DEGREE OF MASTER OF ENGINEERING
IN
STRUCTURAL ENGINEERING

DEPARTMENT OF CIVIL ENGINEERING
FACULTY OF ENGINEERING

(FULL TIME PROGRAMME)

REGULATIONS
CURRICULUM
(2024-2025)

KARPAGAM ACADEMY OF HIGHER EDUCATION

(Deemed to be University)

(Established Under Section 3 of UGC Act 1956)

(Accredited with A^{+} Grade by NAAC in the Second Cycle)

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Enable | Enlighten | Enrich
KARPAGAM
ACADEMY OF HIGHER EDUCATION
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FACULTY OF ENGINEERING

POST GRADUATE PROGRAMME
(M.E – STRUCTURAL ENGINEERING)

REGULAR PROGRAMME

REGULATION
(2024)

KARPAGAM ACADEMY OF HIGHER EDUCATION

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FACULTY OF ENGINEERING

POST–GRADUATE PROGRAMME
REGULAR PROGRAMME
REGULATIONS 2024
CHOICE BASED CREDIT SYSTEM

These Regulations are effective from the academic year 2024-25 and applicable to the students admitted to M. E. / M. Tech. Programmes during the academic year 2024-25 and onwards.

1. PROGRAMMES OFFERED, MODE OF STUDY AND ADMISSION REQUIREMENTS.

1.1 PROGRAMMES OFFERED:

M. E.

The various P.G. Programmes offered by the Karpagam academy of Higher Education are listed in Table 1.

1.2 MODE OF STUDY:

1.2.1 Full–Time:

Candidates admitted under 'Full–Time' should be available in the Karpagam academy of Higher Education during the complete working hours for curricular, co–curricular and extra– curricular activities assigned to them.

1.2.2 Change from full time mode of study to part time mode is not permitted**.**

1.2.3 Change from one programme to another programme is not permitted.

1.3 ADMISSION REQUIREMENTS:

Candidates for admission to the Master's Degree Programme shall be required to have passed an appropriate Degree Examination accepted by the Board of Management of Karpagam academy of Higher Education as equivalent thereto. Admission shall be offered only to the candidates who possess the qualification prescribed against each course, given in the Table–2.

2 DURATIONS OF THE PROGRAMMES:

2.1 The minimum and maximum period for completion of the P.G. Programme is given below:

Programme	Min. No. of Semesters	Max. No. of Semesters
M. E./M. Tech.	4	8

2.2 Each semester shall normally consist of 90 working days or 360 hours for full–time mode of study. The Dean and HOD shall ensure that every teacher imparts instruction as per the number of periods specified in the syllabus and that the teacher teaches the full content of the specified syllabus for the course being taught.

2.3 The prescribed credits required for the award of degree shall be within the limits specified below.

PROGRAMME	PRESCRIBED CREDIT RANGE
M. E./M. Tech.	**65 to 75**

2.4 Credits will be assigned to the courses for different modes of study as given below:

No. of credits per lecture period per week	1
No. of credits per tutorial period per week	1
No. of credits for 3 periods of Laboratory course per week	2
No. of credits for 3 periods of project work per week	2

3. STRUCTURE OF THE PROGRAMME

3.1 Every programme will have a curriculum and syllabi consisting of core theory courses, elective courses, seminars / practical courses and project work.

3.1.1 The elective courses from the curriculum are to be chosen with the approval of the Head of the Department.

3.1.2 The medium of instruction for all courses, examinations, seminar presentations and project thesis shall be English**.**

3.1.3 Choice Based Credit System is implemented offering Choice in professional core and professional Electives.

3.2 MAXIMUM MARKS

3.2.1 The maximum marks assigned to different courses shall be as given below:

Each of the theory and practical course (excluding project work) shall carry maximum of 100 marks of which 40 marks will be through Continuous Internal Assessment (CIA) and 60 marks through End Semester Examination (ESE).

3.3 PROJECT WORK

The project work for M. E./M. Tech. consists of two Phases, Phase– I and Phase – II. Phase – I is to be undertaken during III semester and Phase – II, is during IV semester.

All the students are advised to do their project work within the campus. However, as a special case, if a student is able to get a project from a government organization or private or public

sector company with a turn over about Rs.50 crores, he/she may be permitted to do his/her project work in that institution/research organization/industry.

4. EVALUATION OF PROJECT WORK

The evaluation of Project Work for Phase I & Phase II shall be done independently in the respective semesters. The total marks for project work including Phase I and II are 400. The project work pertained to Phase I is evaluated through Continuous Internal Assessment only. No End Semester Examination will be conducted for the Phase I. The maximum internal marks for Phase I are 100. For Phase – II, the maximum internal mark is 120 and the maximum End Semester Examination mark is 180. The total marks for Phase – II is 300. The overall passing minimum is 50 %.

4.1 The Project Report prepared according to approved guidelines and duly signed by the supervisor(s) and the Head of the Department shall be submitted to the COE through the HOD and the Dean.

4.2 The evaluation of the Project work Phase – I will be purely internal by forming a committee by HOD/ Dean. During CIA of Phase – I, there will be a Viva–Voce Examination by a team consisting of the Supervisor, and an Internal Examiner (other than the Supervisor). The evaluation of the Project work Phase – II will be based on the project report submitted in Phase – II and a Viva–Voce Examination by a team consisting of the Supervisor, an Internal Examiner and an External Examiner for each programme. The External Examiner shall be appointed by the Karpagam academy of Higher Education for Phase – II evaluation.

4.3 If a candidate fails to submit the project report on or before the specified deadline, he/she is deemed to have failed in the project work and shall re–enroll for the same in a subsequent semester.

4.4 If a candidate fails in the Viva–Voce examinations of Phase–I, he/she has to resubmit the project report within 30 days from the date of declaration of the results. If he/she fails in the Viva–Voce examination of Phase–II of project work, he/she shall resubmit the project report within 60 days from the date of declaration of the results. For this purpose, the same Internal and External Examiner shall evaluate the resubmitted report.

4.5 Every candidate shall publish a paper of his or her findings in a peer reviewed journal or present in an International Conference or apply for a patent out of his / her project work. Reprints of the journal publication/acceptance letter from the journal publisher or Proceedings of the International conference/ acceptance letter from the Conference Organizer or application of patent shall be attached to the report of the project work. Such

acknowledgements shall be sent to the Controller of Examinations along with the evaluation marks by the team of examiners without which the thesis shall not be accepted.

4.6 A copy of the approved project report after the successful completion of Viva–Voce Examination shall be kept in the respective department as well as in the Karpagam academy of Higher Education library.

5 REQUIREMENTS FOR COMPLETION OF THE SEMESTER

5.1 A candidate will be permitted to take the End Semester Examination of any semester, if

i) the candidate secures not less than 75% of attendance during the semester and

ii) the conduct of the candidate has been satisfactory

5.2 A candidate who has secured attendance between 65% and 74% (both included), due to medical reasons (Hospitalization/Accident/Specific Illness) or due to participation in Karpagam academy of Higher Education / District / State / National / International level sports or due to participation in Seminar / Conference / Workshop / Training Programme / Voluntary Service / Extension activities or similar programmes with prior permission from the Registrar shall be given exemption from prescribed attendance requirements and shall be permitted to take the examination on the recommendation of the concerned Head of the Department and Dean to condone the lack of attendance. The Head of the Department has to verify and certify the genuineness of the case before recommending to the Dean.

5.3 However, a candidate who has secured attendance less than 65 % in the current semester shall not be permitted to appear for the current ESE. But he/she will be permitted to appear for his/her arrear examination if any and he/she has to re do the course by rejoining the semester in which attendance is less than 65% with proper approval of the "Students' Affairs Committee" and Registrar.

6 CLASS ADVISORS

To help the students in planning their courses of study and for general advice on the academic programme, the Head of the Department will attach a certain number of students to a teacher of the Department who shall function as Class Advisor for those students throughout their period of study. Such Class Advisors shall advise the students and monitor the courses undergone by the students, check the attendance and progress of the students attached to him/her and counsel them periodically. If necessary, the Class Advisor may display the cumulative attendance particulars in the Department Notice Board.

7 CLASS COMMITTEE

7.1. Every class shall have a class committee consisting of teachers of the class concerned, student representatives [two boys and two girls] and the concerned Head of the Department. It is like

the ‘Quality Circle’ with the overall goal of improving the teaching–learning process. The functions of the class committee include

- Solving problems experienced by students in the class room and in the Laboratories.
- Clarifying the regulations of the degree programme and the details of rules therein particularly Clause 2 and 3 which should be displayed on department Notice–Board.
- Informing the student representatives, the details of Regulations regarding weightage used for each assessment.
- Informing the student representatives, the academic schedule including the dates of assessments and the syllabus coverage for each assessment.
- In the case of practical courses (Laboratory/project work, etc.) the breakup of marks for each experiment/exercise /module of work, should be clearly discussed in the class committee meeting and informed to the students.
- Analyzing the performance of the students of the class after each test and finding the ways and means of solving problems, if any.
- Identifying the weak students, if any, and requesting the teachers concerned to provide some additional academic support to them.

7.2 The class committee shall be constituted within the first week of each semester.

7.3 At least 4 student representatives (usually 2 boys and 2 girls) shall be included in the class committee.

7.4 The Chairperson of the Class Committee may convene the meeting of the class committee.

7.5 The Dean may participate in any Class Committee of the Faculty.

7.6 The Chairperson is required to prepare the minutes of every meeting, submit the same to Dean within two days of the meeting and arrange to circulate it among the students and teachers concerned. If there are some points in the minutes requiring action by the Management, the same shall be brought to the notice of the Registrar by the HOD through theDean.

7.7 The first meeting of the Class Committee shall be held within one week from the date of commencement of the semester, in order to inform the students about the nature and weightage of assessments within the framework of the regulations. Two or three subsequent meetings may be held in a semester at suitable intervals. During these meetings, the student members representing the entire class shall meaningfully interact and express their opinions and suggestions of the other students of the class to improve the effectiveness of the teaching-learning process.

8. COURSE COMMITTEE FOR COMMON COURSES

Each common theory course offered to more than one discipline or group, shall have a "Course Committee" comprising all the teachers handling the common course with one of them nominated as Course Coordinator. The nomination of the Course Coordinator shall be made by the Dean depending upon whether all the teachers teaching the common course belong to a single department or to several departments. The 'Course Committee' shall meet in order to arrive at a common schemeof evaluation for the test and shall ensure a uniform evaluation of the tests. Where ever feasible, the Course Committee may also prepare a common question paper for the Internal Assessment test(s).

9. PROCEDURE FOR AWARDING MARKS FOR INTERNAL ASSESSMENT

9.1 Every teacher is required to maintain an 'ATTENDANCE AND ASSESSMENT RECORD' which consists of attendance marked in each theory or practical or project work class, the test marks and the record of class work (topic covered), separately for each course.

9.2 CONTINUOUS INTERNAL ASSESSMENT (CIA):

The performance of students in each subject will be continuously assessed by the respective teachers as per the guidelines given below:

THEORY COURSES:

S. No.	CATEGORY	MAXIMUM MARKS
1.	Seminar*****	15
2.	Attendance	5
3.	Test I	10
4.	Test II	10
	TOTAL	40

***** One refereed journal paper related to the subject and approved by the teacher should be critically presented. A committee should evaluate the Paper Presentation and marks should be entered in Automation software on or before the 60th working day of the semester.

The test scripts should be evaluated and marks should be entered in Automation software on or before 4th working day after the last test.

PATTERN OF TEST QUESTION PAPER:

INSTRUCTION	REMARKS
Maximum Marks	60
Duration	2 Hours
Part- A	1 to 9 Two-mark questions, uniformly covering the two units of the syllabus. All the 9 Questions are to be answered. **(9 x 2 =18 Marks)**
Part- B	Questions 10 to 12 will be of either-or type, covering two syllabus units. Each Question may have a subdivision. **(3 x 14 =42 Marks)**

PRACTICAL COURSES:

S. No	CATEGORY	MAXIMUM MARKS
1.	Attendance	5
2.	Observation work	5
3.	Record work	5
4.	Model examination	15
5.	Viva – voce [Comprehensive]	10
	TOTAL	40

Every practical exercise/experiment shall be evaluated based on the conduct of exercise / experiment and records maintained.

9.3 ATTENDANCE

MARKS DISTRIBUTION FOR ATTENDANCE

S. No.	Attendance %	Marks
1	91 and above	5.0
2	86-90	4.0
3	81-85	3.0
4	75-80	2.0
5	Less than 75	0

10. REQUIREMENTS FOR APPEARING FOR END SEMESTER EXAMINATION (ESE)

A candidate shall normally be permitted to appear for the ESE of any semester commencing from I semester if he/she has satisfied the semester completion requirements (Subject to Clause 5) and has registered for the examination in all courses of the semester. Registration is mandatory for Semester

Examinations as well as supplementary examinations failing which the candidate will not be permitted to move to the higher semester.

A candidate already appeared for a subject in a semester and passed the examination is not entitled to reappear in the same subject for improvement of grade.

11. END SEMESTER EXAMINATION

ESE will be held at the end of each semester for each subject, for 100 marks, later scaled down to 60 marks.

PATTERN OF ESE QUESTION PAPER:

INSTRUCTION	REMARKS
Maximum Marks	100
Duration	3 Hours
Part - A	1 to 10 Two Mark Questions, uniformly covering the Five units of the syllabus. All the 5 Questions are to be answered. (**10 *2 = 20 Marks)**.
Part- B	11 to 15 Sixteen Mark Questions, uniformly covering the Five units of the syllabus. All the 5 Questions are to be answered. (**5 *16= 80 Marks)**.

12. PASSING REQUIREMENTS

12.1 Passing minimum: The passing minimum for CIA is 20 (i.e. out of 40 marks). The passing minimum for End Semester Examination is 30 (i.e. out of 60 marks).

The overall passing minimum for theory/Laboratory course is 50 (Sum of his/her score in internal and external examination) out of 100 marks.

12.2 If the candidate fails to secure a pass in a particular course ESE, it is mandatory that candidate shall register and reappear for the examination in that course during the subsequent semester when examination is conducted in that course. Further, the candidate should continue to register and reappear for the examination till a pass is secured in such supplementary exam within the stipulated maximum duration of the programme (Clause 2.1).

The CIA marks obtained by the candidate in his/her first or subsequent appearance where he/she secures a pass shall be retained by the office of the Controller of Examinations and considered valid for all remaining attempts till the candidate secures a pass in his/her ESE.

12.3 If a candidate fails to secure a pass in a particular course CIA, it is mandatory that candidate shall register and reappear for the CIA in that course during the subsequent semester when CIA is

conducted in that course by the faculty member assigned for that particular course during that semester by the concerned HOD. Further, the candidate should continue to register and reappear for the CIA till a pass is secured in such supplementary exam within the stipulated maximum duration of the programme (Clause 2.1).

13. AWARD OF LETTER GRADES

13.1 All assessments of a course will be done on absolute mark basis. However, for the purpose of reporting the performance of a candidate, letter grades, each carrying certain number of points, will be awarded as per the range of total marks (out of 100) obtained by the candidate in each subject as detailed below:

Letter grade	Marks Range	Grade Point	Description
O	91 - 100	10	OUTSTANDING
A+	81- 90	9	EXCELLENT
A	71-80	8	VERY GOOD
B+	66- 70	7	GOOD
B	61 – 65	6	ABOVE AVERAGE
C	55 - 60	5	AVERAGE
P	50 - 54	4	PASS
RA	<50	-	REAPPEARANCE
AB		0	ABSENT

13.2 GRADE SHEET

After results are declared, Grade sheets will be issued to each student which will contain the following details:

i The list of courses enrolled during the semester and the grade scored.

ii The Grade Point Average (**GPA**) for the semester and

iii The Cumulative Grade Point Average (**CGPA**) of all courses enrolled from first semester onwards.

GPA is the ratio of the sum of the products of the number of Credits (**C**) of courses enrolled and the Grade Points (**GP**) corresponding to the grades scored in those courses, taken for all the courses to the sum of the number of credits of all the courses in the semester.

CGPA will be calculated in a similar manner, considering all the courses enrolled from first semester.

