qualitative understanding).	2
4.3	Stability considerations – concept of second-order effects and overall stability in tall buildings	2
4.4	Drift control and serviceability limits in design. Foundation systems – types and role in tall buildings (overview).	2
4.5	Introduction to vibration control systems – tuned mass dampers and base isolation (Concept).	1
4.6	Case studies	1
Total		**40 Hours**

MODEL QUESTION PAPER

QP CODE: **Pages: 01**

Reg.No.: .....

Name: .....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

SECOND SEMESTER M TECH DEGREE EXAMINATION, APRIL 2027

Course Code: M26CE1E203D

Design of Tall buildings

Max. Marks: 40 Duration: 2 hours

Answer any four questions. Each question carries 10 marks.

1. a) Outline the sequential loading process in a skyscraper. (5)
   b) List out the various software's for structural analysis. What is the difference between high-rise and low-rise buildings? (5)
2. a) Illustrate the infill wall patterns and how it fails under lateral loading. (3)
   b) Analyse the performance of framed structure by the insertion of a bracing mechanism. Draw the sketch of the numerous bracing systems that are utilized in buildings. (7)
3. a) Elucidate the methods used for approximate analysis of high-rise buildings. (3)
   b) Outline the purpose of the wind tunnel test. Suggest any two experiments conducted for tall buildings. (7)
4. a) Describe how the braced frame structural form which is utilized in tall buildings behaves. Also list out the various bracing systems. (3)
   b) Provide examples of how subsystem interactions can affect the overall structural performance (7)
5. a) P-Delta is a second-order effect that is mostly manifested in tall buildings when subjected to lateral sway". Justify the statement. (3)
   b) With the help of neat sketches explain the types of foundation suitable for high rise buildings. (7)
6. a) Briefly explain the structural system of the tallest building in the world. (5)
   b) Evaluate the effects of various types of loads on high-rise structures. (5)

CODE	COURSE NAME	CATEGORY	L	T	P	S	CREDIT
M26CE1S204	BUILDING INFORMATION MODELLING	Industry Integrated Course	4	0	0	5	4

Preamble:

This course introduces Building Information Modeling concepts, emphasizing collaboration, lifecycle management, and digital workflows, enabling students to apply BIM tools and techniques for efficient planning, design, and construction management.

Prerequisites: Nil

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

CO 1	Understand BIM concepts, evolution, benefits, lifecycle applications, and model quality principles (Cognitive knowledge level: Understand)
CO 2	Apply BIM collaboration methods, interoperability standards, and stakeholder roles in project environments (Cognitive knowledge level: Apply)
CO 3	Apply BIM execution planning, workflows, and integrated project delivery principles in projects (Cognitive knowledge level: Apply)
CO 4	Analyze BIM software tools for modeling, coordination, visualization, and project management tasks. (Cognitive knowledge level: Apply)

Mapping of Course Outcomes With Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	2	1	1	2	1
CO 2	2	3	2	2	3	2
CO 3	2	3	3	2	3	2
CO 4	1	3	2	3	3	2

Assessment Pattern

Building Information Modelling			
Bloom's Category	**Continuous Assessment Tests**		**End Semester Examination (%)**
	Test 1 (%)	**Test 2 (%)**	
Remember			
Understand	40	20	10
Apply	50	60	60
Analyse	10	20	30
Evaluate			
Create			

Mark Distribution

Total Marks	**CIE Marks**	**ESE Marks**	**ESE Duration**
100	60	40	2 hours

Continuous Internal Evaluation Pattern

Self-study (Seminar*) : 10 marks
Course based task/Seminar/Data collection and interpretation/Case study : 20 marks
Test paper 1 (Module 1 and Module 2) : 15 marks
Test paper 2 (Module 3 and Module 4) : 15 marks

*Seminar should be conducted in addition to the theory hours. Topics for the seminar should be from recent technologies in the respective course.

End Semester Examination Pattern

The examination will be conducted by the College with the question paper provided by the Industry. The examination will be for 2 Hrs and will contain 6 questions, with minimum one question from each module of which student should answer any four. Each question can carry 10 marks. The valuation of the answer scripts shall be done by the expert in the Industry handling the course.

SYLLABUS

Module 1: Introduction to BIM (10 hours)

Introduction to BIM - Understanding the Evolution of Building Information Modeling (BIM) - Exploring the Transition from Traditional AEC Business Models to BIM- Differentiating BIM from 3D and 2D Approaches- LOD Conceptualizing BIM as both a Product and a Process- Emphasizing BIM as a Lifecycle Platform- Assessing the Incentives and Benefits of BIM: Technical, Financial, and Sustainable Engineering, Object-Based Parametric Modeling and its Role in BIM- Ensuring BIM Model Quality through Model Checking Processes

Module 2: Collaboration and Interoperability (10 hours)

Collaboration, Interoperability, and Roles: Exploring Stakeholder Engagement in BIM: Owners, Facility Managers, Government Institutions, Architects, Engineers, Contractors, Subcontractors, and Fabricators. Analyzing Data Exchange Methods: File-based, Cloud-based, and Local - Standardizing Product Data Models for Interoperability. Implementing File-Based Exchange and BIM Servers: Industry Foundation Classes (IFC), COBie.

Module 3: BIM Execution Planning and IPD (10 Hours)

BIM Execution Planning: Developing a Comprehensive BIM Execution Plan (BEP) - Establishing Project Modeling Goals and Objectives - Selecting Model Uses for Different Project Phases - Designing the BIM Process Workflow - Defining Information Exchanges among Project Stakeholders - Integrated Project Delivery (IPD): Understanding the Principles of Integrated Project Delivery (IPD) - Cultivating Collaboration and Mutual Respect among Project Stakeholders

Module 4: BIM Software and Applications (10 Hours)

BIM Software Training: Hands-on Training with BIM Software (e.g., Revit, ArchiCAD, Tekla, Navisworks) Creating Modeling Views and Architectural, Structural, MEP, and Construction Modeling - Project Management Tools and Techniques within BIM Software - Utilizing Revit Families for Efficient Model Development - Conducting Design Analysis (Energy, Solar, Area, etc.) and Generating Schedules - Enhancing Design Visualization with Rendering and Walkthroughs - Documenting and Presenting Designs Effectively.

Reference Books:

1. "Building Information Modeling: Planning and Managing Construction Projects with 4D CAD and Simulations" by Willem Kymmell (McGraw-Hill Construction Series.)
2. "BIM Handbook: A Guide to Building Information Modeling for Owners, Managers, Designers, Engineers and Contractors" by Chuck Eastman, Paul Teicholz, Rafael Sacks, and Kathleen Liston.
3. "BIM and Integrated Design: Strategies for Architectural Practice" by Randy Deutsch.
4. "Building Information Modeling: Framework for Structural Design" by Rafael Sacks, Chuck Eastman, and Ghang Lee.

5. "Implementing BIM: A Guide to BIM Management in Construction Projects" by Richard Garbe.

6. "BIM for Facility Managers" by Kathleen Liston and Paul Teicholz.

7. "Integrated Project Delivery: An Action Guide for Leaders" by Ed Friedrichs and Iris Tommelein.

COURSE CONTENTS AND LECTURE SCHEDULE

(For 5 credit courses, the content can be for 60 hrs. and for 4 credit courses, the content can be for 40 hrs.)

No	Subtopics / Concepts	No. of Lecture/ Tutorial Hours
1	**Module 1: Introduction to BIM**	**10 hours**
1.1	Evolution of BIM and need for digital construction	2
1.2	Transition from traditional AEC practices to BIM	2
1.3	Difference between BIM, 2D and 3D approaches	2
1.4	LOD concepts; BIM as product and process; lifecycle platform	2
1.5	Parametric modelling; BIM benefits; model checking and quality control	2
2	**Module 2: Collaboration and Interoperability**	**10 hours**
2.1	BIM stakeholders: owners, architects and engineers	2
2.2	Roles of contractors, subcontractors, fabricators and facility managers	2
2.3	Data exchange methods: file-based and local collaboration	2
2.4	Cloud-based collaboration and BIM coordination platforms	2
2.5	Interoperability standards: IFC, COBie and BIM servers	2
3	**Module 3: BIM Execution Planning and IPD**	**10 hours**
3.1	Introduction to BIM Execution Plan (BEP)	2
3.2	Project goals, objectives and model uses in BIM	2
3.3	BIM workflow design and process mapping	2
3.4	Information exchange and coordination among stakeholders	2

3.5	Integrated Project Delivery (IPD) principles and collaboration	2
4	**Module 4: BIM Software and Applications**	**10 hours**
4.1	Introduction to BIM tools: Revit, ArchiCAD, Tekla, Navisworks	2
4.2	Architectural, structural and MEP modelling concepts	2
4.3	Revit families and project management tools in BIM	2
4.4	Design analysis: energy, solar, area and scheduling	2
4.5	Visualization, rendering, walkthroughs and documentation	2
Total		**40 Hours**

MODEL QUESTION PAPER

QP CODE: **Pages: xx**

Reg.No.: .....

