

FACULTY OF ENGINEERING

**DEGREE OF MASTER OF ENGINEERING
IN
STRUCTURAL ENGINEERING**

DEPARTMENT OF CIVIL ENGINEERING

(FULL TIME PROGRAMME)

REGULATIONS,
CURRICULUM
(2022-2023)



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)

Pollachi Main Road, Eachanari Post, Coimbatore – 641 021, Tamil Nadu, India.

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FACULTY OF ENGINEERING POST-GRADUATE PROGRAMME (M.E. – STRUCTURAL ENGINEERING) REGULAR PROGRAMME

**REGULATIONS
(2022)**

KARPAGAM ACADEMY OF HIGHER EDUCATION

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FACULTY OF ENGINEERING

POST-GRADUATE PROGRAMME

REGULAR PROGRAMME

REGULATIONS 2022

CHOICE BASED CREDIT SYSTEM

These Regulations are effective from the academic year 2022-23 and applicable to the students admitted to M. E. / M. Tech. Programmes during the academic year 2022-23 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 of any Karpagam academy of Higher Education 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 are 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 the Dean.

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 in order 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 scheme of 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.	Paper Presentation *	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. The Paper Presentation should be evaluated by a committee and marks should be entered in Automation software on or before 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 =18Marks).
Part- B	Question 10 to 12 will be of either-or type, covering two units of the syllabus. Each Question may have 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 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	Part A will be online Examination. 20 Objective type Questions. Covering all the 5 units. 20*1= 20 Marks (Online Examination)
Part- B	21 to 25 Two Mark Questions, uniformly covering the Five units of the syllabus. All the 5 Questions are to be answered. (5 *2= 10Marks).
Part- C	Question 26 to 30 will be of either-or type, covering Five units of the syllabus. Each Question may have subdivision. (5*14=70 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**.

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

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 declared to 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 of study (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 Notwithstanding 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.

18. PROVISION FOR AUTHORISED BREAK OF STUDY

18.1 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.

18.2 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 do additional courses, if any as per the curriculum and regulations in force at that period of time.

18.3 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.

18.4 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.

18.5 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
2.	M.E. Water Resources and Environmental Engineering
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING	
3.	M.E. Power Systems Engineering (Full Time)
4.	M.E. Power Systems Engineering (Part Time)

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
2	M. E. Water Resources and Environmental Engineering	B.E./B. Tech. – Civil Engineering B.E./B.Tech. – Environmental Engineering
3	M. E. Power Systems Engineering	B. E./B. Tech. – Electrical Engineering/ Electrical and Electronics

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DEPARTMENT OF CIVIL ENGINEERING

M.E. STRUCTURAL ENGINEERING (FULL TIME)

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

- I. To prepare students to excel in research and to succeed in Structural engineering profession through global, rigorous post graduate education
- II. To provide students with a solid foundation in mathematical, scientific and engineering fundamentals required to solve structural engineering problems
- III. To train students with good scientific and engineering knowledge so as to comprehend, analyze, design, and create novel products and solutions for the real-life problems
- IV. To inculcate students in professional and ethical attitude, effective communication skills, teamwork skills, multidisciplinary approach, and an ability to relate structural engineering issues to broader social context.
- V. To provide student with an academic environment aware of excellence, leadership, written ethical codes and guidelines, and the life-long learning needed for a successful professional career

PROGRAMME OUTCOMES (POs):

On successful completion of the programme,

- a. Graduates will demonstrate knowledge of mathematics, science and engineering.
- b. Graduates will demonstrate an ability to design a system, component or process as per needs and specifications.
- c. Graduates will demonstrate an ability to visualize and work on laboratory and multidisciplinary tasks.
- d. Graduate will demonstrate skills to use modern engineering tools, software and equipment to analyze problems.
- e. Graduates will demonstrate knowledge of professional and ethical responsibilities.
- f. Graduate will be able to communicate effectively in both verbal and written form.
- g. Graduate will develop confidence for self education and ability for life-long learning.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

- h. Graduates will demonstrate an ability to identify, formulate and solve engineering problems.
- i. Graduate will demonstrate an ability to design and conduct experiments, analyze and interpret data.
- j. Graduate will show the understanding of impact of engineering solutions on the society and also will be aware of contemporary issues.