RA grade will be excluded for calculating **GPA** and **CGPA**.

$$GPA = \frac{\text{Sum of } [C*GP]}{\text{Sum of } C}$$

13.3 REVALUATION

A candidate can apply for revaluation of his/her semester examination answer paper in a theory course, within 2 weeks from the declaration of results, on payment of a prescribed fee through proper application to the Controller of Examinations through the Head of the Department and Dean. A candidate can apply for revaluation of answer scripts for not exceeding 5 subjects at a time. The Controller of Examinations will arrange for the revaluation and the results will be intimated to the candidate through the Head of the Department and Dean. Revaluation is not permitted for Supplementary examination, Practical examination and Project Work.

14. ELIGIBILITY FOR AWARD OF DEGREE

A student shall be declared to be eligible for award of Degree if he/she has

Successfully gained required number of total credits as specified in the curriculum corresponding to his/her programme within the stipulated time.

No disciplinary action is pending against him/her.

The award of degree must be approved by the Board of Management of Karpagam academy of Higher Education.

15. CLASSIFICATION OF THE DEGREE AWARDED

15.1 A candidate who qualifies for the award of the Degree (vide Clause 14) having passed the examination in all the courses in his/her first appearance within the specified minimum number of semesters (vide Clause 2.1) securing a CGPA of not less than 8.0 shall be declaredto have passed the examination in First Class with Distinction.

15.2 A candidate who qualifies for the award of the Degree (vide Clause 14) having passed the examination in all the courses within the specified minimum number of semesters (vide Clause 2.1) plus one semester securing CGPA of not less than 6.5 shall be declared to have passed the examination in First Class. For this purpose, the withdrawal from examination (vide Clause 16) will not be construed as an appearance. Further, the authorized break ofstudy (vide Clause 18) will not be counted for the purpose of classification.

15.3 All other candidates (not covered in Clauses 15.1 and 15.2) who qualify for the award of the degree (vide Clause 14) shall be declared to have passed the examination in **Second Class**.

16. PROVISION FOR WITHDRAWAL FROM END–SEMESTER EXAMINATION

16.1 A candidate may for valid reasons and on prior application, be granted permission to withdraw from appearing for the examination of any one course or consecutive examinations of more than one course in a semester examination. Withdrawal application shall be valid only if the candidate is otherwise eligible to write the examination.

16.2 Such withdrawal shall be permitted only once during the entire period of study of the degree programme.

16.3 Withdrawal application is valid only if it is made within 10 days prior to the commencement of the examination in that course or courses and recommended by the Head of the Department and Dean and approved by the Registrar.

16.3.1 Not withstanding the requirement of mandatory TEN days' notice, applications for withdrawal for special cases under extraordinary conditions will be considered on the merit of the case.

16.4 Withdrawal shall not be construed as an appearance for the eligibility of a candidate for First Class with Distinction. This provision is not applicable to those who seek withdrawal during IV semester.

16.5 Withdrawal from the ESE is **NOT** applicable to supplementary courses.

16.6 The candidate shall reappear for the withdrawn courses during the examination conducted in the subsequent semester.

17. PROVISION FOR AUTHORISED BREAK OF STUDY

17.1 Break of Study shall be granted only once for valid reasons for a maximum of one year during the entire period of study of the degree programme. However, in extraordinary situation the candidate may apply for additional break of study not exceeding another one year by paying prescribed fee for break of study. If a candidate intends to temporarily discontinue the programme in the middle of the semester for valid reasons and to rejoin the programme in a subsequent year, permission may be granted based on the merits of the case provided he/she applies to the Registrar, but not later than the last date for registering for the ESE of the semester in question, through the Head of the Department and Dean stating the reasons thereof and the probable date of rejoining the programme.

17.2 The candidate thus permitted to rejoin the programme after the break shall be governed by the curriculum and regulations in force at the time of rejoining. Such candidates may have to doadditional courses, if any as per the curriculum and regulations in force at that period of time.

17.3 The authorized break of study (for a maximum of one year) will not be counted for the duration specified for passing all the courses for the purpose of classification (vide Clause 15). However, additional break of study granted will be counted for the purpose of classification.

17.4 The total period for completion of the programme reckoned from, the commencement of the first semester to which the candidate was admitted shall not exceed the maximum period specified in

Clause 2.1 irrespective of the period of break of study (vide Clause 18.1) in order that he/she may be eligible for the award of the degree.

17.5 If any student is detained for want of requisite attendance, progress and good conduct, the period spent in that semester shall not be considered as permitted 'Withdrawal' or 'Break of Study' Clause 16 and 18 respectively is not applicable for this case.

18. SPECIAL SUPPLEMENTARY ESE*:*

After the publication of IV semester results, if a student has an arrear in any theory course of the entire programme, he/she will be permitted to apply within 15 days of the publication of results, and appear for a special supplementary examination.

19. DISCIPLINE

Every student is required to observe disciplined and decorous behavior both inside and outside the Karpagam academy of Higher Education and not to indulge in any activity which will tend to bring down the prestige of the Karpagam academy of Higher Education. The erring student will be referred to the Disciplinary Committee constituted by the Karpagam academy of Higher Education, to inquire into acts of indiscipline and recommend to the Karpagam academy of Higher Education about the disciplinary action to be taken.

If a student indulges in malpractice in any of the CIA/ESE he/she shall be liable for punitive action as prescribed by the Karpagam academy of Higher Education from time to time.

20. REVISION OF REGULATION AND CURRICULUM

The Karpagam academy of Higher Education may from time-to-time revise, amend or change the Regulations, Scheme of Examinations and syllabi if found necessary on the recommendations of Board of Studies, Academic Council and Board of Management of Karpagam academy of Higher Education.

TABLE – 1

M. E./M. TECH. DEGREE (REGULAR) PROGRAMMES

Sl. No.	Name of the Programme
DEPARTMENT OF CIVIL ENGINEERING	
1.	M.E. Structural Engineering

TABLE – 2

M. E. / M.TECH. PROGRAMMES

QUALIFICATIONS FOR ADMISSION

S. No.	Degree and branch of study	Qualification for Admission
1	M.E. Structural Engineering	B.E./B. Tech. – Civil Engineering B.E./ B. Tech. – Civil and Structural Engineering

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

PO-1 Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO-2 Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO-3 Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO-4 Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO-5 Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO-6 The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO-7 Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO-8 Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO-9 Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO-10 Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO-11 Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO-12 Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs):

The PG Degree Programme in Civil Engineering is offered in the department with the following programme specific outcomes:

PSO - 1 The graduates of this programme will be able to meet the needs of public in the design and execution of quality construction work considering principles of mechanics, mathematics and physics to construct sustainable buildings that will ensure safety and durability till the service period.

PSO – 2 The graduates will calculate the loads and the stresses acting on the building, analysis for the loads and design sections of structures to sustain the loads using building analysis software packages.

PSO - 3 The graduates will be able to work effectively as an individual or in a team having acquired leadership skills and manage projects in multidisciplinary environments.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs):

PEO – 1 To provide quality education in the field of structural engineering to empower the students to meet the technological needs and socio-economic challenges.

PEO – 2 To develop the design capability among students so that have the ability to innovate, develop and implement it for economic growth and enrichment of quality of life.

PEO – 3 To promote quality research and undertake research projects related to experimental investigation and use of software techniques, keeping in view the day to day needs of the society.

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(Deemed to be University Established Under Section 3 of UGC Act 1956)(Accredited with A+ Grade by NAAC in the Second Cycle)
Coimbatore – 641 021. INDIA

DEPARTMENT OF CIVIL ENGINEERING

M.E. STRUCTURAL ENGINEERING
COURSE OF STUDY AND SCHEME OF EXAMINATIONS
(2024 BATCH ONWARDS)

SUB CODE	TITLE OF THE COURSE	OBJECTIVES AND OUTCOMES		INSTRUCTIONS HOURS/WEEK			CREDITS	MAXIMUM MARKS			PAGE NO
		PEO's	PO's	L	T	P		CIA	ESE	TOTAL	
								40	60	100	
SEMESTER - I											
24MEST101	Advanced Structural Analysis	I	1,2,3,4	3	0	0	3	40	60	100	18
24MEST102	Advanced Solid Mechanics	I	1,2,3,4	3	0	0	3	40	60	100	19
24MEST103	Research Methodology and IPR	II	3,4,6,8	2	0	0	2	40	60	100	21
24MEST1E0-	1.Theory of Thin Plates and Shells 2.Theory and Applications of Concrete Composites 3.Theory of Structural Stability	II	1,2,3,4, 5,6,7	3	0	0	3	40	60	100	21-28
24MEST1E0-	4. Analytical and Numerical Methods for Structural Engineering 5. Structural Health Monitoring 6. Structural Optimization	I, II	1,2,3,4, 5,6,7,11	3	0	0	3	40	60	100	29-34
24MEST111	Structural Design Laboratory	I	1,2,3,4	0	0	2	2	40	60	100	35
24MEST112	Advanced Concrete Laboratory	I	1,2,3,6	0	0	2	2	40	60	100	36
Total				**14**	**0**	**4**	**18**	**280**	**420**	**700**	
SEMESTER - II											
24MEST201	Finite Element Method in Structural Engineering	I	1,2,3,5	3	0	0	3	40	60	100	37
24MEST202	Structural Dynamics	I	1,2,3,5	3	0	0	3	40	60	100	39
24MEST2E0	1.Advanced Steel Design 2.Design of Formwork 3.Design of High Rise Structures 4.Design of Masonry Structures	I	1,2,3,5	3	0	0	3	40	60	100	41-46

24MEST2E0	5.Design of Advanced Concrete Structures 6.Advanced Design of Foundation Engineering 7.Soil Structure Interaction 8.Design of Industrial Structures	I, II	1,2,3,4, 6,7,9, 11	3	0	0	3	40	60	100	47-54
24MEST211	Model Testing Laboratory	II	1,2,3,4	0	0	2	2	40	60	100	55
24MEST212	Numerical Analysis Laboratory	II	1,2,3,4	0	0	2	2	40	60	100	56
24MEST213	Design Project	II	1,5,6,9, 10	0	0	4	2	40	60	100	57
Total				**12**	**0**	**8**	**18**	**280**	**420**	**700**	
SEMESTER - III											
24MEST3E0	1.Design of Prestressed Concrete Structures 2.Analysis of Laminated Composite Plates 3.Fracture Mechanics of Concrete Structures 4.Design of Plates and Shells 5.Design of Earthquake Resistant Structures	I, II	1,2,3,4, 5,6,7	3	0	0	3	40	60	100	58-67
24MESTOE0	1.Business Analytics 2.Industrial Safety 3.Operations Research 4.CO Not Management of Engineering Projects 5.Composite Materials 6.Waste to Energy	I	1,2,3,4, 6,7,11	3	0	0	3	40	60	100	68-79
24MEST311	In plant Training	I	3,4,5,6, 7,8	0	0	0	2	100	-	100*	80
24MEST391	Project Work – Phase-I	II	1,5,6,9, 10,11	0	0	20	10	40	60	100	81
Total				**6**	**0**	**20**	**18**	**220**	**180**	**400**	
SEMESTER - IV											
24MEST491	Project Work – Phase-II	II	1,5,6,9, 10,11	0	0	32	16	120	180	300	83
Total				**0**	**0**	**32**	**16**	**120**	**180**	**300**	

L-Lecture T-Tutorial P-Practical C-Credit

CIA – Continuous Internal Assessment
ESE – End semester Examination

Total credits = 70
Total Marks = 2100

*** To be evaluated internally by a committee of members**

Review 1& 2 – 40 marks
Final presentation and viva voce – 60 marks

Semester I

24MEST101 ADVANCED STRUCTURAL ANALYSIS 3H:3C

Instruction Hours/ Week: L:3 T:0 P:0 Marks: Internal–40, External–60; Total-100

End Sem. Exam–3 Hrs.

COURSE OBJECTIVES:

The goal of this course is to;

1. Understand the concept of analyzing the structural members
2. To study the concept of stiffness method applied to large frames
3. To develop an understanding of applications analysis in a real-time approach.

COURSE OUTCOMES:

Upon completion of this course, students will be able to

1. Identify the impacts of settlement in structural components using structure-based approaches.
2. Classify the skeleton structures using stiffness analysis code.
3. Apply both structure-based and member-based approaches to design structural components ensuring optimal performance and stability.
4. Solve boundary value problems using Galerkin's method.
5. Analyze shape functions to solve Poisson's equation and evaluate general one-dimensional equilibrium problems.

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	1	2	1	-	1	-	1	2	2	-
CO2	3	3	2	1	-	1	2	1	-	1	-	1	2	2	-
CO3	3	2	1	-	-	1	2	1	-	1	-	1	2	2	-
CO4	3	2	1	-	-	1	2	1	-	1	-	1	2	2	-
CO5	3	3	2	1	-	1	2	1	-	1	-	1	2	2	-
CO	**3**	**2.4**	**1.4**	**1**	**-**	**1**	**2**	**1**	**-**	**1**	**-**	**1**	**2**	**2**	**-**

UNIT I INFLUENCE COEFFICIENTS 9

Physical Significance, Effects of Settlements, Temperature Change and Lack of Fit, Member Approach and Structure Approach.

UNIT II STIFFNESS METHOD APPLIED TO LARGE FRAMES 9

Local Coordinates and Global Coordinates. Stiffness Matrix in Global Coordinates, Boundary Conditions, Solution of Stiffness Matrix Equations, Calculation of Reactions and Member Forces- Flexibility method.

UNIT III APPLICATIONS TO SIMPLE PROBLEMS 9

Beams, Plane Trusses, Plane Rigid Jointed Frames, and Grids by Structure Approach and Member Approach.

UNIT IV BOUNDARY VALUE PROBLEMS (BVP) 9

Approximate Solution of Boundary Value Problems, Modified Galerkin Method for - Dimensional BVP, Matrix Formulation of the Modified Galerkin Method.

UNIT V LINEAR ELEMENT 9

Shape Functions, Solution for Poisson's Equation, General One-Dimensional Equilibrium Problem.

SUGGESTED READINGS:

1. The Finite Element Method, Lewis P. E. and Ward J. P., Addison-Wesley Publication Co, 2017
2. Computer Methods in Structural Analysis, Meek J. L., E and FN, Span Publication, 2010
3. The Finite Element Method, Desai and Able, CBS Publication, 2005

24MEST102 ADVANCED SOLID MECHANICS 3H:3C

Instruction Hours/ Week: L:3 T:0 P:0 Marks: Internal–40, External–60; Total-100

End Sem. Exam–3 Hrs.

COURSE OBJECTIVES:

The goal of this course is to;

1. To learn the principles and relations of stress and strain
2. To understand the concept of stress and strain analysis
3. To develop on equations of elasticity

COURSE OUTCOMES:

Upon completion of this course students will be able to

1. Apply the basic concepts of stress and strain in beam
2. Identify an elasticity, plasticity in stress and strain field
3. Analyze the concept of elastic analysis of plane stress and plane strain in two dimensions
4. Solve the problems on torsion of prismatic bars
5. Construct the theories of failure and plasticity

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	1	1	-	-	2	-	1	1	-	-
CO2	3	2	1	-	-	1	1	-	-	2	-	1	2	-	-
CO3	3	3	2	1	-	1	1	-	-	2	-	1	1	-	-
CO4	3	3	2	1	-	1	1	-	-	2	-	1	2	-	-
CO5	3	2	1	-	-	1	1	-	-	2	-	1	1	-	-
CO	**3**	**2.4**	**1.4**	**1**	**-**	**1**	**1**	**-**	**-**	**2**	**-**	**1**	**1.4**	**-**	**-**

UNIT I INTRODUCTION TO ELASTICITY 9

Analysis of stress and strain, Equilibrium Equations - Compatibility Equations - Stress Strain Relationship. Generalized Hooke's law -Constitutive Equations, Cartesian Tensors, and Equations of Elasticity.

UNIT II STRAIN AND STRESS FIELD 9

Elementary Concept of Strain, Stain at a Point, Principal Strains and Principal Axes, Compatibility Conditions, Stress at a Point, Stress Components on an Arbitrary Plane, Differential Equations of Equilibrium, Hydrostatic and Deviatoric Components.