Name: .....

MAR ATHANASIUS COLLEGE OF ENGINEERING (AUTONOMOUS), KOTHAMANGALAM

SECOND SEMESTER M TECH DEGREE EXAMINATION, MAY 2027

Course Code: M26CE1S204

BUILDING INFORMATION MODELLING

Max. Marks: 40 Duration: 2 hours

Answer any four questions. Each question carries 10 marks.

1. a) Illustrate how LOD levels are applied at different stages of a construction project. (5)
   b) Demonstrate how BIM can be used as a lifecycle platform for facility management. (5)
2. a) Illustrate the role of different stakeholders in a BIM-enabled project workflow. (10)
3. a) Demonstrate information exchange requirements among stakeholders in a BIM project. (5)
   b) Explain different model uses in BIM across project phases. (5)
4. a) Demonstrate the use of Revit families in developing a parametric component. (5)
   b) Describe the process of creating schedules in BIM software. (5)
5. a) Illustrate how energy or solar analysis can be performed using BIM software. (5)
   b) Explain the importance of visualization techniques like rendering and walkthroughs. (5)
6. a) Explain the concept and evolution of Building Information Modeling (BIM). (5)
   b) Explain the benefits of BIM in terms of technical, financial, and sustainability aspects. (5)

CODE	COURSE NAME	CATEGORY	L	T	P	S	CREDIT
M26CE1P205	MINI PROJECT	PROJECT	0	0	4	6	2

Preamble: Mini project can help to strengthen the understanding of student's fundamentals through application of theoretical concepts and to boost their skills and widen the horizon of their thinking. The aim of an engineering student is to resolve a problem by applying theoretical knowledge. Doing more projects increases problem solving skills.

The introduction of mini projects ensures preparedness of students to undertake dissertation. Students should identify a topic of interest in consultation with PG programme coordinator that should lead to their dissertation/research project. Demonstrate the novelty of the project through the results and outputs. The progress of the mini project is evaluated based on three reviews, two interim reviews and a final review. A report is required at the end of the semester.

Course Outcome

After completing dissertation phase 1 student should be able to

CO1: Identify and define an **Engineering problem**: Students will be able to select a relevant and feasible problem based on real-world needs, demonstrating originality and clarity in problem definition.

CO2: Conduct **Literature review** and develop a **methodology**: Students will develop the ability to critically review and synthesize existing literature to identify research gaps and establish the context for their study.

CO3: Implement the proposed **methodology** and **analyze results**: Students will be able to execute the methodology, develop a prototype/model/simulation, and analyze the results to validate the objectives.

CO4: **Communicate** the project outcomes effectively: Students will be able to prepare a structured report and present the work clearly, demonstrating technical knowledge, understanding, and involvement.

Course Outcome (CO)	Mapped Program Outcome (PO)	Justification
CO1: Identify and define an Engineering problem	PO1: Ability to independently carry out research/investigation and development work	Identifying a research topic requires independent exploration, critical thinking, and decision-making,

Course Outcome (CO)	Mapped Program Outcome (PO)	Justification
		forming the foundation for research activities.
	PO3: Demonstrate mastery over the specialization area	Topic selection reflects an understanding of advanced concepts beyond undergraduate level.
CO2: Conduct literature review and develop a methodology	PO1: Ability to independently carry out research/investigation and development work	Literature analysis develops the ability to critically evaluate existing work and identify research gaps.
	PO3: Demonstrate mastery over the specialization area	Analyzing literature demonstrates depth of knowledge in the chosen field.
CO3: Implement the proposed methodology and analyze results	PO1: Ability to independently carry out research/investigation and development work	Defining a problem and planning methodology are key steps in executing independent and systematic research.
	PO4: Apply stream knowledge to design or develop solutions for real-world problems	A well-formulated problem and methodology enable the application of domain knowledge to address practical engineering challenges.
	PO5: Identify, select, and apply appropriate techniques, resources, and tools	Developing methodology involves selecting suitable tools, techniques, and resources required for effective problem-solving.
CO4: Communicate the project outcomes effectively	PO2: Ability to communicate effectively, write and present technical reports	Preparing a structured report enhances technical writing, presentation, and communication skills for conveying research ideas clearly.
	PO6: Engage in life-long learning with consideration of sustainability, societal aspects	A proposal often encourages awareness of broader impacts, fostering continuous learning

Continuous Internal Evaluation

The evaluation committee comprises

1. Project coordinator
2. A senior faculty
3. Project supervisor

Course Outcome (CO)	Marks Allocated	Justification
CO1: Identify and define an Engineering problem	25	Topic selection is foundational stage requiring creativity and basic exploration of relevant problems
CO2: Conduct literature review and develop a methodology	25	Literature review is essential for understanding existing work and identifying research gaps through critical analysis.
CO3: Implement the proposed methodology and analyze results	25	Defining the problem is a pivotal step, formulating objectives and methodology demands detailed planning and technical understanding
CO4: Communicate the project outcomes effectively	25	Proposal preparation integrates all prior work into a concise document, focusing on communication
Total	**100**	

Detailed Breakdown and Rationale:

1. **CO1: Identify and define an Engineering problem (25 marks)**
   - This involves identifying a feasible and innovative topic. It's an essential starting point but less complex than subsequent analytical tasks.
   - Assessment: Relevance, originality, and feasibility of the topic.
2. **CO2: Conduct literature review and develop a methodology (25 marks)**
   - A thorough literature review needs significant effort to survey existing work, analyze gaps, and establish context.
   - Assessment: Depth, breadth, and critical evaluation of sources.
3. **CO3: Implement the proposed methodology and analyze results (25 marks)**
   - Involves defining a clear and specific problem, along with formulating objectives and methodology, requiring planning and technical understanding.
   - Assessment: Clarity, specificity, and significance of the problem statement.
4. **CO4: Communicate the project outcomes effectively (25 marks)**
   - The proposal synthesizes all prior work into a structured document. While important for communication, it's less intensive than analysis or planning, hence a slightly lower weight.
   - Assessment: Structure, clarity, and completeness of the proposal

Evaluation Committee - Programme Coordinator, One Senior faculty and Guide.

Sl. No	Type of evaluations	Marks	Evaluation criteria
1	Interim evaluation I	30	Problem identification, literature base, clarity of objectives
2	Interim evaluation II	30	Methodology, progress achieved, depth of knowledge
3	Final evaluation by a Committee	25	Completion level and demonstration of functionality/ specifications, clarity of presentation, oral examination, work knowledge and involvement
4	Report	10	The committee will be evaluating for the technical content, adequacy of references, templates followed and permitted plagiarism level (not more than 25%)
5	Supervisor/Guide	5	Initiative, regularity, involvement
Total Marks		**100**	

Rubrics for Interim Evaluation I (30 Marks)

Parameter	Excellent	Good	Average	Poor
Problem Identification (CO1) (10 marks)	Clearly defined, relevant, innovative, aligned with real-world issues	Relevant but limited innovation	Basic problem, limited relevance	Problem unclear or irrelevant
Range of marks	(9-10 marks)	(7-8 marks)	(5-6 marks)	(0-4 marks)
Literature Review (CO2) (10 marks)	Comprehensive, recent sources, critical analysis, gap identified	Adequate review with some analysis	Limited sources, mostly descriptive	Very poor or no literature review
Range of marks	(9-10 marks)	(7-8 marks)	(5-6 marks)	(0-4 marks)
Clarity of Objectives (CO3) (10 marks)	Well-defined, measurable and achievable	Clear but partially measurable	Vague or broad objectives	Objectives not defined
Range of marks	(9-10 marks)	(7-8 marks)	(5-6 marks)	(0-4 marks)

Rubrics for Interim Evaluation II (30 Marks)