UNIT III EQUATIONS OF ELASTICITY AND TWO-DIMENSIONAL PROBLEMS OF ELASTICITY 9

Equations of Equilibrium, Stress-Strain Relations, Strain Displacement and Compatibility Relations,Boundary Value Problems, and Co-axiality of the Principal Directions. Plane Stress and Plane Strain Problems, Airy's stress Function, Simple two-dimensional problems in Cartesian and Polar Coordinates.

UNIT IV TORSION OF NON-CIRCULAR SECTION 9

Saint Venant's Method, Prandtl's Membrane analogy - Torsion of Thin-Walled- Open and Closed Sections-Design approach to open web section subjected to torsion - Finite Difference Method

UNIT V PLASTIC DEFORMATION 9

Strain Hardening, Idealized Stress- Strain curve, Yield Criteria, Von Mises Yield Criterion, Tresca Yield Criterion, Plastic Stress-Strain Relations, Principle of Normality and Plastic Potential, IsotropicHardening

SUGGESTED READINGS:

1. Theory of Elasticity, Timoshenko S. and Goodier J. N., McGraw Hill, 2017.
2. Advanced Mechanics of Solids, Srinath L.S., Tata McGraw Hill, 2017.
3. Elasticity, Sadd M.H., Elsevier,2005.
4. Engineering Solid Mechanics, Ragab A.R., Bayoumi S.E., CRC Press,2019.
5. Computational Elasticity, Ameen M., Narosa,2008.

Semester I

24MEST103 RESEARCH METHODOLOGY AND IPR 2H:2C

Instruction Hours/ Week: L:2 T:0 P:0 Marks: Internal–40, External–60; Total-100

End Sem. Exam–3 Hrs.

COURSE OBJECTIVES:

The goal of this course is to;

1. To understand the fundamental concepts of research problems, ethical considerations, and the formulation of research proposals.
2. To identify various forms of intellectual property rights and the processes involved in securing and managing these rights.
3. To utilize statistical modeling techniques and hypothesis testing methods to interpret data, conduct analyses, and draw meaningful conclusions from research findings.

COURSE OUTCOMES:

Upon completion of this course, students will be able to

1. Identify the research problem and research process
2. Make use of research ethics in effective report writing.
3. Apply knowledge of intellectual property principles to effectively navigate the patenting process
4. Utilize knowledge of patent rights, licensing, and technology transfer to analyze and manage intellectual property in various contexts
5. Solve statistical problems by using various probability distributions and regression techniques.

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	2	-	1	-	1	-	2	-	-	1
CO2	3	2	1	-	-	2	-	1	-	1	-	2	-	-	1
CO3	3	2	1	-	-	2	-	1	-	1	-	2	-	-	1
CO4	3	2	1	-	-	2	-	1	-	1	-	2	-	-	1
CO5	3	2	1	-	-	2	-	1	-	1	-	2	-	-	1
CO	**3**	**2**	**1**	**-**	**-**	**2**	**-**	**1**	**-**	**1**	**-**	**2**	**-**	**-**	**1**

UNIT I INTRODUCTION 9

Meaning of research problem, Sources of research problem, Criteria Characteristics of a goodresearch problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

UNIT II RESEARCH ETHICS AND PROPOSAL 9

Effective literature studies approach, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper. Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

UNIT III NATURE OF INTELLECTUAL PROPERTY 9

Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT IV NEW DEVELOPMENTS IN IPR 9

Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. Administration of Patent System. New developments in IPR; IPR ofBiological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs

UNIT V STATISTICAL MODELING AND ANALYSIS

Probability Distributions, Normal, Binomial, Poisson, Fundamentals of Statistical Analysis and Inference, Hypothesis Testing, Confidence interval, Test of Significance, Comparison of Means (T test, Z test), Analysis of variance (ANOVA), Measures of association/Relationship, Simple Regression Analysis, Multiple Regression analysis, Correlation, Data visualization techniques

SUGGESTED READINGS:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step-by-Step Guide for Beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd,2007. Mayall, "IndustrialDesign", McGraw Hill.
5. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in NewTechnological Age", 2016.
6. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

Semester I

24MEST1E01 THEORY OF THIN PLATES AND SHELLS 3H:3C

Instruction Hours/ Week: L:3 T:0 P:0 Marks: Internal–40, External–60; Total-100

End Sem. Exam–3 Hrs.

COURSE OBJECTIVES:

The goal of this course is to;

1. To get introduced to various plate theories, governing equations for bending of plates, and various boundary conditions.
2. To conceptualize Navier's solution and Levy's solution to analyze rectangular plates.
3. To study the bending of circular plates.

COURSE OUTCOMES:

Upon completion of this course, students will be able to

1. Outline about various plate theories.
2. Analyze rectangular plates using Navier's solution, and Levy's solution.
3. Analyze circular plates for the given boundary conditions.
4. Examine the shells using membrane theory.
5. Summarize a different type of plates and shells under different boundary connections by various classical methods and approximate methods.

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	1	-	-	-	1	1	-	-	2	-	1	1	-	-
CO 2	3	3	2	1	-	1	1	-	-	2	-	1	2	-	-
CO 3	3	3	2	1	-	1	1	-	-	2	-	1	1	-	-
CO 4	3	3	2	1	-	1	1	-	-	2	-	1	2	-	-
CO 5	3	3	2	1	-	1	1	-	-	2	-	1	1	-	-
CO	**2.8**	**2.6**	**1.6**	**0.8**	**-**	**1**	**1**	**-**	**-**	**2**	**-**	**1**	**1.4**	**-**	**-**

UNIT I INTRODUCTION 9

Space Curves, Surfaces, Shell Co-ordinates, Strain Displacement Relations, Assumptions in Shell Theory, Displacement Field Approximations, Stress Resultants, Equation of Equilibrium using Principle of Virtual Work, Boundary Conditions.

UNIT II STATIC ANALYSIS OF PLATES: 9

Governing Equation for a Rectangular Plate, Navier Solution for Simply- Supported Rectangular Plate under Various Loadings, Levy solution for Rectangular Plate with other Boundary Conditions.

UNIT III CIRCULAR PLATES: 9

Analysis under Axis- Symmetric Loading, Governing Differential Equation in Polar Co-ordinates. Approximate Methods of Analysis- Rayleigh-Ritz approach for Simple Cases in Rectangular Plates.

UNIT IV STATIC ANALYSIS OF SHELLS: 9

Membrane Theory of Shells - Cylindrical, Conical and Spherical Shells

UNIT V SHELLS OF REVOLUTION WITH BENDING RESISTANCE 9

Cylindrical and Conical Shells, Application to Pipes and Pressure Vessels. Thermal Stresses in Plate Shell

SUGGESTED READINGS:

1. Theory of Plates and Shells, Timoshenko S. and Krieger W., McGraw Hill,2007
2. Stresses in Plates and Shells, Ugural Ansel C., McGraw Hill,2009
3. Theory of Plates, Chandrashekhara K., Universities Press,2001
4. Design and Construction of Concrete Shells, Ramaswamy G.S, 2005
5. Non-linear vibrations of shell-type structures: a review with bibliography, F Moussaoui,R Benamar - Journal of sound and vibration, 2002 – Elsevier

24MEST1E02 THEORY AND APPLICATIONS OF CONCRETE COMPOSITES 3H:3C

Instruction Hours/ Week: L:3 T:0 P:0 Marks: Internal–40, External–60; Total-100

End Sem. Exam–3 Hrs.

COURSE OBJECTIVES:

The goal of this course is to;

1. To understand the behaviour of materials subjected to loads
2. To classify various composite materials.
3. To measure mechanical behaviour under combined stresses

COURSE OUTCOMES:

Upon completion of this course, students will be able to

1. Apply the various constitute behaviour of composite materials
2. Compare the materials as per orthotropic and anisotropic behavior
3. Examine a strain constant using theories applicable to composite materials
4. Utilize a various failure criteria and fracture mechanics of composites
5. Select a various type of composites and its constituents

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	1	-	-	2	2	-	1	2	-	-
CO2	3	2	2	1	-	1	-	-	2	2	-	1	2	-	-
CO3	3	3	2	1	-	1	-	-	2	2	-	1	2	-	-
CO4	3	2	1	-	-	1	-	-	2	2	-	1	2	-	-
CO5	3	2	1	-	-	1	-	-	2	2	-	1	2	-	-
CO	**3**	**2.2**	**1.4**	**0.4**	**-**	**1**	**-**	**-**	**2**	**2**	**-**	**1**	**2**	**-**	**-**

UNIT I INTRODUCTION 9

Classification and Characteristics of Composite Materials- Basic Terminology, Advantages. Stress- Strain Relations- Orthotropic and Anisotropic Materials, Engineering Constants for OrthotropicMaterials, Restrictions on Elastic Constants, Plane Stress Problem, Biaxial Strength, Theories for an Orthotropic Lamina.

UNIT II STRESS STRAIN RELATIONS 9

Mechanics of Materials Approach to Stiffness- Determination of Relations between Elastic Constants, Elasticity Approach to Stiffness- Bounding Techniques of Elasticity, Exact Solutions - Elasticity Solutions with Continuity, Halpin, Tsai Equations, Comparison of approaches to Stiffness.

UNIT III CEMENT COMPOSITES 9

Types of Concrete Composites, Terminology, Constituent Materials and their Properties, Construction Techniques for Fibre Reinforced Concrete - Ferro cement, SIFCON, Polymer Concretes, Preparation of Reinforcement, Casting, and Curing.

UNIT IV MECHANICAL PROPERTIES AND APPLICATION OF CEMENT COMPOSITES 9

Behavior of Ferro cement, Fiber Reinforced Concrete in Tension, Compression, Flexure, Shear, Fatigue and Impact, Durability, and Corrosion. FRC and Ferro cement- Housing, Water Storage, Boats, and Miscellaneous Structures. Composite Materials- Orthotropic and Anisotropic behavior, Constitutive relationship, Elastic Constants.

UNIT V APPLICATIONS AND DESIGN 9

Meal and Ceramic Matrix Composites, Applications of Composites, Composite Joints, Design with Composites, Review, Environmental Issues**.** Design of composite beams, columns, beam – columns – Design of composite trusses.

SUGGESTED READINGS:

1. Mechanics of Composite Materials, Jones R. M, 2nd Ed., Taylor and Francis, BSP Books,1998. Ferrocement – Theory and Applications, Pama R. P., IFIC, 1980.
2. New Concrete Materials, Swamy R.N., 1stEd., Blackie, Academic and Professional, Chapman &Hall,1983
3. Continuum damage theory—application to concrete, J Mazars, G Pijaudier-Cabot - Journal of Engineering Mechanics, 1989
4. Concrete filled steel tubular structures from theory to practice [J], LH Han, Z Tao, W Liu -Journal of Fuzhou University
5. Micromechanics of crack bridging in fibre-reinforced concrete, VC Li, H Stang, H Krenchel - Materials and structures, 1999

Semester I

24MEST1E03 THEORY OF STRUCTURAL STABILITY 3H:3C

Instruction Hours/ Week: L:3 T:0 P:0 Marks: Internal–40, External–60; Total-100

End Sem. Exam–3 Hrs.

COURSE OBJECTIVES:

The goal of this course is to;

1. To study the stability of columns using theoretical and numerical methods.
2. To understand the approximate methods and numerical methods of inelastic buckling.
3. To get accustomed to beam column behavior and that of frames.

COURSE OUTCOMES:

Upon completion of this course, students will be able to

1. Analyze both static and dynamic instabilities, by both theoretical and numerical methods.
2. Analyze the inelastic buckling using various methodologies.
3. Examine the behavior of beam-columns and frames with and without side sway usingclassical and stiffness methods.
4. Summarize lateral buckling, torsional buckling, and flexural torsional buckling of various beams and non-circular sections.
5. Evaluate the buckling of thin plates using energy methods and various numerical techniques.

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	2	1	-	1	1	-	-	2	-	1	1	-	-
CO 2	3	3	2	1	-	1	1	-	-	2	-	1	2	-	-
CO 3	3	3	2	1	-	1	1	-	-	2	-	1	1	-	-
CO 4	3	3	2	1	-	1	1	-	-	2	-	1	2	-	-
CO 5	3	3	2	1	-	1	1	-	-	2	-	1	1	-	-
CO	**3**	**3**	**2**	**1**	**-**	**1**	**1**	**-**	**-**	**2**	**-**	**1**	**1.4**	**-**	**-**

UNIT I CRITERIA FOR DESIGN OF STRUCTURES 9

Stability, Strength, and Stiffness, Classical Concept of Stability of Discrete and Continuous Systems,Linear and nonlinear behavior.

UNIT II STABILITY OF COLUMNS: 9

States of equilibrium - the concept of equilibrium, energy, imperfection, and vibration approaches to stability analysis. Governing equation for column buckling - critical load using Equilibrium, Energy methods - Approximate methods - Rayleigh-Ritz, Galerkins approach - Numerical Techniques - Finite difference method.

UNIT III STABILITY OF BEAM-COLUMNS AND FRAMES 9

Theory of beam-column - Stability analysis of beam-column with single and several concentrated loads, distributed load, and end couples - Analysis of rigid jointed frames with and without sway – Use of stability function to determine the critical load.

UNIT IV STABILITY OF BEAM AND PLATES 9

Governing differential equation - Buckling of thin plates with various edge conditions - Analysis by equilibrium and energy approach – Finite difference method.

UNIT V INELASTIC BUCKLING 9

Double modulus theory - Tangent modulus theory - Shanley's model - Eccentrically loaded inelastic column. Inelastic buckling of plates - post-buckling behavior of plates.

SUGGESTED READINGS:

1. Theory of elastic stability, Timoshenko and Gere, Tata Mc Graw Hill,2010
2. Strength of Metal Structures, Bleich F. Bucking, Tata McGraw Hill, New York,2010
3. Structural stability: theory and implementation

Semester I

24MEST1E04 ANALYTICAL AND NUMERICAL METHODS FOR STRUCTURAL ENGINEERING **3H:3C**

Instruction Hours/ Week: L:3 T:0 P:0 Marks: Internal–40, External–60; Total-100

End Sem. Exam–3 Hrs.

COURSE OBJECTIVES:

The goal of this course is to;

1. To learn ordinary and partial differential equations in structural mechanics using numerical methods.
2. Equip the students with standard concepts at an intermediate to advanced level that will servethem well towards tackling various problems in the discipline.
3. Introduce numerical methods to solve engineering problems, using numerical methods and computer programming.

COURSE OUTCOMES:

Upon completion of this course, students will be able to

1. Apply an ordinary and partial differential equation in structural mechanics using numericalmethods.
2. Solve engineering problems involving Linear and non-linear equations.
3. Apply a computer program to solve problems indifferent areas of chemical engineering e.g., fluid flow, heat and mass transfer, etc.
4. Demonstrate on handling situations involving linear/ non-linear algebraic equations, ordinary /partial differential equations
5. Solving actual chemical engineering problems through computer programming and coding.

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	1	-	-	1	1	-	-	2	-	1	1	-	-
CO 2	3	3	2	1	-	1	1	-	-	2	-	1	2	-	-
CO 3	3	3	2	1	-	1	1	-	-	2	-	1	1	-	-
CO 4	3	3	2	1	-	1	1	-	-	2	-	1	2	-	-
CO 5	3	3	2	1	-	1	1	-	-	2	-	1	1	-	-
CO	**3**	**2.8**	**1.8**	**0.8**	**-**	**1**	**1**	**-**	**-**	**2**	**-**	**1**	**1.4**	**-**	**-**

UNIT I FUNDAMENTALS OF NUMERICAL METHODS **9**

Error Analysis, Polynomial Approximations and Interpolations, Curve Fitting; Interpolation andextrapolation.

UNIT II NUMERICAL METHODS **9**

Solution of Nonlinear Algebraic and Transcendental Equations

UNIT III ELEMENTS OF MATRIX ALGEBRA **9**

Solution of Systems of Linear Equations, Eigen Value Problems.

UNIT IV NUMERICAL DIFFERENTIATION & INTEGRATION **9**

Solution of Ordinary and Partial Differential Equations. Finite Difference scheme: Implicit &Explicit scheme.

UNIT V COMPUTER ALGORITHMS **9**

Numerical Solutions for Different Structural Problems, Fuzzy Logic and Neural Network.