Parameter	Excellent	Good	Average	Poor
Problem statement (CO1) (5 marks)	Clearly defined, relevant, innovative, aligned with real-world issues	Relevant but limited innovation	Basic problem, limited relevance	Problem unclear or irrelevant
Range of marks	(5 marks)	(4 marks)	(3 marks)	(0-2 marks)
Literature Review (CO2) (5 marks)	Comprehensive, recent sources, critical analysis, gap identified	Adequate review with some analysis	Limited sources, mostly descriptive	Very poor or no literature review
Range of marks	(5 marks)	(4 marks)	(3 marks)	(0-2 marks)
Methodology (CO3) (5 marks)	Well-structured, appropriate tools/techniques, justified	Suitable methodology with minor gaps	Basic methodology, limited justification	Inappropriate or unclear methodology
Range of marks	(5 marks)	(4 marks)	(3 marks)	(0-2 marks)
Depth of Knowledge (CO2) (10 marks)	Strong conceptual and technical understanding	Good understanding with minor gaps	Basic understanding	Poor understanding
Range of marks	(9-10 marks)	(7-8 marks)	(5-6 marks)	(0-4 marks)
Progress Achieved (CO3) (5 marks)	Significant progress with validated results	Moderate progress with partial results	Limited progress	Minimal or no progress
Range of marks	(5 marks)	(4 marks)	(3 marks)	(0-2 marks)

Rubrics for Final Evaluation (25 Marks)

Parameter	Excellent	Good	Average	Poor
Relevance of problem statement (CO1) (5 marks)	Clearly defined, relevant, innovative, aligned with real-world issues	Relevant but limited innovation	Basic problem, limited relevance	Problem unclear or irrelevant
Range of marks	(5 marks)	(4 marks)	(3 marks)	(0-2 marks)

Implementation of methodology (CO3) (5 marks)	Well-structured, appropriate tools/techniques, justified	Methodology implemented with minor gaps	Basic methodology, limited justification	Inappropriate or unclear methodology
Range of marks	(5 marks)	(4 marks)	(3 marks)	(0-2 marks)
Knowledge & Involvement (CO4) (10 marks)	Demonstrates good understanding and active involvement throughout the project	Good understanding with consistent involvement	Basic understanding with moderate involvement	Poor understanding; minimal involvement
Range of marks	(9-10 marks)	(7-8 marks)	(5-6 marks)	(0-4 marks)
Presentation & Viva (CO4) (5 marks)	Clear, confident, logical, excellent responses	Good presentation, answers most questions	Less communication, limited clarity	Poor communication, unable to answer
Range of marks	(5 marks)	(4 marks)	(3 marks)	(0-2 marks)

Rubrics for Miniproject report (10 Marks)

Parameter	**Excellent**	**Good**	**Average**	**Poor**
Technical Depth (CO4) (5 marks)	Comprehensive, well-analyzed content	Good technical content	Basic description	Poor/incomplete
Range of marks	(5 marks)	(4 marks)	(3 marks)	(0-2 marks)
Organization & Format (CO4) (5 marks)	Well-structured, follows guidelines	Minor deviations	Inconsistent format	Poor structure
Range of marks	(5 marks)	(4 marks)	(3 marks)	(0-2 marks)

SEMESTER III

CODE	COURSE NAME	CATEGORY	L	T	P	S	CREDIT
M26CE1M301	MOOC	MOOC	To be completed successfully				2

A MOOC course of a minimum 8-week duration must be successfully completed before the end of the fourth semester (starting from Semester 1). The MOOC course shall be considered valid only if it is conducted by AICTE, NPTEL, SWAYAM, or NITTTR. The course must have a minimum duration of 8 weeks and should include syllabus content equivalent to at least 40 hours of teaching. Additionally, it must have a proctored/offline end-semester examination. Students may complete the MOOC course at their convenience but must do so before the end of the fourth semester. The Board of Studies (BoS) will provide a list of approved MOOC courses, ensuring that at least 70% of the course content aligns with the student's area or stream of study. However, a MOOC course will not be considered if more than 50% of its content overlaps with a core/elective course in the respective discipline or with an open elective. A credit of 2 will be awarded to students who successfully complete the MOOC course as per the evaluation criteria of the respective agency conducting the course.

LIST OF APPROVED MOOC COURSE

1. Maintenance and Repair of Concrete Structures

Duration: 12 weeks

Provider: NPTEL

Course Content: This course focuses on identifying damage mechanisms in concrete structures, such as reinforcement and cement matrix deterioration, and explores the use of non-destructive testing methods along with techniques for structural strengthening and stabilization.

Relevance: The students will be able to suggest evaluation and repair/retrofitting methods for extending the service life of concrete structures.

2. Retrofitting and Rehabilitation of Civil Infrastructure

Duration: 12 weeks

Provider: NPTEL

Course Content: This course explores repair, retrofitting, and rehabilitation techniques for

masonry and concrete structures, covering deterioration causes, evaluation, and strengthening methods.

Relevance: It provides students with essential knowledge in challenging issues for efficient retrofitting and rehabilitation to extend the durability of existing structure in a sustainable manner.

3. Development and Applications of Special Concretes

Duration: 8 weeks

Provider: NPTEL

Mar Athanasius College of Engineering (Govt. Aided & Autonomous), Kothamangalam

M Tech in Structural Engineering and Construction Management

Course Content: This course explores the development of special concretes and construction methods and the use of concrete in diverse environments.

Relevance: It equips the students with better knowledge on concrete materials and construction methods and construction environment

4. Energy Efficiency Acoustics and Daylighting in Building

Duration: 12 weeks

Provider: NPTEL

Course Content: This course exposes the students to the concepts of functional design of building for thermal aspects and energy efficiency; especially in tropical climates i.e. in Indian context.

Relevance: The student will be capable of performing fenestration design for natural ventilation and daylighting & design of space for external and internal noise control.

5. Vibration of Continuous Systems

Duration: 12 weeks

Provider: NPTEL Swayam

Course Content: This course emphasizes continuous modeling of structures to accurately capture their dynamic behavior of the structures or machine components. Relevance: It will equip the students to formulate and solve vibration problems of the continuous systems by exact method as well as by numerical techniques.

6. Earthquake Geology: A tool for Seismic Hazard Assessment

Duration: 12 weeks

Provider: NPTEL Swayam

Course Content: This course focuses on seismically active faults to assess past earthquakes and understand fault behavior, especially in regions lacking historic records.

Relevance: It aims to equip the students with knowledge essential for seismic hazard assessment and future earthquake prediction.

7. Rock Mechanics and Tunneling

Duration: 12 weeks

Provider: NPTEL Swayam

Course Content: This course provides a foundational understanding of load transfer and stability in geotechnical structures built on or in rock, essential for civil and mining engineers.

Relevance: It equips the students with knowledge of applications of tunnelling in underground transport systems.

8. Elastic Stability of Structures Duration: 12 weeks

Provider: NPTEL

Course Content: This course covers the principles of structural stability, focusing on how small changes in load can lead to catastrophic instability and collapse.

Relevance: It is highly relevant for students, providing skills to analyze various structural members and systems with the application of stability theory in design guidelines and international standards.

9. Natural Hazards Duration: 8 weeks

Provider: NPTEL Swayam

Course Content: This course explores the mechanisms, origins, and impacts of natural disasters like earthquakes, floods, and tsunamis, focusing on different environments such as coastal and hilly terrains.

Relevance: It equips students with hazard mitigation approaches and assessment techniques to minimize disaster impacts.

10. Characterization of Construction Materials

Duration: 12 weeks

Provider: NPTEL

Course Content: The objective of the course is to introduce the characterization of construction materials and their behaviour, with a view of developing their understanding of the mechanisms

that govern the performance of these materials.

Relevance: The students will get better understanding on physics of the characterization techniques and their application to cement science.

11. Earthquake Resistant Design of Foundations

Duration: 8 weeks

Provider: NPTEL

Course Content: This course covers various types of foundations, soil investigations, and seismic design considerations for both shallow and deep foundations.

Relevance: It equips students with the skills to design foundations that can withstand lateral loads and prevent failure during earthquakes.

12. Strategies For Sustainable Design

Duration: 12 weeks

Provider: NPTEL Swayam

Course Content: This course covers sustainability principles, climate change mitigation, and real-world applications through case studies, field visits, and assignments.

Relevance: The students can explore environmental performance, building technologies, and key standards like NBC India and GRIHA, with a focus on UN SDGs and assessment methods.

13. Introduction to Accounting and Finance for Civil Engineers

Duration: 8 weeks

Provider: NPTEL

Course Content: This course addresses the growing need for civil engineers to understand basic accounting and finance amidst evolving contracting models and reduced government financial involvement.

Relevance: It offers a foundational understanding of accounting and finance.

14. Advanced Foundation Engineering

Duration: 12 weeks

Provider: NPTEL

Course Content: This course covers advanced foundation design topics such as shallow foundations on slopes, layered soils, and eccentric/inclined loading, as well as pile behavior under uplift and lateral loads.

Relevance: It enables students to design foundation for complex conditions.

15. Soil Structure Interaction

Duration: 12 weeks

Provider: NPTEL

Course Content: This course explores soil-structure interaction models for shallow foundations and piles under various loading conditions, including beams and plates on elastic foundations solved using Finite Difference Method.