SUGGESTED READINGS:

1. An Introduction to Numerical Analysis, Atkinson K.E, J. Wiley and Sons, 1989.
2. Theory and Problems of Numerical Analysis, Scheid F, McGraw Hill Book Company,(Shaum Series), 1988.
3. Introductory Methods of Numerical Analysis, Sastry S. S, Prentice Hall of India, 1998
4. Structural stability: theory and implementation, WF Chen, EM Lui
5. Reliability-based optimization in structural engineering, I Enevoldsen, JD Sørensen
6. Two-dimensional discontinuous deformation analysis, GH Shi, RE Goodman

Semester I

24MEST1E05 STRUCTURAL HEALTH MONITORING 3H:3C

Instruction Hours/ Week: L:3 T:0 P:0 Marks: Internal–40, External–60; Total-100

End Sem. Exam–3 Hrs.

COURSE OBJECTIVES:

The goal of this course is to;

1. To access the errors in measurement and learn the principles of measurement using various electronic and physical testing machines.
2. To measure the distress in concrete structures using various electrical and electronic machineries.
3. To test various civil engineering structures using Non-Destructive Testing methodologies

COURSE OUTCOMES:

Upon completion of this course, students will be able to

1. Utilize vibration measuring instruments for assuming the structural deteriorations
2. Analyze the distress in the structures using various electronic equipment
3. Examine the structural health by non-destructive testing methods
4. Assume the quality of structures by advanced NDT methods.
5. Apply model analysis techniques as an effective experimental technique in Structural Health Monitoring.

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	1	-	-	2	2	-	1	2	-	-
CO2	3	3	2	1	-	1	-	-	2	2	-	1	2	-	-
CO3	3	3	2	1	-	1	-	-	2	2	-	1	2	-	-
CO4	3	3	2	1	-	1	-	-	2	2	-	1	2	-	-
CO5	3	2	1	-	-	1	-	-	2	2	-	1	2	-	-
CO	**3**	**2.6**	**1.6**	**1**	**-**	**1**	**-**	**-**	**2**	**2**	**-**	**1**	**2**	**-**	**-**

UNIT I INTRODUCTION TO STRUCTURAL HEALTH MONITORING 9

Need for SHM, Structural Health Monitoring versus Non-Destructive Evaluation, Methods of SHM Local & Global Techniques for SHM, Short & Long-Term Monitoring, Active & Passive Monitoring, Remote Structural Health Monitoring- Advantages of SHM - Challenges in SHM

UNIT II SENSORS AND INSTRUMENTATION FOR SHM 9

Sensors for measurements: Electrical Resistance Strain Gages, Vibrating Wire Strain Gauges, Fiber Optic Sensors, Temperature Sensors, Accelerometers, Displacement Transducers, Load Cells, Humidity Sensors, Crack Propagation Measuring Sensors, Corrosion Monitoring Sensors, Pressure Sensors, Data Acquisition – Data Transmission - Data Processing – Storage of processed data - Knowledgeable information processing

UNIT III STRUCTURAL AUDIT 9

Damage Diagnostic methods based on vibrational response- Method based on modal frequency/shape/damping, Curvature and flexibility method, Modal strain energy method, Sensitivitymethod, Baseline-free method, Cross-correlation method, Damage Diagnostic methods based on wave propagation Methods-Bulk waves/Lamb waves, Reflection and transmission, Wave tuning/mode selectivity, Migration imaging, Phase array imaging, Focusing array/SAFT imaging

UNIT IV STATIC AND DYNAMIC FIELD TESTING 9

Static measurement - Load test, Concrete core trepanning, Flat jack techniques, Static response measurement, Dynamic measurement -Vibration based testing- Ambient Excitation methods,

Measured forced Vibration-Impact excitation, step relaxation test, shaker excitation method.

UNIT V DATA PROCESSING AND CASE STUDIES 9

Advanced signal processing methods -Wavelet, Hilbert-Huang transform, Neural networks, Support Vector Machine Principal component analysis, Outlier analysis. Applications of SHM on bridges andbuildings, case studies of SHM in Civil/ Structural engineering.

SUGGESTED READINGS:

1. Daniel Balageas, Peter Fritzen, Alfredo Guemes, Structural Health Monitoring, John Wiley& Sons,2006.
2. Douglas E Adams, Health Monitoring of Structural Materials and Components Methodswith Applications, Wiley Publishers, 2007
3. Hua-Peng Chen, Structural Health Monitoring of Large Civil Engineering Structures,Wiley Publishers, 2018
4. J. P. Ou, H. Li and Z. D, "Duan Structural Health Monitoring and IntelligentInfrastructure", Vol1, Taylor and Francis Group, London, UK, 2006.
5. Victor Giurglutiu, "Structural Health Monitoring with Wafer Active Sensors", AcademicPress Inc, 2007.

Semester I

24MEST1E06 STRUCTURAL OPTIMIZATION 3H:3C

Instruction Hours/ Week: L:3 T:0 P:0 Marks: Internal–40, External–60; Total-100

End Sem. Exam–3 Hrs.

COURSE OBJECTIVES:

The goal of this course is to;

1. To introduce the fundamentals of optimization concepts and their applications in thestructural engineering field.
2. To study the linear programming methods of the optimization.
3. To know the constrained and unconstrained variables of the various structural engineeringproblems.

COURSE OUTCOMES:

Upon completion of this course, students will be able to

1. Apply the basic ideas in optimization to make the structures as lightly as possible.
2. Outline a linear programming technique in engineering optimization.
3. Evaluate the unconstrained and constrained optimization problems in structural design.
4. Illustrate the methods adopted in solving the problems related to geometric and dynamic Programming.
5. Apply advanced techniques of optimization such as genetic algorithm and ArtificialNeural Networks in structures.

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	2	1	-	1	1	-	-	2	-	1	1	-	-
CO 2	3	3	2	1	-	1	1	-	-	2	-	1	2	-	-
CO 3	3	3	2	1	-	1	1	-	-	2	-	1	1	-	-
CO 4	3	3	2	1	-	1	1	-	-	2	-	1	2	-	-
CO 5	3	3	2	1	-	1	1	-	-	2	-	1	1	-	-
CO	**3**	**3**	**2**	**1**	**-**	**1**	**1**	**-**	**-**	**2**	**-**	**1**	**1.4**	**-**	**-**

UNIT I INTRODUCTION 9

Definition – Objective Function; Constraints – Equality and inequality – Linear and non-linear Side, Non-negativity, Behavior and other constraints – Design space – Feasible and infeasible- Convex and Concave – Active constraint – Local and global optima. Differential calculus – Optimality criteria – Single variable optimization – Multivariable optimization with no constraints- - (Lagrange Multiplier method) – with inequality constraints (Khun – Tucker Criteria).

UNIT II LINEAR AND NON-LINEAR PROGRAMMING 9

LINEAR PROGRAMMING: Formulation of problems -Graphical solution – Analytical methods- Standard form - Slack, surplus and artificial variables – Canonical form – Basic feasible solution - simplex method – Two phase method – Penalty method- Duality theory – Primal – Dual algorithm, Dual Simplex method.

Non-linear programming: One Dimensional minimization methods: Unidimensional - Unimodalfunction – Exhaustive and unrestricted search – Dichotomous search - Fibonacci Method – Golden section method - Interpolation methods. Unconstrained optimization Techniques.

UNIT III GEOMETRIC PROGRAMMING 9

Polynomial – degree of difficulty – reducing G.P.P to a set of simultaneous equations – Unconstrained and constrained problems with zero difficulty – Concept of solving problems with one degree of difficulty.

UNIT IV DYNAMIC PROGRAMMING 9

Bellman's principle of optimality – Representation of a multistage decision problem- concept of sub-optimization problems using classical and tabular methods.

UNIT V STRUCTURAL APPLICATIONS 9

Methods for optimal design of structural elements, continuous beams and single storied frames using plastic theory -Minimum weight design for truss members - Fully stressed design – Optimization principles to design of R.C. structures such as multistory buildings, water tanks and bridges.

SUGGESTED READINGS:

1. Elements of Structural Optimization, Haftka, Raphael T., Gürdal, Zafer, Springer, 2014
2. Variational methods for Structural optimization, Cherkaev Andrej, Springer, 2012
3. Structural optimization using sensitivity analysis and a level-set method, G Allaire, FJouve, AM Toader - Journal of computational physics
4. A new structural optimization method based on the harmony search algorithm, KS Lee, ZWGeem - Computers & structures,
5. Mixed variable structural optimization using firefly algorithm, AH Gandomi, XS Yang, AHAlavi - Computers & Structures
6. Reliability-based structural optimization using neural networks and Monte Carlo, simulation,M Papadrakakis, ND Lagaros

Semester I

24MEST111 STRUCTURAL DESIGN LABORATORY 2H:2C

Instruction Hours/ Week: L:0 T:0 P:2 Marks: Internal–40, External–60; Total-100

End Sem. Exam–3 Hrs.

COURSE OBJECTIVES:

The goal of this course is to;

1. To understand the concept of design and detailing
2. Students have to work individually with standard codes
3. Students have to use computational tools and software packages for analyzing, designing and detailing a structure.

COURSE OUTCOMES:

Upon completion of this course, students will be able to

1. Analyze a layout of a structure and Calculate loads using IS codes and various computational tools
2. Examinee the structure for various loads and load combination according to the relevant IScodes
3. Inspect a detail structure using computer software/tools and check the correctness usingmanual approximate methods
4. Categorize the complete structural drawings using computer software
5. Assume the various concept of design and detailing

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	2	1	-	1	1	-	-	2	-	1	1	-	-
CO 2	3	3	2	1	-	1	1	-	-	2	-	1	2	-	-
CO 3	3	3	2	1	-	1	1	-	-	2	-	1	1	-	-
CO 4	3	3	2	1	-	1	1	-	-	2	-	1	2	-	-
CO 5	3	3	2	1	-	1	1	-	-	2	-	1	1	-	-
CO	**3**	**3**	**2**	**1**	**-**	**1**	**1**	**-**	**-**	**2**	**-**	**1**	**1.4**	**-**	**-**

LIST OF EXPERIMENTS

1. Design of Square/ Rectangular Bunker.
2. Design of Circular Bunker.
3. Design of silos for storing of cement.
4. Design of Transmission tower.
5. Design of Intez Type overhead water tank.
6. Design of Conical Type overhead water tank.
7. Design of Box Culvert.
8. Design of sLaboratory Deck Bridge.

SUGGESTED READINGS:

Manual for Detailing of Steel Structures by S. Kanthimathinathan

24MEST112 ADVANCED CONCRETE LABORATORY 2H:2C

Instruction Hours/ Week: L:0 T:0 P:2 Marks: Internal–40, External–60; Total-100
End Sem. Exam–3 Hrs.

COURSE OBJECTIVES:

The goal of this course is to;

1. To perform advanced Laboratoryoratory experiments that emphasizes the structure-propertyrelationship, statistical analysis and technical manuscript preparation.
2. Apply engineering principles to understand behavior of structural/ elements.
3. To provides a thorough knowledge of material selection through the material testingbased on specification

COURSE OUTCOMES:

Upon completion of this course, students will be able to

1. Analyze the behavior of reinforced concrete and steel beam by carrying out experimental study.
2. Examine the concrete mix to archive desired strength and quality of concrete.
3. List a high-grade concrete and study the parameters affecting its performance.
4. Compare Non-Destructive Tests on existing concrete structures.
5. Categorize the effect of mineral and chemical admixture in concrete

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	2	1	-	1	1	-	-	2	-	1	1	-	-
CO 2	3	3	2	1	-	1	1	-	-	2	-	1	2	-	-
CO 3	3	3	2	1	-	1	1	-	-	2	-	1	1	-	-
CO 4	3	3	2	1	-	1	1	-	-	2	-	1	2	-	-
CO 5	3	3	2	1	-	1	1	-	-	2	-	1	1	-	-
CO	**3**	**3**	**2**	**1**	**-**	**1**	**1**	**-**	**-**	**2**	**-**	**1**	**1.4**	**-**	**-**

LIST OF EXPERIMENTS:

1. Mix design of concrete as per IS, ACI & BS methods for high performance concrete.
2. Flow Characteristics of Self-Compacting concrete.
3. Study of stress-strain curve of high strength concrete, Correlation between cube strength,cylinder strength, split tensile strength and modulus of rupture.
4. Effect of cyclic loading on steel.
5. Non-Destructive testing of existing concrete members.
6. Behavior of Beams under flexure, Shear and Torsion.
7. Effect of minerals and chemical admixtures in concrete at fresh and hardened state with relevance to workability, strength and durability.
8. Strain gauge meter – Determination of Young's modulus of a metallic wire

SUGGESTED READINGS:

1. Properties of Concrete, Neville A. M., 5th Edition, Prentice Hall, 2012.
2. Concrete Technology, Shetty M. S., S. Chand and Co., 2006.

24MEST201 FINITE ELEMENT METHOD IN STRUCTURAL ENGINEERING 3H:3C

Instruction Hours/ Week: L:3 T:0 P:0 Marks: Internal–40, External–60; Total-100

End Sem. Exam–3 Hrs.

COURSE OBJECTIVES:

The goal of this course is to;

1. To acquire knowledge on formulation of boundary value problems.
2. To be familiar with meshing using various mesh generation methods.
3. To understand the behaviour of plate and shell elements.

COURSE OUTCOMES:

Upon completion of this course, students will be able to

1. Apply the finite element approach to boundary value problems.
2. Analyze the structure and use elements to interpolate functions.
3. Apply direct stiffness method as Finite Element Analysis tool.
4. Analyze complex structural problems using iso parametric and axis symmetric formulations.
5. Apply a Finite Element method by standard software.

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	1	-	-	-	-	-	-	2	-	1	-	-	-
CO 2	3	3	2	1	-	1	-	-	-	2	-	1	-	-	-
CO 3	3	2	1	-	-	1	-	-	-	2	-	1	2	-	-
CO 4	3	3	2	1	-	1	-	-	-	2	-	1	2	-	-
CO 5	3	2	1	-	-	-	-	-	-	2	-	1	-	-	-
CO	**3**	**2.4**	**1.4**	**1**	**-**	**1**	**-**	**-**	**-**	**2**	**-**	**1**	**2**	**-**	**-**

UNIT I INTRODUCTION 9

Introduction - Basic Concepts of Finite Element Analysis - Introduction to Elasticity- Steps in FiniteElement Analysis - Finite Element Formulation Techniques - Virtual Work and Variational Principle -Galerkin Method - Finite Element Method: Displacement Approach - Stiffness Matrix andBoundary Conditions

UNIT II ELEMENT PROPERTIES 9

Natural Coordinates - Triangular Elements-Rectangular Elements - Lagrange and SerendipityElements - Solid Elements - Isoparametric Formulation - Stiffness Matrix of Isoparametric Elements Numerical Integration: One, Two and Three Dimensional - Problems

UNIT III ANALYSIS OF FRAME STRUCTURES 9

Stiffness of Truss Members-Analysis of Truss-Stiffness of Beam Members-Finite Element Analysisof Continuous Beam-Plane Frame Analysis-Analysis of Grid and Space Frame

UNIT IV TWO- AND THREE-DIMENSIONAL SOLIDS 9

Constant Strain Triangle - Linear Strain Triangle - Rectangular Elements- Numerical Evaluation of Element Stiffness - Computation of Stresses, Geometric Nonlinearity and Static Condensation Axisymmetric Element - Finite Element Formulation of Axisymmetric Element - Finite Element Formulation for 3 Dimensional Elements- Problems

UNIT V APPLICATIONS OF FEM 9

Introduction to Plate Bending Problems - Finite Element Analysis of Thin Plate - Finite Element Analysis of Thick Plate - Finite Element Analysis of Skew Plate -Introduction to Finite Strip Method - Finite Element Analysis of Shell -Finite Elements for Elastic Stability - Dynamic Analysis

SUGGESTED READINGS:

1. Finite Element Analysis, Seshu P., Prentice-Hall of India, 2005.
2. Fundamentals of Finite Element Analysis, Hutton David, Mc-Graw Hill, 2004.
3. Finite Element Analysis, Buchanan G.R., McGraw Hill Publications, New York, 1995.
4. Finite Element Method, Zienkiewicz O.C. & Taylor R.L. Vol. I, II & III, Elsevier, 2000.
5. Finite Element Analysis on The Structural Behavior of Square CFST Beams, M.F.Javed, N.H. Ramli, S. Kashif- Ur-Rehman and N.B. Khan
6. Finite Element for Calculation of Structures made of Thin-Walled Open Profile Rods,A.Tusnin

24MEST202 **STRUCTURAL DYNAMICS** **3H:3C**

Instruction Hours/ Week: L:3 T:0 P:0 Marks: Internal–40, External–60; Total-100
End Sem. Exam–3 Hrs.