Relevance: It equips students with essential knowledge of soil-structure interaction models for various loading and subgrade conditions.

16. Predictive Analytics - Regression and Classification

Duration: 12 weeks

Provider: NPTEL Swayam

Course Content: This course offers a foundational understanding of statistical predictive models, focusing on their construction and implementation for solving prediction problems.

Relevance: It provides students with a comprehensive understanding of statistical predictive models, emphasizing their development and practical application.

17. Measure Theoretic Probability 1

Duration: 8 weeks

Provider: NPTEL Swayam

Course outline: This course builds on basic probability distributions and random variables, focusing on the mathematical formulation of probability using measure theory.

Relevance: It provides students with essential knowledge of probability spaces, integration theory, convergence theorems which are relevant for advanced studies in the field.

18. Theory and Practice of Non Destructive Testing

Duration: 8 weeks

Provider: NPTEL

Course outline: This course covers the fundamental science and principles behind non destructive testing methods, focusing on their role in quality control, flaw detection, and structural health monitoring.

Relevance: It is highly relevant for students, fostering applications in overall quality control and structural health monitoring

19. Bridge Engineering

Duration: 12 weeks

Provider: NPTEL

Course Content: This course provides knowledge of principles of engineering mechanics, load transfer mechanisms, analysis methodologies, design principles, damage mechanics, failure mechanisms, construction, inspection, maintenance, repair and retrofit strategies in the realm of bridge engineering.

Relevance: The students will be able to equip themselves with fundamental concepts of analysis and design of bridges, understand field based construction, inspection, maintenance, repair and rehabilitation techniques of bridges and comprehend the emerging global trends in the domain of bridge engineering.

20. Admixtures and Special Concretes

Duration: 12 weeks

Provider: NPTEL Swayam

Course Content: This course explores the mechanisms of chemical and mineral admixtures and their impact on concrete performance, covering the formulation and properties of special concretes used in modern construction.

Relevance: It is highly relevant for students, equipping them with the skills to apply their knowledge of the properties of special concretes increasingly used in modern construction.

21. Construction methods and equipment management

Duration: 8 weeks

Provider: NPTEL Swayam

Course Content: This course covers key guidelines for selecting the right equipment, estimating its cost and productivity and determining optimal replacement time in construction industry.

Relevance: The students will be able to equip themselves with understanding of equipment capabilities for successful project planning and cost estimation in construction.

INTERNSHIP

Slot	Course Code	Course	Marks		L-T-P-S	Hours	Credit
K	M26CE1I302	Internship	50	50	--	-	10

Internship - mandatory internship of minimum 16 weeks duration

Internships are educational and career development opportunities, providing practical experience in a field or discipline. They are structured, short-term, supervised placements often focused around particular tasks or projects with definedtimescales. An internship may be compensated or non-compensated by the organization providing the internship. The internship has to be meaningful and mutually beneficial to the intern and the organization. It is important that the objectives and the activities of the internship program are clearly defined and understood. The internship offers the students an opportunity to gain hands-on industrial or organizational exposure; to integrate the knowledge and skills acquired through the coursework; interact with professionals and other interns; and to improve their presentation, writing, and communication skills. Internship often acts as a gateway for final placement for many students.

A student shall opt for carrying out the Internship at an Industry/Research Organization or at another institute of higher learning and repute (Academia). The organization for Internship shall be selected/decided by the students on their own with prior approval from the faculty advisor/respective PG Programme Coordinator/Guide/Supervisor. Every student shall be assigned an internship Supervisor/Guide at the beginning of the Internship. The training shall be related to their specialization after the second semester for a minimum duration of 16 weeks. On completion of the course, the student is expected to be able to develop skills in facing and solving the problems experiencing in the related field.

Objectives

- Exposure to the industrial environment, which cannot be simulated in the classroom and hence creating competent professionals for the industry.
- Provide possible opportunities to learn understand and sharpen the real time technical / managerial skills required at the job.
- Exposure to the current technological developments relevant to the subjectarea of

training.

- Create conducive conditions with quest for knowledge and its applicabilityon the job.
- Understand the social, environmental, economic and administrative considerations that influence the working environment.
- Expose students to the engineer's responsibilities and ethics.

Benefits of Internship

Benefits to Students

- An opportunity to get hired by the Industry/ organization.
- Practical experience in an organizational setting & Industry environment.
- Excellent opportunity to see how the theoretical aspects learned in classes are integrated into the practical world. On-floor experience provides much more professional experience which is often worth more than classroom teaching.
- Helps them decide if the industry and the profession is the best career optionto pursue.
- Opportunity to learn new skills and supplement knowledge.
- Opportunity to practice communication and teamwork skills.
- Opportunity to learn strategies like time management, multi-tasking etc in an industrial setup.
- Makes a valuable addition to their resume.
- Enhances their candidacy for higher education/placement.
- Creating network and social circle and developing relationships with industry people.
- Provides opportunity to evaluate the organization before committing to afull time position.

Benefits to the Institute

- Build industry academia relations.
- Makes the placement process easier.
- Improve institutional credibility & branding.
- Helps in retention of the students.
- Curriculum revision can be made based on feedback from Industry/students.
- Improvement in teaching learning process.

Benefits to the Industry

- Availability of ready to contribute candidates for employment.
- Year round source of highly motivated pre-professionals.
- Students bring new perspectives to problem solving.
- Visibility of the organization is increased on campus.
- Quality candidate's availability for temporary or seasonal positions andprojects.
- Freedom for industrial staff to pursue more creative projects.
- Availability of flexible, cost-effective workforce not requiring a longterm employer commitment.
- Proven, cost-effective way to recruit and evaluate potential employees.
- Enhancement of employer's image in the community by contributing to the educational enterprise.

Types of Internships

- Industry Internship with/without Stipend
- Govt / PSU Internship (BARC/Railway/ISRO etc)
- Internship with prominent education/research Institutes
- Internship with Incubation centres /Start-ups

Guidelines

- All the students need to go for internship for minimum duration of 16 weeks.
- Students can take mini projects, assignments, case studies by discussing it with concerned authority from industry and can work on it during internship.
- All students should compulsorily follow the rules and regulations as laid by industry.
- Every student should take prior permissions from concerned industrial authority if they want to use any drawings, photographs or any other document from industry.
- Student should follow all ethical practices and SOP of industry.
- Students have to take necessary health and safety precautions as laid by the industry.
- Student should contact his /her Guide/Supervisor from college on weeklybasis to communicate the progress.
- Each student has to maintain a diary/log book
- After completion of internship, students are required to submit

- Report of work done
- Internship certificate copy
- Feedback from employer / internship mentor
- Stipend proof (in case of paid internship).

Total Marks 100: The marks awarded for the Internship will be on the basis of (i)Evaluation done by the Industry (ii)) Internal evaluation & Student's diary (iii) Internship Report and (iv) Comprehensive Viva Voce.

Continuous Internal Evaluation: 50 marks

Internal evaluation & Student's diary - 25 Marks

Evaluation done by the Industry - 25 Marks

Internal evaluation committee comprises of Programme coordinator, Project coordinator and a senior faculty.

Student's Diary/ Daily Log: The main purpose of writing daily diary is to cultivate the habit of documenting and to encourage the students to search for details. It develops the students' thought process and reasoning abilities. The students shouldrecord in the daily training diary the day to day account of the observations, impressions, information gathered and suggestions given, if any. It should contain the sketches & drawings related to the observations made by the students. The dailytraining diary should be signed after every day by the supervisor/ in charge of the section where the student has been working. The diary should also be shown to the Faculty Mentor visiting the industry from time to time and got ratified on the day ofhis visit. Student's diary will be evaluated on the basis of the following criteria:

- Regularity in maintenance of the diary
- Adequacy & quality of information recorded
- Drawings, design, sketches and data recorded
- Thought processand recording techniques used
- Organization of the information.

The format of student's diary

Name of the Organization/Section:

Name and Address of the Section Head:

Name and Address of the Supervisor:

Name and address of the student:

Internship Duration: From ..... To .....

Brief description about the nature of internship:

Day	Brief write up about the Activities carried out: Such as design,sketches, result observed, issues identified, data recorded, etc.
1	
2	
3	

Signature of Industry Supervisor *Signature of Section Head/HR Manager*

Attendance Sheet

Name of the Organization/Section:

Name and Address of the Section Head:

Name and Address of the Supervisor:

Name and address of the student:

Internship Duration: From .....To .....

Month & Year		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	...
Month & Year																						
Month & Year																						

Signature of Industry Supervisor *Signature of Section Head/HR Manager*

Note:

- Student's Diary shall be submitted by the students along with attendance record and an evaluation sheet duly signed and stamped by the industry to the Institute immediately after the completion of the training.
- Attendance Sheet should remain affixed in daily training diary. Do not remove or tear it off.
- Student shall sign in the attendance column. Do not mark 'P'.
- Holidays should be marked in red ink in the attendance column. Absent should be marked as 'A' in red ink.

Evaluation done by the Industry (Marks 25)

Format for Supervisor Evaluation of Intern

Student Name :_____Date:__ Supervisor Name :_____Designation:__

_____Company/Organization :_____

Internship Address: _____ Dates of Internship: From_____To_____

Please evaluate intern by indicating the frequency with which you observed following parameters:

Parameters	**Marks** Rating (0-10 mark)
Behavior	
Performs in a dependable Manner	
Cooperates with coworkers and supervisor	
Shows interest in work	
Learns quickly	
Shows initiative	
Produces high quality work	
Accepts responsibility	
Accepts criticism	
Demonstrates organizational skills	
Uses technical knowledge and expertise	
Shows good judgment	
Demonstrates creativity/originality	
Analyzes problems effectively	
Is self-reliant	
Communicates well	
Writes effectively	
Has a professional attitude	
Is punctual	
Uses time effectively	

Overall performance of student:

Intern (Tick one): Needs improvement (0 – 1 mark) / Satisfactory (2 mark) / Good (3 mark) / Very Good (4 mark) / Excellent (5 mark)

Additional comments, if any:

Signature of Industry Supervisor *Signature of Section Head/HRManager*

End Semester Evaluation (External Evaluation): 50 Marks

Internship Report	-	25 Marks
Viva Voce	-	25 Marks

Internship Report: After completion of the internship, the student should prepare a comprehensive report to indicate what he has observed and learnt in the training period and should be submitted to the faculty Supervisor. The student may contact Industrial Supervisor/ Faculty Mentor for assigning special topics andproblems and should prepare the final report on the assigned topics. Daily diary willalso help to a great extent in writing the industrial report since much of theinformation has already been incorporated by the student into the daily diary. The training report should be signed by the Internship Supervisor, Programme Coordinator and Faculty Mentor.

The Internship report (25 Marks) will be evaluated on the basis of following criteria:

- Originality
- Adequacy and purposeful write-up
- Organization, format, drawings, sketches, style, language etc.
- Variety and relevance of learning experience
- Practical applications, relationships with basic theory and concepts taught in the course

Viva Voce (25 Marks) will be done by a committee comprising Project coordinator, Programme Coordinator and an external expert (from Industry or research/academic Institute). This committee will be evaluating the internship report also.

Rubrics for Students diary and Internal Evaluation (25 Marks)

Parameter	Excellent	Good	Average	Poor
Regularity & Completeness (5 marks)	Diary maintained regularly with complete and consistent entries	Mostly regular with minor gaps	Irregular entries; some missing records	Rarely maintained; major gaps
Range of marks	(5 marks)	(4 marks)	(3 marks)	(0-2 marks)
Application of Concepts (5 marks)	Strong real-world application	Moderate application	Limited application	No application
Range of marks	(5 marks)	(4 marks)	(3 marks)	(0-2 marks)
Understanding of Work (5 marks)	Thorough understanding, confident	Good understanding	Basic knowledge	Poor understanding
Range of marks	(5 marks)	(4 marks)	(3 marks)	(0-2 marks)
Organization & Clarity (5 marks)	Well-structured, clear and logical	Minor issues in organization	Poor structure	Disorganized
Range of marks	(5 marks)	(4 marks)	(3 marks)	(0-2 marks)
Presentation skills (5 marks)	Clear and well structured	Good presentation	Average clarity	Poor communication
Range of marks	(5 marks)	(4 marks)	(3 marks)	(0-2 marks)

Rubrics for External Evaluation (Viva Voce) (25 Marks)

Parameter	Excellent	Good	Average	Poor
Understanding of Work (10 marks)	Thorough understanding, confident	Good understanding	Basic knowledge	Poor understanding
Range of marks	(9-10 marks)	(7-8 marks)	(5-6 marks)	(0-4 marks)
Integration with theory (5 marks)	Strong linkage with academic concepts	Moderate linkage	Weak linkage	No linkage
Range of marks	(5 marks)	(4 marks)	(3 marks)	(0-2 marks)
Application of Concepts (5 marks)	Strong real-world application	Moderate application	Limited application	No application
Range of marks	(5 marks)	(4 marks)	(3 marks)	(0-2 marks)

Presentation skills (5 marks)	Clear and well structured	Good presentation	Average clarity	Poor communicatio n
Range of marks	(5 marks)	(4 marks)	(3 marks)	(0-2 marks)

Rubrics for Internship report (25 Marks)

Parameter	**Excellent**	**Good**	**Average**	**Poor**
Technical Depth (10 marks)	Comprehensive, well-analyzed, industry relevance	Good technical content	Basic description	Poor/ incomplete
Range of marks	(9-10 marks)	(7-8 marks)	(5-6 marks)	(0-4 marks)
Organization & Format (10 marks)	Well-structured, follows guidelines	Minor deviations	Inconsistent format	Poor structure
Range of marks	(9-10 marks)	(7-8 marks)	(5-6 marks)	(0-4 marks)
Originality (5 marks)	Highly original work	Some originality	Limited originality	Copied/ plagiarized
Range of marks	(5 marks)	(4 marks)	(3 marks)	(0-2 marks)

DISSERTATION PHASE I

Slot	Course Code	Course	Marks		L-T-P-S	Hours	Credit
			CIE	ESE			
P	M26CE1P303	Dissertation Phase I	100	--	0-0-12-18	12	8

Dissertation Phase I may be undertaken either in the college or in industry. Dissertation Phase I can be linked with internship. Such students are expected to have the following skills: Technical Skills, Research Skills, Communication Skills, Critical Thinking Skills, and Problem-Solving Skills.

Objectives

The objectives of Phase I of an M.Tech dissertation typically focus on laying a strong foundation for the research work to be conducted in subsequent phases. While specific objectives can vary depending on the institution, discipline, and dissertation, the following are common goals for Phase 1:

1. **Topic Identification and Selection**: To identify a relevant, feasible, and innovative research topic aligned with the student's area of interest and the field's current trends or challenges.
2. **Literature Review**: To conduct a preliminary review of existing research and literature to understand the state of the art, identify gaps, and establish the context for the proposed work.
3. **Problem Definition**: To clearly define the research problem or question that the dissertation aims to address, ensuring it is specific, measurable, and researchable.
4. **Objective Formulation**: To establish clear and achievable objectives for the overall dissertation, outlining what the research intends to accomplish.
5. **Feasibility Assessment**: To evaluate the practicality of the proposed research in terms of available resources, time constraints, and technical requirements.
6. **Methodology Outline**: To develop a preliminary plan for the research methodology, including the tools, techniques, or approaches that will be used to investigate the problem.
7. **Synopsis Preparation**: To prepare and submit a concise synopsis or proposal summarizing the research topic, objectives, significance, and planned approach for approval by the academic supervisor or committee.

8. **Background Knowledge Building**: To deepen the student's understanding of the chosen domain and related concepts, ensuring a solid theoretical foundation for the research.

These objectives are designed to set the stage for Phase 2 and beyond, where the focus typically shifts to implementation, experimentation, and analysis. Phase 1 is critical for ensuring that the research is well-planned and directed toward a meaningful contribution to the field.

Course Outcome

After completing dissertation phase 1 students should be able to

CO1: Demonstrate **Research Topic Selection Skills**: Students will be able to identify and select a research topic that is innovative, relevant, and feasible within the scope of their M. Tech program.

CO2: Conduct **Effective Literature Analysis**: Students will develop the ability to critically review and synthesize existing literature to identify research gaps and establish the context for their study.

CO3: Define **a Clear Research Problem**, **formulate objectives and methodology**: Students will acquire the skill to articulate a well-defined research problem or question, ensuring it is specific, measurable, and aligned with their dissertation goals.

CO4: Prepare **a Comprehensive Research Proposal**: Students will gain the capability to create a structured synopsis or proposal, effectively communicating the significance, objectives, and planned approach of their research for evaluation.

Course Outcome (CO)	Mapped Program Outcome (PO)	Justification
CO1: Demonstrate Research Topic Selection Skills	PO1: Ability to independently carry out research/investigation and development work	Selecting a research topic requires independent exploration and judgment, aligning with research skills.
	PO3: Demonstrate mastery over the specialization area	Topic selection reflects an understanding of advanced concepts beyond undergraduate level.
CO2: Conduct Effective Literature Analysis	PO1: Ability to independently carry out research/investigation and development work	Literature analysis is a core research skill, requiring independent critical thinking.
	PO3: Demonstrate mastery over the specialization area	Analyzing literature demonstrates depth of knowledge in the chosen field.