COURSE OBJECTIVES:

The goal of this course is to;

1. To examine the displacement of structural elements by time-varying dynamic loads.
2. To analyze the behavior of MDOF structures with various static and dynamic loading.
3. To impart knowledge on dynamic analysis of continuous structural systems.

COURSE OUTCOMES:

Upon completion of this course, students will be able to

1. Identify the displacement of structural elements by dynamics loading
2. Analyze the distress in the structures using time-varying dynamic load
3. Examine the structure by destructive testing methods and develop models from the analysis.
4. Utilize load tests and advanced designs in accessing the quality of structures.
5. Apply model dynamic analysis for nodal points

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	1	-	-	1	-	-	-	2	-	1	2	-	-
CO 2	3	3	2	1	-	1	-	-	-	2	-	1	2	-	-
CO 3	3	3	2	1	-	1	-	-	-	2	-	1	2	-	-
CO 4	3	2	1	-	-	1	-	-	-	2	-	1	2	-	-
CO 5	3	2	1	-	-	1	-	-	-	2	-	1	2	-	-
CO	**3**	**2.4**	**1.4**	**1**	**-**	**1**	**-**	**-**	**-**	**2**	**-**	**1**	**2**	**-**	**-**

UNIT I INTRODUCTION **9**

Objectives, Importance of Vibration Analysis, Nature of Exciting Forces, Mathematical Modeling of Dynamic Systems.

UNIT II SINGLE DEGREE OF FREEDOM SYSTEM **9**

Free and Forced Vibration with and without Damping, Response to Harmonic Loading, Response to General Dynamic Loading using Duhamel's Integral, Fourier Analysis for Periodic Loading, State Space Solution for Response.

UNIT III NUMERICAL SOLUTION **9**

Numerical to Response using Newmark Method and Wilson Method, Numerical Solution for State Space Response using Direct Integration.

UNIT IV MDOF (LUMPED PARAMETER) **9**

Two Degree of Freedom System, Multiple Degree of Freedom System, Inverse Iteration Method for Determination of Natural Frequencies and Mode Shapes, Dynamic Response by Modal Superposition Method, Direct Integration of Equation of Motion.

Multiple Degree of Freedom System (Distributed Mass and Load): Single Span Beams, Free and Forced Vibration, Generalized Single Degree of Freedom System.

UNIT V ADVANCED STRUCTURAL DYNAMICS (CONCEPTS ONLY) **9**

Dynamic Effects of Wind Loading, Moving Loads, Vibrations caused by Traffic, Blasting and Pile Driving, Foundations for Industrial Machinery, Base Isolation.

SUGGESTED READINGS:

1. Dynamics of Structures, Clough R. W. and Penzien J., Mc Graw Hil, 2010
2. Structural Dynamics and Introduction to Earthquake Engineering, Chopra A. K,2016
3. Dynamics of Structures, Humar J. L., Prentice Hall, 2002
4. Structural Dynamics - Theory and Computation, Paz Mario, CBS Publication,2004
5. Dynamics of Structures, Hart and Wong, 2000

Semester II

24MEST2E01 ADVANCED STEEL DESIGN 3H:3C

Instruction Hours/ Week: L:3 T:0 P:0 Marks: Internal–40, External–60; Total-100

End Sem. Exam–3 Hrs.

COURSE OBJECTIVES:

The goal of this course is to;

1. To perform appropriate structural analyses based on the loads designed for the steel structure.
2. To categorize the mechanical properties of steel and their implications on design, including hysteresis, ductility, and residual stresses.
3. To explore different design philosophies and codes such as IS, EC, and AISC and apply stability criteria to beam columns and frames.
4. To impart the design concepts of light gauge steel structures.

COURSE OUTCOMES:

Upon completion of this course, students will be able to

1. Apply the mechanical properties and procedures and current code requirements for designing hot rolled steel section, purlins, girder.
2. Compute the stability and bracing of columns.
3. Examine the behavior of compression elements and webs of beam.
4. Design columns under axial loads using IS specifications.
5. Utilize different types of bolted and welded connections in steel structures.

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	1	-	-	2	-	2	2	1	-
CO2	3	3	2	1	-	-	1	-	-	2	-	2	2	1	-
CO3	3	3	2	1	-	-	1	-	-	2	-	2	2	1	-
CO4	3	2	1	-	-	-	1	-	-	2	-	2	2	1	-
CO5	3	2	1	-	-	-	1	-	-	2	-	2	2	1	-
CO	3	2	1	1	-	-	1	-	-	2	-	2	2	1	-

UIT I INTRODUCTION 9

Mechanical Properties, Hysteresis, Ductility. Hot Rolled Sections**:** compactness and non- compactness, slenderness, residual stresses. Design Philosophies and Design Codes (IS, EC, AISC) –Stability Criteria –Beam-Columns and Frames (Sway and Non-Sway) – Design of members subjected to combined forces – Design of Purlins, Louver rails, Gable column and Gable wind girder.

UNIT II DESIGN OF STEEL STRUCTURES 9

Inelastic Bending Curvature, Plastic Moments, Design Criteria Stability, Strength, Drift. Stability of Beams**:** Local Buckling of Compression Flange & Web, Lateral Torsional Buckling. Stability of Columns**:** Slenderness Ratio, Local Buckling of Flanges and Web, Bracing of Column about Weak Axis.

UNIT III DESIGN OF LIGHT GAUGE STEEL STRUCTURES 9

Introduction to Direct Strength Method - Behavior of Compression Elements - Effective width for load and deflection determination – Behavior of Unstiffened and Stiffened Elements – Design of webs of beams – Flexural members – Lateral buckling of beams – Shear Lag – Flange Curling – Design of Compression Members – Wall Studs.

UNIT IV STRENGTH CRITERIA AND DRIFT CRITERIA 9

Strength Criteria:

Beams - Flexure, Shear, Torsion, Columns - Moment Magnification Factor, Effective Length, PM Interaction, Biaxial Bending, Joint Panel Zones.

Drift Criteria: P Effect, Deformation Based Design

UNIT V DESIGN OF CONNECTIONS 9

Types of connections – Welded and Bolted – Design of simple base, Gusseted base and Moment Resisting Base – Flexible Connections - Seated Connections – Unstiffened and Stiffened Seated Connections – Moment Resistant Connections– Clip angle Connections – Split beam Connection

TEXT BOOKS:

T1: Ramchandra, Design of Steel Structures - Vol. II, Standard Book House, Delhi, 2010.

T2: Arya A. S., Ajmani J. L., Nemchand and Bros., Design of Steel Structures - Roorkee, 2014.

T3: S.K. Duggal, Limit State Design of Steel Structures, McGraw Hill Book Company, 2017

T4: Subramanian. N, Design of Steel Structures, Oxford University Press, 2016.

24MEST2E02 **DESIGN OF FORMWORK** **3H:3C**

Instruction Hours/ Week: L:3 T:0 P:0 Marks: Internal–40, External–60; Total-100

End Sem. Exam–3 Hrs.

COURSE OBJECTIVES:

The goal of this course is to;

1. To impart knowledge on formwork materials
2. Design the form work for Beams, SLaboratorys, columns, Walls and Foundations.
3. Design the form work for Special Structures.

COURSE OUTCOMES:

Upon completion of this course, students will be able to

1. Extend a materials and behavior of formwork
2. Illustrate the design of foundation, wall and column formwork
3. Describe the design the formwork for beam, sLaboratory, bridges and special structures
4. Demonstrate the design of Flying Formwork slipform techniques
5. Examine the design of formwork for supports – Scaffolds and precast concrete

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	-	2	-	1	-	-	-
CO2	3	2	2	1	-	1	-	-	-	2	-	1	-	-	-
CO3	3	2	1	-	-	1	-	-	-	2	-	1	2	-	-
CO4	3	2	2	1	-	1	-	-	-	2	-	1	2	-	-
CO5	3	2	1	-	-	-	-	-	-	2	-	1	-	-	-
CO	**3**	**2**	**1.4**	**1**	**-**	**1**	**-**	**-**	**-**	**2**	**-**	**1**	**2**	**-**	**-**

UNIT I INTRODUCTION AND FORMWORK MATERIALS 9

Requirements and Selection of Formwork, Formwork Materials-Timber, Plywood, Steel, Aluminum,Plastic, and Accessories. Horizontal and Vertical Formwork Supports.

UNIT II FORMWORK DESIGN 9

Concepts, Formwork Systems and Design for Foundations, Walls, Columns, SLaboratory and Beams.

UNIT III FORMWORK DESIGN FOR SPECIAL STRUCTURES 9

Shells, Domes, Folded Plates, Overhead Water Tanks, Natural Draft Cooling Tower, Bridges.

UNIT IV FLYING FORMWORK 9

Table Form, Tunnel Form, Slip Form, Formwork for Precast Concrete, Formwork ManagementIssues – Pre- and Post-Award.

UNIT V FORMWORK FAILURES 9

Causes and Case studies in Formwork Failure, Formwork Issues in Multi-Story BuildingConstruction.

SUGGESTED READINGS:

1. Formwork for Concrete Structures, Peurify, Mc Graw Hill India, 2015.
2. Formwork for Concrete Structures, Kumar Neeraj Jha, Tata McGraw HillEducation, 2012.

Semester II

24MEST2E03 DESIGN OF HIGH-RISE STRUCTURES 3H:3C

Instruction Hours/ Week: L:3 T:0 P:0 Marks: Internal–40, External–60; Total-100

End Sem. Exam–3 Hrs.

COURSE OBJECTIVES:

The goal of this course is to;

1. To introduce various aspects of planning of tall buildings and know about different typesof loads.
2. To introduce various structural systems for high rise buildings with their behavior and analysis.
3. To impart knowledge about analysis involved in tall structures.

COURSE OUTCOMES:

Upon completion of this course, students will be able to

1. Identify different types of loading acting on tall buildings.
2. Interpret various structural systems used in the construction of tall structures.
3. Analyze different components of tall structures.
4. Design structural elements for secondary effects.
5. Evaluate stability analysis of frames for various secondary effects such as creep,shrinkage and temperature.

CO No	PO1	PO2	PO 3	PO4	PO5	PO 6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	-	2	-	1	-	-	-
CO2	3	2	2	1	-	1	-	-	-	2	-	1	-	-	-
CO3	3	2	1	-	-	1	-	-	-	2	-	1	2	-	-
CO4	3	2	2	1	-	1	-	-	-	2	-	1	2	-	-
CO5	3	2	1	-	-	-	-	-	-	2	-	1	-	-	-
CO	**3**	**2**	**1.4**	**1**	**-**	**1**	**-**	**-**	**-**	**2**	**-**	**1**	**2**	**-**	**-**

UNIT I DESIGN OF TRANSMISSION/ TV TOWER, MAST AND TRESTLES 9

Configuration, bracing system, analysis and design for vertical transverse and longitudinal loads.

UNIT II RC CHIMNEY 9

Introduction, types, joint, analysis and design of RC Chimney, Foundation design for varied soilstrata.

UNIT III STEEL CHIMNEY 9

Introduction, analysis and design of Steel Chimney, Foundation design for varied soil strata.

UNIT IV TALL BUILDINGS 9

Structural Concept, Configurations, various systems, Wind and Seismic loads, Dynamic approach, structural design considerations and IS code provisions. Firefighting design provisions.

UNIT V APPLICATION OF SOFTWARE 9

Application of software in analysis and design.

SUGGESTED READINGS:

1. Structural Design of Multi-storeyed Buildings, Varyani U. H., 2nd Ed., South Asian Publishers, New Delhi, 2002.
2. Structural Analysis and Design of Tall Buildings, Taranath B. S., Mc Graw Hill, 2011.
3. Illustrated Design of Reinforced Concrete Buildings (GF+3storeyed), Shah V. L. & Karve S. R., Structures Publications, Pune, 2013.
4. Design of Multi Storeyed Buildings, Vol. 1 & 2, CPWD Publications, 2013.

Semester II

24MEST2E04 DESIGN OF MASONRY STRUCTURES 3H:3C

Instruction Hours/ Week: L:3 T:0 P:0 Marks: Internal–40, External–60; Total-100

End Sem. Exam–3 Hrs.

COURSE OBJECTIVES:

The goal of this course is to;

1. Explain basic principles of design of masonry elements.
2. Apply the analysis procedures to find the member forces in connecting elements.
3. Use codal provisions to arrive strength of masonry.

COURSE OUTCOMES:

Upon completion of this course, students will be able to

1. Apply the masonry design approaches.
2. Analyze Reinforced Masonry Members.
3. Determine interactions between members.
4. Examine shear strength and ductility of Reinforced Masonry members.
5. List the stability of walls and perform elastic and inelastic analysis of masonry walls.

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	-	2	-	1	-	-	-
CO2	3	2	2	1	-	1	-	-	-	2	-	1	-	-	-
CO3	3	2	1	-	-	1	-	-	-	2	-	1	2	-	-
CO4	3	2	2	1	-	1	-	-	-	2	-	1	2	-	-
CO5	3	2	1	-	-	-	-	-	-	2	-	1	-	-	-
CO	**3**	**2**	**1.4**	**1**	**-**	**1**	**-**	**-**	**-**	**2**	**-**	**1**	**2**	**-**	**-**

UNIT I INTRODUCTION 9

Historical Perspective, Masonry Materials, Masonry Design Approaches, Overview of Load Conditions, Compression Behavior of Masonry, Masonry Wall Configurations, Distribution ofLateral Forces.

UNIT II FLEXURAL STRENGTH 9

Flexural Strength of Reinforced Masonry Members: In plane and Out-of-plane Loading.

UNIT III INTERACTIONS AND SHEAR STRENGTH 9

Interaction: Structural Wall, Columns and Pilasters, Retaining Wall, Pier and Foundation. Shear Strength and Ductility of Reinforced Masonry Members.

UNIT IV PRESTRESSED MASONRY 9

Stability of Walls, Coupling of Masonry Walls, Openings, Columns, Beams.

UNIT V ELASTIC AND INELASTIC ANALYSIS 9

Modeling Techniques, Static Push over Analysis and use of Capacity Design Spectra.

SUGGESTED READINGS:

1. Design of Reinforced Masonry Structures, Narendra Taly, ICC, 2nd Edn,2010
2. Mechanics of Masonry Structures, Editor: Maurizio Angelillo, 2014.

24MEST2E05 DESIGN OF ADVANCED CONCRETE STRUCTURES 3H:3C

Instruction Hours/ Week: L:3 T:0 P:0 Marks: Internal–40, External–60; Total-100

End Sem. Exam–3 Hrs.

COURSE OBJECTIVES:

The goal of this course is to;

1. To understand the basic design on limit states.
2. To impart the design concepts of yield line theory and designing flat sLaboratorys.
3. To acquire knowledge in plastic analysis and design of concrete structures.

COURSE OUTCOMES:

Upon completion of this course, students will be able to

1. Analyze the structural elements for serviceability as per IS code.
2. Examine RC columns to calculate moment distribution.
3. Apply strut and tie method for special structures like RC walls, grid floors and corbels.
4. Utilize yield line theory in designing flat sLaboratory.
5. Analyze inelastic behaviour of beams and columns.

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	3	3	2	1	-	2	1	-	-	2	-	2	3	3	-
CO2	3	3	2	1	-	2	1	-	-	2	-	2	3	3	-
CO3	3	2	1	-	-	2	1	-	-	2	-	2	3	3	-
CO4	3	2	1	-	-	2	1	-	-	2	-	2	3	3	-
CO5	3	3	2	1	-	2	1	-	-	2	-	2	3	3	-
CO	**3**	**2.6**	**1.6**	**1**	**-**	**2**	**1**	**-**	**-**	**2**	**-**	**2**	**3**	**3**	**-**

UNIT I ADVANCE CONCRETE DESIGN IN RC BEAM 9

Properties and behavior of concrete and steel – Behavior and design of R.C. beams in flexure,shear and torsion - modes of failure - calculations of deflections and crack width as per IS 456.