Course Outcome (CO)	Mapped Program Outcome (PO)	Justification
CO3: Define a Research Problem, formulate objectives and methodology	PO1: Ability to independently carry out research/investigation and development work	Defining a research problem is a fundamental step in independent research.
	PO4: Apply stream knowledge to design or develop solutions for real-world problems	A well-defined problem often addresses real-world challenges using specialized knowledge.
	PO5: Identify, select, and apply appropriate techniques, resources, and tools	Outlining methodology involves selecting suitable techniques and tools for the research.
CO4: Prepare a Comprehensive Research Proposal	PO2: Ability to communicate effectively, write and present technical reports	Writing a proposal requires clear communication and presentation skills for technical audiences.
	PO6: Engage in life-long learning with consideration of sustainability, societal aspects	A proposal often reflects awareness of broader impacts, fostering

Continuous Internal Evaluation

Evaluation committee comprises of

1. Project coordinator
2. A senior faculty
3. Project supervisor / Industry mentor

Course Outcome (CO)	Marks Allocated	Justification
CO1: Demonstrate Research Topic Selection Skills	25	Topic selection is foundational but less intensive than later stages; it requires creativity and initial research.
CO2: Conduct Effective Literature Analysis	25	Literature review is critical, time-intensive, and requires critical thinking to identify gaps.
CO3: Define a Clear Research Problem; formulate objectives and Methodology	25	Defining the problem is a pivotal step, requiring clarity and alignment with research goals; formulating objectives and methodology demands detailed planning and technical understanding
CO4: Prepare a Comprehensive Research Proposal	25	Proposal preparation integrates all prior work into a concise document, focusing on communication

Course Outcome (CO)	Marks Allocated	Justification
Total	100	

Detailed Breakdown and Rationale:

1. **CO1: Demonstrate Research Topic Selection Skills (25 marks)**
    - This involves identifying a feasible and innovative topic. It's an essential starting point but less complex than subsequent analytical tasks.
    - Assessment: Relevance, originality, and feasibility of the topic.
2. **CO2: Conduct Effective Literature Analysis (25 marks)**
    - A thorough literature review is a cornerstone of Phase 1, requiring significant effort to survey existing work, analyze gaps, and establish context.
    - Assessment: Depth, breadth, and critical evaluation of sources.
3. **CO3: Define a Clear Research Problem, formulate objectives and methodology (25 marks)**
    - Involves defining a clear and specific research problem and formulating objectives and methodology, requiring critical thinking, planning, and technical understanding as it sets the direction for the dissertation.
    - Assessment: Clarity, specificity, and significance of the problem statement.
4. **CO4: Prepare a Comprehensive Research Proposal (25 marks)**
    - The proposal synthesizes all prior work into a structured document. While important for communication, it's less intensive than analysis or planning, hence a slightly lower weight.
    - Assessment: Structure, clarity, and completeness of the proposal.

M.Tech Dissertation Phase 1 (Industry-Based)

Overview

- **Target Students**: Those who have completed a long-term internship (≥16 weeks) and aim to conduct their dissertation in industry.
- **Focus**: In-depth research, industry-relevant problem-solving, and collaboration with industrial mentors.
- **Total Marks**: 100 (for Phase 1).

Evaluation Process

- **Industry Mentor Involvement**: The industry mentor (from the internship or project site) provides feedback and assesses feasibility.

- **Academic Supervisor**: Ensures academic rigor and alignment with M.Tech standards.
- **Expert Committee Review**: Evaluates the final proposal.
- **Deliverables**:
    - Interim report (literature review, problem statement) – Mid-Phase 1.
    - Final proposal (synopsis) – End of Phase 1.

Evaluation of Dissertation Phase I

Rubrics for Zeroth presentation (30 Marks)

Parameter	Excellent	Good	Average	Poor
Topic Selection (10 marks) (CO1)	Relevant to current research/industry, strong SDG alignment	Relevant with some novelty	Limited relevance	Irrelevant/unclear
Range of marks	(9-10 marks)	(7-8 marks)	(5-6 marks)	(0-4 marks)
Literature Review & Analysis (10 marks) (CO2)	Comprehensive, recent, critically analyzed; clear research gap	Adequate review with some analysis	Limited, descriptive	Poor/no review
Range of marks	(9-10 marks)	(7-8 marks)	(5-6 marks)	(0-4 marks)
Problem Definition (5 marks) (CO3)	Clearly defined, specific, research-worthy	Defined but lacks depth	Vague or broad	Not defined
Range of marks	(5 marks)	(4 marks)	(3 marks)	(0-2 marks)
Presentation & Communication (5 marks) (CO4)	Highly clear, logical, confident delivery	Good clarity	Basic clarity	Poor communication
Range of marks	(5 marks)	(4 marks)	(3 marks)	(0-2 marks)

Rubrics for Interim presentation (30 Marks)

Parameter	Excellent	Good	Average	Poor
Relevance of Topic (5 marks) (CO1)	Highly innovative, relevant to current research/industry	Relevant with some novelty	Limited relevance	Irrelevant/unclear

	, strong SDG alignment			
Range of marks	(5 marks)	(4 marks)	(3 marks)	(0-2 marks)
Literature Review & Analysis (10 marks) (CO2)	Comprehensive, recent, critically analyzed; clear research gap	Adequate review with some analysis	Limited, descriptive	Poor/no review
Range of marks	(9-10 marks)	(7-8 marks)	(5-6 marks)	(0-4 marks)
Objectives & Methodology (10 marks) (CO3)	Well-defined objectives; robust, feasible, justified methodology	Suitable with minor gaps	Basic methodology	Inappropriate/ missing
Range of marks	(9-10 marks)	(7-8 marks)	(5-6 marks)	(0-4 marks)
Progress Achieved (5 marks) (CO4)	Significant progress with validated results	Moderate progress with partial results	Limited progress	Minimal or no progress
Range of marks	(5 marks)	(4 marks)	(3 marks)	(0-2 marks)

Rubrics for Final presentation (College based) (40 Marks)

Parameter	Excellent	Good	Average	Poor
Topic Selection & Novelty (10 marks) (CO1)	Topic is highly relevant, innovative, and aligned with current research/ industry needs; clear demonstration of originality	Topic is relevant with some degree of novelty; partial alignment with current trends	Topic is basic with limited originality; minimal relevance to current trends	Topic is outdated, irrelevant, or lacks clarity; no evidence of novelty
Range of marks	(9-10 marks)	(7-8 marks)	(5-6 marks)	(0-4 marks)
Literature Review & Analysis (5 marks) (CO2)	Comprehensive, recent, critically analyzed; clear research gap	Adequate review with some analysis	Limited, descriptive	Poor/no review
Range of marks	(5 marks)	(4 marks)	(3 marks)	(0-2 marks)

Definition of Research Problem, Formulation of Research (10 marks) (CO3)	Problem is clearly defined, Objectives are clear, measurable, and research-worthy; well-justified with appropriate tools/techniques	Problem is defined and relevant, Objectives are clear; methodology is suitable with minor gaps in justification	Problem is vague, Objectives are basic or partially aligned; methodology is limited or lacks clarity	Problem and objectives are unclear, irrelevant, or not defined
Range of marks	(9-10 marks)	(7-8 marks)	(5-6 marks)	(0-4 marks)
Report (10 marks) (CO4)	Well-structured, technically sound, excellent clarity, proper references	Good documentation with minor issues	Average documentation	Poor/ incomplete
Range of marks	(9-10 marks)	(7-8 marks)	(5-6 marks)	(0-4 marks)
Presentation & Communication (5 marks) (CO4)	Highly clear, logical, confident delivery	Good clarity	Basic clarity	Poor communication
Range of marks	(5 marks)	(4 marks)	(3 marks)	(0-2 marks)

Rubrics for Final presentation (Industry based) (40 Marks)

Parameter	**Excellent**	**Good**	**Average**	**Poor**
Topic Selection & Novelty (10 marks) (CO1)	Topic is highly relevant, innovative, and aligned with current research/ industry needs; clear demonstration of originality	Topic is relevant with some degree of novelty; partial alignment with current trends	Topic is basic with limited originality; minimal relevance to current trends	Topic is outdated, irrelevant, or lacks clarity; no evidence of novelty
Range of marks	(9-10 marks)	(7-8 marks)	(5-6 marks)	(0-4 marks)
Literature Review & Analysis	Comprehensive, recent, critically analyzed; clear research gap	Adequate review with some analysis	Limited, descriptive	Poor/no review

(5 marks) (CO2)				
Range of marks	(5 marks)	(4 marks)	(3 marks)	(0-2 marks)
Definition of Research Problem, Formulation of Objectives (5 marks) (CO3)	Problem is clearly defined, Objectives are clear, measurable, and research-worthy; well-justified with appropriate tools/techniques	Problem is defined and relevant, Objectives are clear; methodology is suitable with minor gaps in justification	Problem is vague, Objectives are basic or partially aligned; methodology is limited or lacks clarity	Problem and objectives are unclear, irrelevant, or not defined
Range of marks	(5 marks)	(4 marks)	(3 marks)	(0-2 marks)
*Feedback from industry (5 marks) CO3)	Excellent	Good	Satisfactory	Needs improvement
Range of marks	(5 marks)	(4 marks)	(3 marks)	(0-2 marks)
Report (10 marks) (CO4)	Well-structured, technically sound, excellent clarity, proper references	Good documentation with minor issues	Average documentation	Poor/ incomplete
Range of marks	(9-10 marks)	(7-8 marks)	(5-6 marks)	(0-4 marks)
Presentation & Communication (5 marks) (CO4)	Highly clear, logical, confident delivery	Good clarity	Basic clarity	Poor communication
Range of marks	(5 marks)	(4 marks)	(3 marks)	(0-2 marks)

*Feedback from industry may be taken in 5-point scale

Feedback from Industry (Marks 25)

Format for Supervisor Evaluation of Intern

Student Name :_____Date:__ Supervisor Name :_____Designation:__

_____Company/Organization :_____

Internship Address: _____ Dates of Internship: From_____To_____

Please evaluate intern by indicating the frequency with which you observed following parameters:

Parameters	**Marks** Rating (0-10 mark)
Behavior	
Performs in a dependable Manner	
Cooperates with coworkers and supervisor	
Shows interest in work	
Learns quickly	
Shows initiative	
Produces high quality work	
Accepts responsibility	
Accepts criticism	
Demonstrates organizational skills	
Uses technical knowledge and expertise	
Shows good judgment	
Demonstrates creativity/originality	
Analyzes problems effectively	
Is self-reliant	
Communicates well	
Writes effectively	
Has a professional attitude	
Is punctual	
Uses time effectively	

Overall performance of student:

Intern (Tick one): Needs improvement (0 – 1 mark) / Satisfactory (2 mark) / Good (3 mark) / Very Good (4 mark) / Excellent (5 mark)

Additional comments, if any:

Signature of Industry Supervisor *Signature of Section Head/HRManager*

SEMESTER IV

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DISSERTATION PHASE II

Slot	Course Code	Course Name	Marks		L-T-P-S	Hours	Credit
			CIE	ESE			
P	M26CE2P401	Dissertation Phase II	100	100	0-0-24-26	24	20
	Total		100	100		24	20

- **Duration**: Typically the final semester (e.g., fourth semester of M.Tech).
- **Focus**: Implementation, experimentation, analysis, and conclusion of the research initiated in Phase 1.
- **Common Objectives**:
    1. Execute the proposed methodology.
    2. Analyze results and draw meaningful conclusions.
    3. Demonstrate technical proficiency and problem-solving.
    4. Document and present findings effectively.

Scheme for Dissertation Phase II (College-Based)

Course Outcomes (COs)

1. **CO1**: Implement the research methodology proposed in Phase 1 using appropriate tools and techniques (Technical Skills, Problem-Solving Skills).
2. **CO2**: Conduct experiments or simulations to generate data or validate the approach (Research Skills, Critical Thinking Skills).
3. **CO3**: Analyze results and interpret findings to address the research problem (Critical Thinking Skills, Research Skills).
4. **CO4**: Prepare a comprehensive dissertation report that systematically documents the research process, outcomes, and effectively present the work (Communication Skills, Technical Skills).

Evaluation Scheme

1. **Continuous Internal Evaluation (CIE) – 100 Marks**
    - Assessed by the project coordinator throughout the semester.
    - Focus: Progress, effort, and intermediate deliverables.

Paper publication/acceptance (10 marks): Awarded only if at least one paper (authored by the student) is published or accepted in:

- A recognized national/international conference or,

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- An indexed journal
- Proof required: Acceptance letter/publication link/DOI/conference proceedings page

Component	Marks	CO Assessed	Justification
Methodology Implementation Progress	25	CO1	Monitors execution of the proposed plan in a college lab or simulation setup.
Experimental/Simulation Work	25	CO2	Assesses data collection or validation efforts in a controlled academic setting.
Interim Result Analysis	25	CO3	Evaluates preliminary analysis and critical thinking during the semester.
Draft Report Submission, Presentation	25	CO4	Checks documentation quality and adherence to academic standards; assesses communication and ability to discuss progress with the supervisor.
Total	**100**		

Rubrics for Interim Presentation I (30 marks)

Parameter	Excellent	Good	Average	Poor
Implementation of Methodology (10 marks) (CO1)	Methodology implemented	Implementation initiated with good progress	Partial implementation with limited clarity	No meaningful progress
Range of marks	(9-10 marks)	(7-8 marks)	(5-6 marks)	(0-4 marks)
Experimental/ Analytical Work (10 marks) (CO2)	Results are well-validated and critically analyzed	Results interpreted with some validation	Basic interpretation	No meaningful interpretation
Range of marks	(9-10 marks)	(7-8 marks)	(5-6 marks)	(0-4 marks)
Validation & Interpretation of Results (5 marks) (CO3)	Strong validation with comparison and justification	Adequate validation	Limited validation	No validation
Range of marks	(5 marks)	(4 marks)	(3 marks)	(0-2 marks)
Presentation & Viva (5 marks) (CO4)	Excellent communication and defense	Good communication	Average	Poor
Range of marks	(5 marks)	(4 marks)	(3 marks)	(0-2 marks)

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Rubrics for Interim Presentation II (30 marks)

Parameter	Excellent	Good	Average	Poor
Execution of the Proposed Methodology (5 marks) (CO1)	Complete, accurate, well-executed	Minor gaps in execution/accuracy	Partially complete, limited accuracy	Incomplete, incorrect implementation
Range of marks	(5 marks)	(4 marks)	(3 marks)	(0-2 marks)
Progress Achieved (5 marks) (CO2)	Significant progress with validated results	Moderate progress with partial results	Limited progress	Minimal or no progress
Range of marks	(5 marks)	(4 marks)	(3 marks)	(0-2 marks)
Quality of Results/Data & Analysis (5 marks) (CO3)	Robust results, deep analysis, strong conclusions	Good results, adequate analysis	Basic results, limited analysis	Weak/invalid results, poor analysis
Range of marks	(5 marks)	(4 marks)	(3 marks)	(0-2 marks)
Depth of Knowledge (5 marks) (CO3)	Strong conceptual and technical understanding	Good understanding with minor gaps	Basic understanding	Poor understanding
Range of marks	(5 marks)	(4 marks)	(3 marks)	(0-2 marks)
Presentation Skills (5 marks) (CO4)	Highly professional and confident	Good	Average	Poor
Range of marks	(5 marks)	(4 marks)	(3 marks)	(0-2 marks)

Rubrics for Final Internal Presentation (40 marks)

Parameter	Excellent	Good	Average	Poor
Proposed Methodology (10 marks) (CO1)	Complete, accurate, well-executed	Minor gaps in execution/ accuracy	Partially complete, limited accuracy	Incomplete, incorrect implementation
Range of marks	(9-10 marks)	(7-8 marks)	(5-6 marks)	(0-4 marks)
Understanding of Work (10 marks) (CO2)	Thorough understanding, confident	Good understanding	Basic knowledge	Poor understanding
Range of marks	(9-10 marks)	(7-8 marks)	(5-6 marks)	(0-4 marks)

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Validation & Results (10 marks) (CO3)	Strong validation with comparison and justification	Adequate validation	Limited validation	No validation
Range of marks	(9-10 marks)	(7-8 marks)	(5-6 marks)	(0-4 marks)
Report (10 marks) (CO4)	Excellent technical report with proper structure and references	Good clarity	Basic clarity	Poor communication
Range of marks	(9-10 marks)	(7-8 marks)	(5-6 marks)	(0-4 marks)
Presentation skill (5 marks) (CO4)	Clear& confident presentation	Good communication	Average	Poor
Range of marks	(5 marks)	(4 marks)	(3 marks)	(0-2 marks)

2. **End Semester Evaluation (ESE) – 100 Marks**
   - Assessed by a panel (Project coordinator+ supervisor + external examiner) at the semester's end.
   - Focus: Final output, rigor, and presentation.