UNIT II DESIGN OF RC COLUMN 9

Behavior of short and long columns - behavior of short column under axial load with uniaxialand bi-axial moments - construction of Pu - Mu interaction curves - Design of slender columns.

UNIT III SPECIAL STRUTURES 9

Design of RC walls - design of corbels - strut and tie method - design of simply supported and continuous deep beams - analysis and design of grid floors.

UNIT IV FLAT SLABORATORYS AND YIELD LINE-BASED DESIGN 9

Design of flat sLaboratorys according to IS method – Check for shear - Design of spandrel beams – Yield line theory and design of sLaboratorys - virtual work method - equilibrium method.

UNIT V INELASTIC BEHAVIOR OF CONCRETE STRUCTURES 9

Inelastic behavior of concrete beams - Moment-curvature curves - moment redistribution – Conceptof Ductility – Detailing for ductility – Design of beams, columns for ductility - Design of cast-in-situjoints in frames.

SUGGESTED READINGS:

1. Design of Steel Structures, Subramaniam N., Oxford University Press, 2008.
2. Advanced Reinforced Concrete Design, Varghese P. C., Prentice Hall of India, NewDelhi,2008
3. Unified Theory of Concrete Structures, Hsu T. T. C. and Mo Y. L., John Wiley & Sons, 2010.
4. Performance-based design in earthquake engineering: state of development, A Ghobarah Engineering structures

Semester II

24MEST2E06 ADVANCED DESIGN OF FOUNDATION ENGINEERING 3H:3C

Instruction Hours/ Week: L:3 T:0 P:0 Marks: Internal–40, External–60; Total-100End Sem. Exam–3 Hrs.

COURSE OBJECTIVES:

The goal of this course is to;

1. Evaluate the importance of soil exploration for major construction projects.
2. Analyze and design shallow foundations.
3. Analyze the capacity of pile as single and in group.

COURSE OUTCOMES:

Upon completion of this course, students will be able to

1. Examine the suitability of soil strata for different projects.
2. Design shallow foundations deciding the bearing capacity of soil.
3. Analyze and design the pile foundation.
4. Analyze well foundation and tunnels.
5. Apply theoretical concepts related to analysis of other miscellaneous foundations.

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	-	2	-	1	-	-	-
CO2	3	2	1	1	-	1	-	-	-	2	-	1	-	-	-
CO3	3	2	1	-	-	1	-	-	-	2	-	1	2	-	-
CO4	3	2	1	1	-	1	-	-	-	2	-	1	2	-	-
CO5	3	2	1	-	-	-	-	-	-	2	-	1	-	-	-
CO	**3**	**2**	**1**	**1**	**-**	**1**	**-**	**-**	**-**	**2**	**-**	**1**	**2**	**-**	**-**

UNIT I PLANNING OF SOIL EXPLORATION 9

Planning of Soil Exploration for Different Projects, Methods of Subsurface Exploration, Methods of Borings along with Various Penetration Tests.

UNIT II SHALLOW FOUNDATIONS 9

Requirements for Satisfactory Performance of Foundations, Methods of Estimating Bearing Capacity, Settlements of Footings and Rafts, Proportioning of Foundations using Field Test Data,Pressure - Settlement Characteristics from Constitutive Laws.

UNIT III PILE FOUNDATIONS 9

Methods of Estimating Load Transfer of Piles, Settlements of Pile Foundations, Pile Group Capacity and Settlement, Laterally Loaded Piles, Pile Load Tests, Analytical Estimation of Load- Settlement Behavior of Piles, Proportioning of Pile Foundations, Lateral and Uplift Capacity of Piles- Design of Foundation for Expansive Soil.

UNIT IV WELL FOUNDATION 9

IS and IRC Code Provisions, Elastic Theory and Ultimate Resistance Methods. Tunnels and Arching in Soils, Pressure Computations around Tunnels. Open Cuts, Sheeting and BracingSystems in Shallow and Deep Open Cuts in Different Soil Types.

UNIT V COFFER DAMS **9**

Various Types, Analysis and Design, Foundations under uplifting loads, Soil-structure interaction

SUGGESTED READINGS:

1. Design of foundation system, N.P. Kurian, Narosa Publishing House,2001
2. Analysis and Design of Substructures, Sawmi Saran, Oxford and IBH Publishing Co. Pvt.Ltd, New Delhi, 2006.

Semester II

24MEST2E07 SOIL STRUCTURE INTERACTION 3H:3C

Instruction Hours/ Week: L:3 T:0 P:0 Marks: Internal–40, External–60; Total-100

End Sem. Exam–3 Hrs.

COURSE OBJECTIVES:

The goal of this course is to;

1. Make students understand soil structure.
2. Understand stress-strain characteristics of soils.
3. Evaluate soil structure interaction for different types of structure under various conditionsof loading and subsoil characteristics.

COURSE OUTCOMES:

Upon completion of this course, students will be able to

1. Explain the importance of soil structure interaction.
2. Analyze the behavior of the soil under elastic and plastic condition as beam element.
3. Analyze the behavior of the soil as plate element.
4. List the behavior of the pile under static and dynamic loads.
5. Demonstrate the behavior of the laterally loaded piles.

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	-	2	-	1	-	-	-
CO2	3	2	1	1	-	1	-	-	-	2	-	1	-	-	-
CO3	3	2	1	-	-	1	-	-	-	2	-	1	2	-	-
CO4	3	2	1	1	-	1	-	-	-	2	-	1	2	-	-
CO5	3	2	1	-	-	-	-	-	-	2	-	1	-	-	-
CO	**3**	**2**	**1**	**0.4**	**-**	**1**	**-**	**-**	**-**	**2**	**-**	**1**	**2**	**-**	**-**

UNIT I INTRODUCTION 9

Critical Study of Conventional Methods of Foundation Design, Nature and Complexities of Soil Structure Interaction. Introduction to soil-foundation interaction problems – Soil behavior – Foundation behavior Interface behavior- Scope of soil foundation interaction analysis- soil response models–Elastic continuum-Two parameter elastic models- Elastic-plastic behavior- Timedependent behavior.

UNIT II ADVANCED APPLICATION 9

Infinite beam – Two-parameters models – Isotropic elastic half space model – Analysis of beams of finite length – combined footings. Thin and thick rafts – Analysis of finite plates - Numerical analysis of finite plates.

UNIT III SUBSOIL CHARACTERISTICS 9

Effect of structure on ground-foundation interaction – Static and dynamic loads- Contact pressure and its estimation – Estimation of the settlement from the constitutive laws – Free-field response – Kinetic interaction – Inertial interaction

UNIT IV DESIGN ORIENTED COMPUTER PROGRAMS 9

Preparation of Comprehensive Design Oriented Computer Programs for Specific Problems, Interaction Problems based on Theory of Sub Grade Reaction Such as Beams, Footings, Rafts Etc. Analysis of Different Types of Frame Structures Founded on Stratified Natural Deposits with Linear and Non-Linear Stress-Strain Charact

UNIT V GROUND IMPROVEMENT TECHNIQUES 9

Need of Ground Improvement, Different methods of Ground improvement, Ground Improvement in Granular Soil, Ground Improvement in Cohesive Soil, preloading methods, Stone Column, Ground Improvement by Grouting and Soil Reinforcement, Soil stabilization.

SUGGESTED READINGS:

1. Analytical and Computer Methods in Foundation, Bowels J.E. Mc Graw Hill Book Co.,New York, 2013.
2. Numerical Methods in Geotechnical Engineering, Desai C.S. and Christian J.T., McGrawHill Book Co., New York.
3. Elastic Analysis of Soil Foundation Interaction, Developments in Geotechnical Engg.Vol-17, Elsevier Scientific Publishing Company.
4. Analysis & Design of substructures, Swami Saran, Oxford & IBH Publishing Co.Pvt. Ltd,2010
5. Design of Foundation System- Principles & Practices, Kurian N. P., Narosa Publishing,2001

Semester II

24MEST2E08 DESIGN OF INDUSTRIAL STRUCTURES 3H:3C

Instruction Hours/ Week: L:3 T:0 P:0 Marks: Internal–40, External–60; Total-100

End Sem. Exam–3 Hrs.

COURSE OBJECTIVES:

The goal of this course is to;

1. To impart knowledge in the area of planning and functional requirements for industrial structures.
2. To understand the basic idea about the materials and design of industry structural elements.
3. To know the design concepts of power plant structures.

COURSE OUTCOMES:

Upon completion of this course, students will be able to

1. Identify the various functional requirements of Industrial structure.
2. Examine various structural elements of Industrial structure.
3. Classify and design of power plant structures.
4. Analyze and design power transmission structures.
5. List the concepts in design concepts of chimneys, bunkers and silos

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	-	2	-	1	-	-	-
CO2	3	2	1	1	-	1	-	-	-	2	-	1	-	-	-
CO3	3	2	1	-	-	1	-	-	-	2	-	1	2	-	-
CO4	3	2	1	1	-	1	-	-	-	2	-	1	2	-	-
CO5	3	2	1	-	-	-	-	-	-	2	-	1	-	-	-
CO	**3**	**2**	**1**	**0.4**	**-**	**1**	**-**	**-**	**-**	**2**	**-**	**1**	**2**	**-**	**-**

UNIT - I PLANNING AND FUNCTIONAL REQUIREMENTS 9

Classification of Industries and Industrial structures –planning for lay out Requirements regarding Lighting, Ventilation and Fire safety- Protection against noise and vibration- guide lines fromfactories Act.

UNIT - II INDUSTRIAL, BUILDING 9

Roofs for Industrial Buildings- Steel and RC- folded plates and shell roofs- Gantry Girders- Designof Corbels and Nibs- Machine Foundations

UNIT - III POWER PLANT STRUCTURES 9

Bunkers and Silos - Chimney and cooling Towers – Design of steel storage tanks- Nuclear containment structures

UNIT - IV POWER TRANSMISSION STRUCTURES 9

Cables- Transmission Line Towers – Substation structures- Tower Foundations – Testing towers.

UNIT – V CURRENT DESIGN TRENDS 9

Concepts of shear walls, Walls-frames, tubular, Cores, outrigger, bundled tubes, diagonal tubes,mega tubes Environmental control structures for industries-concept of Electro static precipitators- functioning and components.

SUGGESTED READINGS:

1. Design of Steel Structure, Punmia B. C., Jain Ashok Kr., Jain Arun Kr., 2nd Ed., Lakshmi Publishers, 1998.
2. Design of Steel Structures, Ram Chandra, 12th Ed., Standard Publishers, 2011.
3. Design of Steel Structures, Subramaniya, Oxford university Press,2008

Semester II

24MEST211 **MODEL TESTING LABORATORY** **2H:2C**

Instruction Hours/ Week: L:0 T:0 P:2 Marks: Internal–40 , External–60; Total-100

End Sem. Exam–3 Hrs.

COURSE OBJECTIVES:

The goal of this course is to;

1. Understand the response of structures.
2. Prepare the models.
3. Understand the concept of free and forced vibrations

COURSE OUTCOMES:

Upon completion of this course, students will be able to

1. Conduct model testing for static loading
2. Conduct model testing for free and forced vibrations
3. Conduct free and forced vibrations
4. Conduct vibration test on various structural elements
5. Dynamic analysis of frames and analyze the RC beams and sLaboratorys

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	-	2	-	1	-	-	-
CO2	3	2	1	1	-	1	-	-	-	2	-	1	-	-	-
CO3	3	2	1	-	-	1	-	-	-	2	-	1	2	-	-
CO4	3	2	1	1	-	1	-	-	-	2	-	1	2	-	-
CO5	3	2	1	-	-	-	-	-	-	2	-	1	-	-	-
CO	**3**	**2**	**1**	**0.4**	**-**	**1**	**-**	**-**	**-**	**2**	**-**	**1**	**2**	**-**	**-**

LIST OF EXPERIMENTS:

1. Response of structures and its elements against extreme loading events.
2. Model Testing: Static - testing of plates, shells, and frames models.
3. Free and forced vibrations, Evaluation of dynamic modulus.
4. Beam vibrations, Vibration isolation, Shear wall building model, Time and frequency-domainstudy, Vibration Characteristics of RC Beams using Piezoelectric Sensors etc.

24MEST212 **NUMERICAL ANALYSIS LABORATORY** **2H:2C**

Instruction Hours/ Week: L:0 T:0 P:2 Marks: Internal–40, External–60; Total-100

End Sem. Exam–3 Hrs.

COURSE OBJECTIVES:

The goal of this course is to;

1. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling various problems in the discipline.
2. To introduce students to numerical methods used to solve engineering problems.
3. Fundamentals of numerical methods/algorithms to solve systems of different mathematical equations (e.g. linear/ non-linear algebraic equations, ordinary /partial differential equations)

COURSE OUTCOMES:

Upon completion of this course, students will be able to

1. To solve engineering problems involving Linear and non-linear equations.
2. Hands-on experience will be provided to apply these computer programs to solve problems in different areas of engineering.
3. To acquire skills in handling situations involving linear/ non-linear algebraic equations, ordinary /partial differential equations
4. To solving actual engineering problems through computer programming and coding.
5. To solve ordinary and partial differential equations using programming languages like C and software like Excel.

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	-	2	-	1	-	-	-
CO2	3	2	1	1	-	1	-	-	-	2	-	1	-	-	-
CO3	3	2	1	-	-	1	-	-	-	2	-	1	2	-	-
CO4	3	2	1	1	-	1	-	-	-	2	-	1	2	-	-
CO5	3	2	1	-	-	-	-	-	-	2	-	1	-	-	-
CO	**3**	**2**	**1**	**0.4**	**-**	**1**	**-**	**-**	**-**	**2**	**-**	**1**	**2**	**-**	**-**

CONTENTS:

1. Find the Roots of the Non-Linear Equation Using Bisection Method.
2. Find the Roots of Non-Linear Equation Using Newton's Method.
3. Curve Fitting by Least Square Approximations.
4. Solve the System of Linear Equations Using Gauss - Elimination Method.
5. Solve the System of Linear Equations Using the Gauss-Seidel Iteration Method.
6. Solve the System of Linear Equations Using the Gauss - Jorden Method.
7. Integrate numerically using the Trapezoidal Rule.
8. Integrate numerically using Simpson's Rules.
9. Numerical Solution of Ordinary Differential Equations by Euler's Method.
10. Numerical Solution of Ordinary Differential Equations by Runge- Kutta Method.

SUGGESTED READINGS:

1. Numerical Methods for Engineers, Steven C. Chapra, Raymond P. Canale, McGraw-Hill Pub. Co. Ltd., 2014.
2. Applied Numerical Analysis, Curtis F. Gerald and Patrick O. Wheatley, Pearson Education, South Asia, 2009.

24MEST213 **DESIGN PROJECT** **4H:2C**

Instruction Hours/ Week: L:0 T:0 P:4 Marks: Internal–40, External–60; Total-100

End Sem. Exam–3 Hrs.

Course Objectives:

The goal of this course is to;

1. To Identify structural engineering problems reviewing avaiLaboratoryle literature.
2. To study different techniques used to analyze complex structural systems.
3. To work on the solutions given and present solution by using his/her technique applying engineering principles.

Course Outcomes

Upon completion of this course, students will be able to

1. Identify structural engineering problems reviewing avaiLaboratoryle literature.
2. Study different techniques used to analyze complex structural systems.
3. work on the solutions given and present solution by using his/her technique applying engineering principles.
4. Work individually on a project involving theoretical and experimental studiesrelated to Civil Engineering.
5. Produce a comprehensive report covering background information, literatureSurvey, problem statement, Project work details and conclusions.

SYLLABORATORYUS:

- Design Project will have mid semester presentation and end semester presentation. Mid semester presentation will include identification of the problem based on the literature review on the topic referring to latest literature avaiLaboratoryle.
- End semester presentation should be done along with the report on identification of topic for the work and the methodology adopted involving scientific research, collection and analysis of data, determining solutions highlighting individuals' contribution.
- The design project should comprise of planning, analysis, design and Modeling of structures. Continuous assessment of Design Project at Mid Semester and End Semester will be monitored by the departmental committee.