Component	Marks	CO Assessed	Justification
Final Methodology Implementation	25	CO1	Evaluates completeness and technical accuracy of the implemented solution.
Quality of Results/Data, Depth of Analysis and Conclusions	30	CO2	Assesses the robustness and validity of experimental or simulation outcomes, examines the interpretation and significance of findings.
Final Dissertation Report	20	CO3	Judges the quality, structure, and clarity of the written report.
Viva Voce/Presentation	25	CO4	Tests ability to defend work and communicate findings to an academic panel.
Total	**100**		

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Rubrics for End Semester Evaluation

Parameter	Excellent	Good	Average	Poor
Methodology Implementation (25 marks) (CO1)	Complete, accurate, well-executed	Minor gaps in execution/accuracy	Partially complete, limited accuracy	Incomplete, incorrect implementation
Range of marks	(20-25 marks)	(15-19 marks)	(10-14 marks)	(0-9 marks)
Quality of Results/Data & Analysis (30 marks) (CO2)	Robust results, deep analysis, strong conclusions	Good results, adequate analysis	Basic results, limited analysis	Weak/invalid results, poor analysis
Range of marks	(25-30 marks)	(20-24 marks)	(10-19 marks)	(0-9 marks)
Dissertation Report (20 marks) (CO3)	Clear, well-structured, high quality	Good structure with minor issues	Adequate but lacks clarity/flow	Poorly written, unstructured
Range of marks	(15-20 marks)	(10-14 marks)	(5-9 marks)	(0-4 marks)
Viva Voce / Presentation (25 marks) (CO4)	Confident, clear, presentation with in-depth knowledge	Clear with minor gaps	Basic explanation, weak defense	Unclear, unable to defend
Range of marks	(20-25 marks)	(15-19 marks)	(10-14 marks)	(0-9 marks)

Scheme for Dissertation Phase II (Industry-Based)

Course Outcomes (COs)

1. **CO1**: Implement the industry-oriented methodology proposed in Phase 1 using industry tools/resources (Technical Skills, Problem-Solving Skills).
2. **CO2**: Perform industry-relevant experiments, validations, or prototypes (Research Skills, Critical Thinking Skills).
3. **CO3**: Analyze results and draw conclusions applicable to the industry problem (Critical Thinking Skills, Research Skills).
4. **CO4:** Prepare a comprehensive dissertation report that systematically documents the research process and outcomes, and effectively present and defend the work before an academic audience (Communication Skills, Technical Skills).Evaluation Scheme

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1. **Continuous Internal Evaluation (CIE) – 100 Marks**
   - Assessed jointly by the Project coordinator, supervisor / industry mentor during the semester.
   - Focus: Industry collaboration, progress, and practical application.

Component	Marks	CO Assessed	Justification
Methodology Implementation Progress	25	CO1	Tracks execution of the plan in an industry environment using real-world tools.
Industry Validation/Prototype Work, result Analysis	30	CO2	Evaluates practical outputs (e.g., prototypes, tests) relevant to industry needs, assesses industry-applicable insights derived during the process.
Draft Report Submission	20	CO3	Ensures documentation meets both academic and industry standards.
Industry Feedback/Interaction	25	CO4	Gauges communication with industry mentor and progress updates.
Total	**100**		

Rubrics for Internal Evaluation (100 marks)

Parameter	Excellent	Good	Average	Poor
Methodology Implementation (25 marks) (CO1)	Systematic, on-time, effective use of tools	Good progress, minor gaps	Partial progress, some delays	Poor progress, inadequate execution
Range of marks	(20-25 marks)	(15-19 marks)	(10-14 marks)	(0-9 marks)
Industry Validation / Prototype & Analysis (30 marks) (CO2)	High-quality validation, deep analysis, strong relevance	Good validation and analysis	Basic validation, limited analysis	No meaningful validation or analysis
Range of marks	(25-30 marks)	(20-24 marks)	(10-19 marks)	(0-9 marks)
Draft Report (20 marks) (CO3)	Clear, structured, comprehensive	Good with minor issues	Adequate, lacks depth/clarity	Poor, incomplete, unstructured
Range of marks	(15-20 marks)	(10-14 marks)	(5-9 marks)	(0-4 marks)
Industry Feedback / Interaction (25 marks) (CO4)	Proactive, regular updates, effective feedback use	Good interaction, periodic updates	Limited interaction, partial feedback use	Poor communication, no feedback use
Range of marks	(20-25 marks)	(15-19 marks)	(10-14 marks)	(0-9 marks)

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Feedback from Industry (Marks 25)

Format for Supervisor Evaluation of Intern

Student Name :_____Date:__ Supervisor Name :_____Designation:__

_____Company/Organization :_____

Internship Address: _____ Dates of Internship: From_____To_____

Please evaluate intern by indicating the frequency with which you observed following parameters:

Parameters	**Marks** Rating (0-10 mark)
Behavior	
Performs in a dependable Manner	
Cooperates with coworkers and supervisor	
Shows interest in work	
Learns quickly	
Shows initiative	
Produces high quality work	
Accepts responsibility	
Accepts criticism	
Demonstrates organizational skills	
Uses technical knowledge and expertise	
Shows good judgment	
Demonstrates creativity/originality	
Analyzes problems effectively	
Is self-reliant	
Communicates well	
Writes effectively	
Has a professional attitude	
Is punctual	
Uses time effectively	

Overall performance of student:

Intern (Tick one): Needs improvement (0 – 1 mark) / Satisfactory (2 mark) / Good (3 mark) / Very Good (4 mark) / Excellent (5 mark)

Additional comments, if any:

Signature of Industry Supervisor *Signature of Section Head/HRManager*

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2. **End Semester Evaluation (ESE) – 100 Marks**
    - Assessed by a panel (Project coordinator, supervisor/industry mentor, external examiner).
    - Focus: Final deliverables, industry relevance, and dual-audience presentation.
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Component	Marks	CO Assessed	Justification
Final Methodology Implementation	25	CO1	Evaluates the technical success of the industry-implemented solution.
Quality of Industry Outputs/Results, depth of Analysis and Industry Impact	30	CO2	Assesses the practical utility and quality of industry-specific deliverables, examines conclusions and their relevance to industry challenges.
Final Dissertation Report	20	CO3	Judges the report's ability to address academic rigor and industry needs.
Viva Voce/Presentation (Dual Audience)	25	CO4	Tests communication to both academic and industry evaluators.
Total	**100**		

Rubrics for End Semester Evaluation (100 marks)

Parameter	Excellent	Good	Average	Poor
Methodology Implementation (25 marks) (CO1)	Innovative, well-executed, validated	Appropriate, minor gaps	Acceptable, limited depth/validation	Poor, unclear, or irrelevant
Range of marks	(20-25 marks)	(15-19 marks)	(10-14 marks)	(0-9 marks)
Results, Analysis & Industry Impact (30 marks) (CO2)	Highly relevant, deep analysis, strong impact	Relevant, good analysis	Limited relevance, basic analysis	Irrelevant, weak/no analysis
Range of marks	(25-30 marks)	(20-24 marks)	(10-19 marks)	(0-9 marks)
Final Dissertation Report (20 marks) (CO3)	Well-structured, clear, technically strong	Good structure, minor issues	Adequate, lacks clarity/depth	Poorly written, unstructured
Range of marks	(15-20 marks)	(10-14 marks)	(5-9 marks)	(0-4 marks)

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Viva Voce / Presentation (25 marks) (CO4)	Confident, clear, presentation with in-depth knowledge	Clear with minor gaps	Basic, limited clarity	Unclear, unable to defend
Range of marks	(20-25 marks)	(15-19 marks)	(10-14 marks)	(0-9 marks)

EVALUATION COMMITTEES AT A GLANCE

MINI PROJECT (100 Marks)

Continuous Internal Evaluation (CIE) – 100 Marks

Evaluation committee comprises Project coordinator, senior faculty and Project supervisor. Final evaluation by a Committee of Project coordinator, Project supervisor and a senior faculty.

INTERNSHIP (100 Marks)

Internal evaluation committee (25 Marks) comprises of Programme coordinator, Project coordinator and a senior faculty.

Viva Voce (25 Marks) will be done by a committee comprising Programme Coordinator, Project coordinator and an external expert (from Industry or research/academic Institute)

DISSERTATION PHASE I (100 Marks)

Continuous Internal Evaluation (CIE) – 100 Marks

Evaluation committee comprises of Project coordinator, senior faculty and project supervisor / Industry mentor

DISSERTATION PHASE II (200 Marks)

Continuous Internal Evaluation (CIE) – 100 Marks

Assessed jointly by the Project coordinator, supervisor / industry mentor and senior faculty during the semester.

End Semester Evaluation (ESE) – 100 Marks

Assessed by a panel of Project coordinator, supervisor and external examiner at the semester end.