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	-	2	-	1	-	-	-
CO2	3	2	1	1	-	1	-	-	-	2	-	1	-	-	-
CO3	3	2	1	-	-	1	-	-	-	2	-	1	2	-	-
CO4	3	2	1	1	-	1	-	-	-	2	-	1	2	-	-
CO5	3	2	1	-	-	-	-	-	-	2	-	1	-	-	-
CO	**3**	**2**	**1**	**0.4**	**-**	**1**	**-**	**-**	**-**	**2**	**-**	**1**	**2**	**-**	**-**

Semester III

24MEST3E01 DESIGN OF PRESTRESSED CONCRETE STRUCTURES 3H:3C

Instruction Hours/ Week: L:3 T:0 P:0 Marks: Internal–40, External–60; Total-100

End Sem. Exam–3 Hrs.

COURSE OBJECTIVES:

The goal of this course is to ;

1. To get exposed to various systems of pre-stressing.
2. To understand the design of flexural members for shear, bond and torsion and end blocks.
3. To acquire knowledge on continuous beams and their design.

COURSE OUTCOMES:

Upon completion of this course, students will be able to

1. Analyze the pre-stressed concrete element using various methods.
2. Design pre-stressed concrete flexural members.
3. Design profiles for pre-stressed continuous beams.
4. Design pre-stressed tension and compression members as per codal recommendations.
5. Design pre-stressed concrete bridges as per IRC specifications.

CO No	PO 1	PO 2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	2	1	-	-	-	-	-	-	2	-	1	-	-	-
CO2	3	2	1	1	-	1	-	-	-	2	-	1	-	-	-
CO3	3	2	1	-	-	1	-	-	-	2	-	1	2	-	-
CO4	3	2	1	1	-	1	-	-	-	2	-	1	2	-	-
CO5	3	2	1	-	-	-	-	-	-	2	-	1	-	-	-
CO	**3**	**2**	**1**	**1**	**-**	**1**	**-**	**-**	**-**	**2**	**-**	**1**	**2**	**-**	**-**

UNIT I INTRODUCTION TO PRESTRESSED CONCRETE 9

Types of prestressing, systems and devices, materials, losses in prestress. Analysis of PSC flexural members: basic concepts, stresses at transfer and service loads, ultimate strength in flexure, code provisions.

UNIT II STATICALLY DETERMINATE PSC BEAMS 9

Design for ultimate and serviceability limit states for flexure, analysis and design for shear and torsion, code provisions Analysis and design of prestressed concrete pipes, columns with moments

UNIT III TRANSMISSION OF PRESTRESS 9

Transmission of prestressing pretensioned members; Anchorage zone stresses for post tensioned members.

UNIT IV STATICALLY INDETERMINATE STRUCTURES 9

Analysis and design - continuous beams and frames, choice of cable profile, linear transformation and concordancy.

UNIT V COMPOSITE CONSTRUCTION 9

Composite construction with precast PSC beams and cast in-situ RC sLaboratory - Analysis and design, creep and shrinkage effects. Partial prestressing - principles, analysis and design concepts, crack- width calculations

SUGGESTED READINGS:

1. Design of Prestressed Concrete Structures, Lin T.Y., Asia Publishing House, 2010.
2. Prestressed Concrete, Krishnaraju N., Tata McGraw Hill, New Delhi, 2012.
3. Limited State Design of Prestressed Concrete, Guyan., Applied Science Publishers, 1972.
4. IS 1343- Code of Practice for Prestressed Concrete,

24MEST3E02 ANALYSIS OF LAMINATED COMPOSITE PLATES 3H:3C

Instruction Hours/ Week: L:3 T:0 P:0 Marks: Internal–40, External–60; Total-100
End Sem. Exam–3 Hrs.

COURSE OBJECTIVES:

The goal of this course is

1. To study the behavior of lamina.
2. To provide knowledge on the behavior of laminate.
3. To study the effect of Hygrothermal forces on the mechanical behavior of composite.

COURSE OUTCOMES:

Upon completion of this course, students will be able to

1. Use various laminated composites.
2. Analyze the behavior of lamina.
3. Analyze the behavior of laminates.
4. Analyze the effect of Hydrothermal forces on mechanical behavior.
5. Familiarize with numerical and soft computing techniques.

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO10	PO11	PO12	PSO1	PSO 2	PSO 3
CO1	3	2	1	-	-	-	-	-	-	2	-	1	-	-	-
CO2	3	2	1	1	-	1	-	-	-	2	-	1	-	-	-
CO3	3	2	1	-	-	1	-	-	-	2	-	1	2	-	-
CO4	3	2	1	1	-	1	-	-	-	2	-	1	2	-	-
CO5	3	2	1	-	-	-	-	-	-	2	-	1	-	-	-
CO	**3**	**2**	**1**	**0.4**	**-**	**1**	**-**	**-**	**-**	**2**	**-**	**1**	**2**	**-**	**-**

UNIT I INTRODUCTION 9

Displacement Field Approximations for Classical Laminated Plate Theory (CLPT) and First Order Shear Deformation Theory (FSDT), Analytical Solutions for Bending of Rectangular Laminated Plates using CLPT.

UNIT II EQUATIONS 9

Governing Equations. Navier Solutions of Cross-Ply and Angle-Ply Laminated Simply-Supported Plates, Determination of Stresses. Levy Solutions for Plates with Other Boundary

UNIT III SOLUTIONS 9

Conditions, Analytical Solutions for Bending of Rectangular Laminated Plates Using FSDT.

UNIT IV FINITE ELEMENT SOLUTIONS 9

Finite Element Solutions for Bending of Rectangular Laminated Plates using CLPT. Introduction to Finite Element Method, Rectangular Elements, Formation of Stiffness Matrix, Formation of Load Vector, Numerical Integration, Post Computation of Stresses. Finite Element Solutions for Bending of Rectangular Laminated Plates using FSDT. Finite Element Model, C^0 Element Formulation, Post Computation of Stresses.

UNIT V ANALYTICAL METHODS 9

Analysis of Rectangular Composite Plates using Analytical Methods. Static, Dynamic and Stability analysis for Simpler cases of composite plates, Inter laminar stresses.

SUGGESTED READINGS:

1. Mechanics of Laminated Composites Plates and Shells, Reddy J. N., CRC Press.
2. Mechanics of laminated composite plates and shells: theory and analysis, JN Reddy
3. Analysis of laminated composite plates using a higher-order shear deformation theory,ND Phan, JN Reddy

Semester III

24MEST3E03 FRACTURE MECHANICS OF CONCRETE STRUCTURES 3H:3C

Instruction Hours/ Week: L:3 T:0 P:0 Marks: Internal–40, External–60; Total-100

End Sem. Exam–3 Hrs.

COURSE OBJECTIVES:

The goal of this course is to ;

1. Gain knowledge in fracture mechanics principles.
2. Understand the effect of scale in fracture mechanics.
3. Exposed to numerical methods for analysis of concrete elements.

COURSE OUTCOMES:

Upon completion of this course, students will be able to

1. Apply the fundamentals of fracture mechanics to concrete structures.
2. Demonstrate scale effects in crack analysis of concrete elements.
3. Use FEM concepts to analyze cracked concrete members.
4. Model the pre-cracked element
5. Explain the fracture of steel.

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	-	2	-	1	-	-	-
CO2	3	2	1	1	-	1	-	-	-	2	-	1	-	-	-
CO3	3	2	1	-	-	1	-	-	-	2	-	1	2	-	-
CO4	3	2	1	1	-	1	-	-	-	2	-	1	2	-	-
CO5	3	2	1	-	-	-	-	-	-	2	-	1	-	-	-
CO	**3**	**2**	**1**	**0.4**	**-**	**1**	**-**	**-**	**-**	**2**	**-**	**1**	**2**	**-**	**-**

UNIT I INTRODUCTION **9**

Basic Fracture Mechanics, Crack in a Structure, Mechanisms of Fracture and Crack Growth, Cleavage Fracture, Ductile Fracture, Fatigue Cracking, Environment assisted Cracking, ServiceFailure Analysis.

UNIT II STRESS AT CRACK TIP **9**

Stress at Crack Tip, Linear Elastic Fracture Mechanics, Griffith's Criteria, Stress Intensity Factors, Crack Tip Plastic Zone,

UNIT III CORRECTION TO CRACK TIP **9**

Erwin's Plastic Zone Correction, R curves, Compliance, J Integral, Concept of CTOD and CMD.

UNIT IV MATERIAL MODELS: **9**

General Concepts, Crack Models, Band Models, Models based on Continuum Damage Mechanics.

UNIT V APPLICATIONS OF MODELING **9**

Applications to High Strength Concrete, Fibre Reinforced Concrete, Crack Concepts and Numerical Modeling.

SUGGESTED READINGS:

1. Fracture Mechanics, Suri C. T. and Jin Z.H., 1st Edition, Elsevier Academic Press, 2012.
2. Elementary Engineering Fracture Mechanics, Broek David, 3rd Rev. Ed. Springer, 1982.
3. Fracture Mechanics of Concrete Structures – Theory and Applications, Elfgreen L., RILEMReport, Chapman and Hall, 1989.
4. Fracture Mechanics – Applications to Concrete, Victor, Li C., Bazant Z. P., ACI SP 118, ACIDetroit, 1989.

Semester III

24MEST3E04 DESIGN OF PLATES AND SHELLS 3H:3C

Instruction Hours/ Week: L:3 T:0 P:0 Marks: Internal–40, External–60; Total-100

End Sem. Exam–3 Hrs.

COURSE OBJECTIVES:

The goal of this course is to;

1. Analyze and design prismatic folded plate systems.
2. Analyze and design shells using approximate solutions
3. Analyze and Design Cylindrical Shells

COURSE OUTCOMES:

Upon completion of this course, students will be able to

1. Analyze and design prismatic folded plate systems.
2. Analyze and design shells using approximate solutions
3. Analyze and design Cylindrical Shells
4. Analyze bending of long rectangular plates using thin plate theory
5. Analyze circular plates with various loading conditions

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	-	2	-	1	-	-	-
CO2	3	2	1	1	-	1	-	-	-	2	-	1	-	-	-
CO3	3	2	1	-	-	1	-	-	-	2	-	1	2	-	-
CO4	3	2	1	1	-	1	-	-	-	2	-	1	2	-	-
CO5	3	2	1	-	-	-	-	-	-	2	-	1	-	-	-
CO	**3**	**2**	**1**	**0.4**	**-**	**1**	**-**	**-**	**-**	**2**	**-**	**1**	**2**	**-**	**-**

UNIT I PRISMATIC FOLDED 9

Folded Plate structures, structural behavior, types, design by ACI - ASCE Task Committee method – pyramidal roof- Prismoidal roof.

UNIT II PLATE SYSTEMS SHELL EQUATIONS 9

Simply supported rectangular plates – Navier's solution and Levy's method.

UNIT III APPROXIMATE SOLUTIONS 9

Classification of shells, types of shells, structural action, - Design of circular domes, conical roofs,circular cylindrical shells by ASCE Manual No.31.

UNIT IV ANALYSES AND DESIGN OF CYLINDRICAL SHELLS 9

Analysis of space frames – Design of Nodes – Pipes - Space frames – Introduction to ComputerAided Design.

UNIT V APPROXIMATE DESIGN METHODS FOR DOUBLY CURVED SHELLS 9

Design of spherical dome – cylindrical shells – folded plate- Application of Formex Algebra, FORMIAN for generation of configuration

SUGGESTED READINGS:

1. Theory of Plates and Shells, Timoshenko and Woinowsky-Krieger S., Tata McGrawHill Edition, 2010.
2. Design and Construction of Concrete Shell Roofs, Ramaswamy G. S., 1st Edition,2005.
3. Design of Reinforced Concrete Shells & Folded Plate, Varghese P. C., 2010
4. Design of Plate and Shell Structures, JawadMaan H., Springer Science.

Semester III

24MEST3E05 DESIGN OF EARTHQUAKE RESISTANT STRUCTURES 3H:3C

Instruction Hours/ Week: L:3 T:0 P:0 Marks: Internal–40, External–60; Total-100

End Sem. Exam–3 Hrs.

COURSE OBJECTIVE:

The goal of this course is to;

1. To understand the fundamentals of engineering seismology, including causes of earthquakes, characteristics of seismic waves, and the seismic history of India.
2. To introduce Indian seismic design codes for the analysis and design of structures subjected to earthquake forces.
3. To apply various seismic analysis and design methods for earthquake-resistant design of multi-storey reinforced concrete (RC) buildings and other structural systems.

COURSE OUTCOME:

Upon completion of this course, students will be able to

1. Illustrate the causes of earthquakes on structures, and use of seismographs, accelerographs in Indian seismology.
2. Plan structures for earthquake resistance using Indian codes.
3. Classify different methods of seismic, static and dynamic analysis.
4. Utilize earthquake-resistant design principles, and construction guidelines for multi-storey buildings.
5. Compare soil behavior during earthquakes, modern protection methods, and strategies for evaluating retrofitting structures.

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	-	-	-	-	-	2	-	2	-	1	2	-	-
CO2	3	2	1	-	-	-	-	2	-	2	-	1	2	-	-
CO3	3	3	2	1	-	-	-	2	-	2	-	1	2	-	-
CO4	3	2	1	-	-	-	-	2	-	2	-	1	2	-	-
CO5	3	3	2	1	-	-	-	2	-	2	-	1	2	-	-
CO	**2.8**	**2.2**	**1.5**	**1**	**-**	**-**	**-**	**2**	**-**	**2**	**-**	**1**	**2**	**-**	**-**

NIT I INTRODUCTION: 9

Elements of engineering seismology-causes of earthquakes, seismic waves, magnitude, intensity and energy Release-Indian Seismology-Earthquake History-Seismic Zone Map of India-seismographs- seismogram-accelerograph-strong motion characteristics-initiation into vibration of structures.

UNIT II IS CODE PROVISIONS: 9

Modal response contribution-modal participation factor-response history-spectral analysis- approximate methods for lateral load analysis-IS 1893-2002 provisions-IS 4326 provisions-behavior and design of masonry structures-discussion of codes IS 13827 and 13828. Ductile detailing of reinforcement in RC Building as per IS 13920.

UNIT III SEISMIC ANALYSIS OF BUILDINGS: 9

Introduction to methods of seismic Analysis-Equivalent static analysis IS 1893 Provisions-Design horizontal seismic coefficient-design base shear-distribution-idealization of building frames-seismic analysis and modeling-determination of lateral forces-equivalent static lateral force method-response spectrum method-time history method-push over analysis-mathematical modeling of multistory RC Building.

UNIT IV SEISMIC DESIGN CONCEPTS: 9

Concept of earthquake resistant design-concept of ductility-lateral force resisting systems-strong column weak beam concept-guidelines for seismic resistant construction-beam column joints-effect of structural

Irregularities-Earthquake Resistant Design for multi storey RC frames, shear wall, braced frames and their combinations-capacity based design

UNIT V MODERN CONCEPTS: 9

Soil Performance-Liquefaction-Modern concepts-base isolation-adaptive system-seismic evaluation- retrofiting and strengthening of structures-seismic retrofitting strategies.

SUGGESTED READINGS:

1. Anil K.Chopra, Dynamics of Structures, Fifth edition, Pearson Education, 2020.
2. Leonard Meirovitch, Elements of Vibration Analysis, McGraw Hill,2014.
3. Mario Paz, Structural Dynamics -Theory and Computation, Kluwer Academic Publishers,Fifth Edition, 2006.
4. Roy R.Craig, Jr, Andrew J. Kurdila, Fundamentals of Structural Dynamics, John Wiley &Sons, 2011.
5. Brebbia C. A.," Earthquake Resistant Engineering Structures VIII", WIT Press, 2015
6. Mohiuddin Ali Khan "Earthquake-Resistant Structures: Design, Build and Retrofit", Elsevier Science& Technology, 2013.

24MESTOE01 **BUSINESS ANALYTICS** **3H:3C**

Instruction Hours/ Week: L:3 T:0 P:0 Marks: Internal–40, External–60; Total-100

End Sem. Exam–3 Hrs.

Course Objectives:

The goal of this course is to;

1. To understand the basics of business analytics and its life cycle.
2. To gain knowledge about fundamental business analytics.
3. To learn modeling for uncertainty and statistical inference.

Course Outcomes

Upon completion of this course, students will be able to

1. Identify the real-world business problems and model with analytical solutions.
2. Solve analytical problem with relevant mathematics background knowledge.
3. Enumerate any real-world decision-making problem to hypothesis and apply suitablestatistical testing.
4. Demonstrate simple applications involving analytics using Hadoop andMapReduce
5. List open-source frameworks for modeling and storing data.

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	-	2	-	1	-	-
CO2	3	2	1	1	-	1	-	-	-	2	-	1	-	-
CO3	3	2	1	-	-	1	-	-	-	2	-	1	2	-
CO4	3	2	1	1	-	1	-	-	-	2	-	1	2	-
CO5	3	2	1	-	-	-	-	-	-	2	-	1	-	-
CO	**3**	**2**	**1**	**0.4**	**-**	**1**	**-**	**-**	**-**	**2**	**-**	**1**	**2**	**-**

UNIT- 1 BUSINESS ANALYTICS **9**

Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, competitive advantages of Business Analytics, Statistical Tools- Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modeling, sampling and estimation methods overview

UNIT- II TRENDINESS AND REGRESSION ANALYSIS **9**

Modeling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizingand Exploring Data, Business Analytics Technology.

UNIT- III ORGANIZATIONAL SETUP: **9**

Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, measuring contribution of Business analytics, Managing Changes.

UNIT- IV DESCRIPTIVE ANALYSIS: **9**

Descriptive Analytics, predictive analytics, predicative modeling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive modeling, nonlinear Optimization

UNIT- V FORECASTING TECHNIQUES **9**

Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression

SUGGESTED READINGS:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

OPEN ELECTIVES **Semester III**

24MESTOE02 **INDUSTRIAL SAFETY** **3H:3C**

Instruction Hours/ Week: L:3 T:0 P:0 Marks: Internal–40, External–60; Total-100

End Sem. Exam–3 Hrs.

Course Objectives:

The goal of this course is to;

1. Summarize basics of industrial safety
2. Describe fundamentals of maintenance engineering
3. Explain wear and corrosion

Course Outcomes

Upon completion of this course, students will be able to

1. Ability to summarize basics of industrial safety
2. Ability to describe fundamentals of maintenance engineering
3. Ability to explain wear and corrosion
4. Ability to illustrate fault tracing
5. Ability to identify preventive and periodic maintenance

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	-	2	-	1	-	-
CO2	3	2	1	1	-	1	-	-	-	2	-	1	-	-
CO3	3	2	1	-	-	1	-	-	-	2	-	1	2	-
CO4	3	2	1	1	-	1	-	-	-	2	-	1	2	-
CO5	3	2	1	-	-	-	-	-	-	2	-	1	-	-
CO	**3**	**2**	**1**	**0.4**	**-**	**1**	**-**	**-**	**-**	**2**	**-**	**1**	**2**	**-**

UNIT-I: INDUSTRIAL SAFETY **9**

Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT-II: FUNDAMENTALS OF MAINTENANCE ENGINEERING **9**

Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance CO Not & its relation with replacement economy, Service life of equipment.

UNIT-III WEAR AND CORROSION AND THEIR PREVENTION: **9**

Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure greasegun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication,

vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT-IV: FAULT TRACING: **9**

Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault-finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like,

i. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT-V PERIODIC AND PREVENTIVE MAINTENANCE: **9**

Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

SUGGESTED READINGS:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, McGraw Hill Publication.

24MESTOE03 **OPERATIONS RESEARCH** **3H:3C**

Instruction Hours/ Week: L:3 T:0 P:0 Marks: Internal–40, External–60; Total-100

End Sem. Exam–3 Hrs.

Course Objectives:

The goal of this course is to;

1. Solve linear programming problem and solve using graphical method.
2. Solve LPP using simplex method
3. Solve transportation, assignment problems

Course Outcomes

Upon completion of this course, students will be able to

1. Formulate linear programming problem and solve using graphical method.
2. Solve LPP using simplex method
3. Formulate and solve transportation, assignment problems
4. Solve project management problems
5. Solve scheduling problems

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	-	2	-	1	-	-
CO2	3	2	1	1	-	1	-	-	-	2	-	1	-	-
CO3	3	2	1	-	-	1	-	-	-	2	-	1	2	-
CO4	3	2	1	1	-	1	-	-	-	2	-	1	2	-
CO5	3	2	1	-	-	-	-	-	-	2	-	1	-	-
CO	**3**	**2**	**1**	**0.4**	**-**	**1**	**-**	**-**	**-**	**2**	**-**	**1**	**2**	**-**

UNIT 1 MODEL FORMULATION: **9**

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

UNIT II SIMPLEX METHODS: **9**

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplexmethod - sensitivity analysis - parametric programming

UNIT III NONLINEAR PROGRAMMING **9**

Nonlinear programming problem - Kuhn-Tucker conditions min CO Not flow problem - max flow problem - CPM/PERT

UNIT IV SCHEDULING AND SEQUENCING **9**

Scheduling and sequencing - single server and multiple server models - deterministic inventorymodels - Probabilistic inventory control models - Geometric Programming.

UNIT V PROGRAMMING: **9**

Competitive Models, Single and Multi-Channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

SUGGESTED READINGS:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimization: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

OPEN ELECTIVES **Semester III**

24MESTOE04 CO NOT MANAGEMENT OF ENGINEERING PROJECTS 3H:3C

Instruction Hours/ Week: L:3 T:0 P:0 Marks: Internal–40, External–60; Total-100

End Sem. Exam–3 Hrs.

Course Objectives:

The goal of this course is to;

1. Summarize the CO Noting concepts and their role in decision making
2. Infer the project management concepts and their various aspects in selection
3. Interpret CO Noting concepts with project execution

Course Outcomes

Upon completion of this course, students will be able to

1. Understand the CO Noting concepts and their role in decision making
2. Understand the project management concepts and their various aspects in selection 57
3. Interpret CO Noting concepts with project execution
4. Gain knowledge of CO Noting techniques in service sector and various budgetary controltechniques
5. Become familiar with quantitative techniques in CO Not management

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	-	2	-	1	-	-
CO2	3	2	1	1	-	1	-	-	-	2	-	1	-	-
CO3	3	2	1	-	-	1	-	-	-	2	-	1	2	-
CO4	3	2	1	1	-	1	-	-	-	2	-	1	2	-
CO5	3	2	1	-	-	-	-	-	-	2	-	1	-	-
CO	**3**	**2**	**1**	**0.4**	**-**	**1**	**-**	**-**	**-**	**2**	**-**	**1**	**2**	**-**

UNIT I INTRODUCTION 9

Introduction and Overview of the Strategic CO Not Management Process. CO Not concepts in decision- making; Relevant CO Not, Differential CO Not, Incremental CO Not and Opportunity CO Not. Objectives of a CO Noting System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

UNIT II PROJECT 9

Project: meaning, Different types, why to manage, CO Not overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and non-technical activities. Detailed Engineering activities. Pre project execution main clearances anddocuments Project team: Role of each member. Importance Project site: Data required withsignificance. Project contracts. Types and contents. Project execution Project CO Not control. Bar chartsand Network diagram. Project commissioning: mechanical and process

UNIT III CO NOT BEHAVIOR AND PROFIT PLANNING 9

CO Not Behavior and Profit Planning Marginal CO Noting; Distinction between Marginal CO Noting and Absorption CO Noting; Break-even Analysis, CO Not-Volume-Profit Analysis. Various decision- making problems. Standard CO Noting and Variance Analysis. Pricing strategies: Pareto Analysis.Target CO Noting, Life Cycle CO Noting. CO Noting of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning,

UNIT IV TOTAL QUALITY MANAGEMENT 9

Total Quality Management and Theory of constraints. Activity-Based CO Not Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

UNIT V QUANTITATIVE TECHNIQUES 9

Quantitative techniques for CO Not management, Linear Programming, PERT/CPM,Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

SUGGESTED READINGS:

1. CO Not Accounting a Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & CO Not Accounting
4. Ashish K. Bhattacharya, Principles & Practices of CO Not Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

24MESTOE05 **COMPOSITE MATERIALS** **3H:3C**

Instruction Hours/ Week: L:3 T:0 P:0 Marks: Internal–40, External–60; Total-100
End Sem. Exam–3 Hrs.

Course Objectives:

The goal of this course is to;

1. Summarize the characteristics of composite materials and effect of reinforcement incomposite materials.
2. Identify the various reinforcements used in composite materials.
3. Compare the manufacturing process of metal matrix composites.

Course Outcomes

Upon completion of this course, students will be able to

1. Know the characteristics of composite materials and effect of reinforcement in composite materials.
2. Know the various reinforcements used in composite materials.
3. Understand the manufacturing processes of metal matrix composites.
4. Understand the manufacturing processes of polymer matrix composites.
5. Analyze the strength of composite materials.

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	-	2	-	1	-	-
CO2	3	2	1	1	-	1	-	-	-	2	-	1	-	-
CO3	3	2	1	-	-	1	-	-	-	2	-	1	2	-
CO4	3	2	1	1	-	1	-	-	-	2	-	1	2	-
CO5	3	2	1	-	-	-	-	-	-	2	-	1	-	-
CO	**3**	**2**	**1**	**0.4**	**-**	**1**	**-**	**-**	**-**	**2**	**-**	**1**	**2**	**-**

UNIT–I INTRODUCTION **9**

Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT – II REINFORCEMENTS **9**

Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

UNIT – III MANUFACTURING OF METAL MATRIX COMPOSITES 9

Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

UNIT–IV MANUFACTURING OF POLYMER MATRIX COMPOSITES: **9**

Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and

applications.

UNIT – V STRENGTH: **9**

Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

SUGGESTED READINGS:

1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.

OPEN ELECTIVES **Semester III**

24MESTOE06 **WASTE TO ENERGY** **3H:3C**

Instruction Hours/ Week: L:3 T:0 P:0 Marks: Internal–40, External–60; Total-100

End Sem. Exam–3 Hrs.

Course Objectives:

The goal of this course is to;

1. To introduce the types of wastes used for various production.
2. To assess the biomass pyrolysis process and its applications.
3. To learn types of biomass gasifiers and their operations.

Course Outcomes

Upon completion of this course, students will be able to

1. Identify the types of waste based on its origin and characteristics.
2. Make use of the biomass pyrolysis process to extract chemicals and liquid fuel.
3. Develop the performance of a specific biomass gasification system.
4. Utilize the biomass combustors for generating energy.
5. Apply the principles associated with bioenergy systems and energy management.

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	2	2	-	-	2	-	2	2	2	-
CO2	3	2	1	-	-	2	2	-	-	2	-	2	2	2	-
CO3	3	2	1	-	-	2	2	-	-	2	-	2	2	2	-
CO4	3	2	1	-	-	2	2	-	-	2	-	2	2	2	-
CO5	3	2	1	-	-	2	2	-	-	2	-	2	2	2	-
CO	**3**	**2**	**1**	**-**	**-**	**2**	**2**	-	-	**2**	**-**	**2**	**2**	**2**	-

UNIT-I INTRODUCTION TO ENERGY FROM WASTE **9**

Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

UNIT-II BIOMASS PYROLYSIS **9**

Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods -Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT-III: BIOMASS GASIFICATION: **9**

Gasifiers – Fixed bed system – Downdraft and updraft gasifiers –Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

UNIT-IV BIOMASS COMBUSTION: **9**

Biomass stoves – Improved chullahs, types, some exotic designs, fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNIT-V BIOGAS: **9**

Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

TEXT BOOKS:

1. Waste to Energy: Prospects and Applications, Brijendra Kumar Kashyap, Manoj Kumar Solanki, Springer Nature, 2021.
2. Waste-to-Energy, Marc J. Rogoff, Francois Screve, 3rd Edition, March 2019.
3. Fuel Production from Non-Food Biomass, Barnabas Gikonyo., CRC Press., 2015.
4. Biomass Combustion Science, Technology And Engineering, Woodhead Publishing, 2013.

24MEST311 **IN PLANT TRAINING** **0H:2C**

Instruction Hours/ Week: L:0 T:0 P0: Marks: Internal–0, External–0; Total-100*

COURSE OBJECTIVES:

The goal of this course is to;

1. In plant training will provide students the feel of the actual working environment.
2. It will help in gaining practical knowledge and skills
3. Motivate, develop and build their confidence.

COURSE OUTCOMES:

Upon completion of this course, students will be able to

1. To train the students in the field work so as to have a firsthand knowledge of practical problems related to Structural Engineering in carrying out engineering tasks.
2. To develop skills in facing and solving the field problems
3. They are trained in tackling a practical field/industry orientated problem related to Structural Engineering.

SYLLABORATORYUS:

The students individually undertake training in reputed Industries during the summer vacation for aspecified period of four weeks. At the end of training, a detailed report on the work done should besubmitted within ten days from the commencement of the semester. The students will be evaluatedthrough a viva-voce examination by a team of internal staff

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	2	3	2	1	2	-	1	-	-	2	-	-
CO2	-	-	-	2	3	2	1	2	-	1	-	-	2	-	-
CO3	-	-	-	2	3	2	1	2	-	1	-	-	2	-	-
CO4	-	-	-	2	3	2	1	2	-	1	-	-	2	-	-
CO5	-	-	-	2	3	2	1	2	-	1	-	-	2	-	-
CO	-	-	-	2	3	2	1	2	-	1	-	-	2	-	-

Semester III

24MEST391 **PROJECT WORK – PHASE-I** **20H:10C**

Instruction Hours/ Week: L:0 T:0 P:20 Marks: Internal–40 , External–60; Total-100

COURSE OBJECTIVES:

To impart knowledge on

1. Developing analytical skills of the students to address any specific structural relatedproblems.
2. Select suitable experimental method to solve the structural engineering problems.
3. Execution of the project using suitable techniques

COURSE OUTCOMES:

Upon completion of this course, students will be able to

1. Identify the problem by analyzing the gap through literature survey
2. Conduct the experimental work to solve structural engineering problems
3. Validate the experimental results using simulation models
4. Write a technical report related to selected topic
5. Present outcome of the study with the help of ppt.

SYLLABORATORYUS:

The student individually works on a specific topic approved by faculty member who is familiar in this area of interest. The student can select any topic which is relevant to his/her specialization of the programme. The topic may be experimental or analytical or case studies. At the end of the semester,a detailed report on the work done should be submitted which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology forcarrying out the work. The students will be evaluated through a viva-voce examination by a panel of examiners including one external examiner.

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	2	3	2	1	2	-	1	-	-	2	-	-
CO2	-	-	-	2	3	2	1	2	-	1	-	-	2	-	-
CO3	-	-	-	2	3	2	1	2	-	1	-	-	2	-	-
CO4	-	-	-	2	3	2	1	2	-	1	-	-	2	-	-
CO5	-	-	-	2	3	2	1	2	-	1	-	-	2	-	-
CO	-	-	-	2	3	2	1	2	-	1	-	-	2	-	-

24MEST491 **PROJECT WORK – PHASE-II** **32H:16C**

Instruction Hours/ Week : L:0 T:0 P:32 Marks: Internal–120 , External–180; Total-300

COURSE OBJECTIVES:

To impart knowledge on

1. Developing analytical skills of the students to address any specific structural related problems.
2. Select suitable experimental method to solve the structural engineering problems.
3. Execution of the project using suitable techniques

COURSE OUTCOMES:

Upon completion of this course, students will be able to

1. Identify the problem by analyzing the gap through literature survey
2. Conduct the experimental work to solve structural engineering problems
3. Validate the experimental results using simulation models
4. Examine a technical report related to selected topic
5. Present outcome of the study with the help of ppt.

SYLLABORATORYUS:

The student should continue the phase I work on the selected topic as per the formulated methodology. At the end of the semester, after completing the work to the satisfaction of thesupervisor and review committee, a detailed report should be prepared and submitted to the head of the department. The students will be evaluated through based on the report and the viva-voceexamination by a panel of examiners including one external examiner.

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	2	3	2	1	2	-	1	-	-	2	-	-
CO2	-	-	-	2	3	2	1	2	-	1	-	-	2	-	-
CO3	-	-	-	2	3	2	1	2	-	1	-	-	2	-	-
CO4	-	-	-	2	3	2	1	2	-	1	-	-	2	-	-
CO5	-	-	-	2	3	2	1	2	-	1	-	-	2	-	-
CO	-	-	-	2	3	2	1	2	-	1	-	-	2	-	-