MAPPING:

PEOs	a	b	c	d	e	f	g	h	i	j
I	√			√			√	√	√	
II		√			√				√	√
III			√		√	√		√	√	
IV	√			√			√			√
V		√	√			√			√	√

PO i) – High, PO j)- Medium, PO a)- Low

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DEPARTMENT OF CIVIL ENGINEERING

M.E. STRUCTURAL ENGINEERING (FULL TIME) COURSE OF STUDY AND SCHEME OF EXAMINATIONS (2022 BATCH ONWARDS)

SUB CODE	TITLE OF THE COURSE	OBJECTIVES AND OUT COMES		INSTRUCTI ON HOURS/WE EK			CREDITS	MAXIMUM MARKS		
		PEO’s	PO’s	L	T	P		CIA	ESE	TOTAL
								40	60	100
SEMESTER - I										
22MEST101	Advanced Structural Analysis	I,II,III	a,b,h	3	0	0	3	40	60	100
22MEST102	Advanced Solid Mechanics	I,II,III	a,b,d,h,j	3	0	0	3	40	60	100
22MEST103	Research Methodology and Statistics	IV,V	e,f,g,h	2	0	0	2	40	60	100
22MEST1E0-	1. Theory of Thin Plates and Shells 2. Theory and Applications of Concrete Composites 3. Theory of Structural Stability	I,II,III	a,b,f,h,j	3	0	0	3	40	60	100
22MEST1E0-	4. Analytical and Numerical Methods for Structural Engineering 5. Structural Health Monitoring 6. Structural Optimization	I,II,IV	a,b,c, h,i	3	0	0	3	40	60	100
22MEST111	Structural Design Lab	I,II	b,c,d,g,j	0	0	2	2	40	60	100
22MEST112	Advanced Concrete Lab	I,II	b,c,d,g,j	0	0	2	2	40	60	100
Total				14	0	4	18	280	420	700
SEMESTER - II										
22MEST201	FEM in Structural Engineering	I,II,III	c,d	3	0	0	3	40	60	100
22MEST202	Structural Dynamics	II,III	e,f,i	3	0	0	3	40	60	100
22MEST2E0	1. Advanced Steel Design 2. Design of Formwork 3. Design of High-Rise Structures 4. Design of Masonrv Structures	II,III,I V	b,f,i,j	3	0	0	3	40	60	100

22MEST2E0	5. Design of Advanced Concrete Structures 6. Advanced Design of Foundation Engineering 7. Soil Structure Interaction 8. Design of Industrial Structure	II,III,I V	a,f,j	3	0	0	3	40	60	100
22MEST211	Model Testing Lab	II,III	b,j	0	0	2	2	40	60	100
22MEST212	Numerical Analysis Lab	II	d,e,i	0	0	2	2	40	60	100
22MEST213	Design Project	IV	a,b,h	0	0	4	2	40	60	100*
Total				12	0	8	18	280	420	700
SEMESTER - III										
22MEST3E0	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,III,I V	a,b,f,j	3	0	0	3	40	60	100
22MESTOE0	1. Business Analytics 2. Industrial Safety 3. Operations Research 4. Cost Management of Engineering Projects 5. Composite Materials 6. Waste to Energy	IV,V	a,b,c, h	3	0	0	3	40	60	100
22MEST311	In-plant Training	III	c,d,e,f, g,h	0	0	0	2	40	60	100*
22MEST391	Project Work – Phase I	III	c,d,e,f, g,h	0	0	20	10	40	60	100*
Total				6	0	20	18	160	240	400
SEMESTER - IV										
22MEST491	Project Work – Phase II	III	c,d,e,f, g,h	0	0	32	16	120	180	300
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

****-- Skill Development**

****-- Employability**

****--Entrepreneurship**

COURSE OBJECTIVES:

1. Understanding the concept of analyzing the structural members
2. To study the concept of stiffness method applied to large frames
3. To develop an understanding on applications analysis in real time approach.
4. To arrive the solution for boundary value problems
5. To study the behavior of Linear elements

COURSE OUTCOMES: At the end of the course,

1. Students will be in a position to arrive structural approach for the influencing coefficients
2. Students will be able to analyze the skeleton structures using stiffness analysis code
3. students will be able to understand the applications analysis in real time approach
4. They will be able to solve boundary value problems
5. Students will know about the behavior of Linear elements

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 One-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. Matrix Analysis of Framed Structures, Weaver and Gere, CBS publishers and distributors pvt ltd (April 18, 2018)
2. The Finite Element Method, Lewis P. E. and Ward J. P., Addison-Wesley Publication Co, 2017
3. Computer Methods in Structural Analysis, Meek J. L., E and FN, Span Publication, 2010
4. The Finite Element Method, Desai and Able, CBS Publication, 2005
5. nptel.ac.in/courses/105106050/
6. Advanced analysis and design of spatial structures, J.Y.Richard Liew N.M.Punniyakotty N.E.Shanmugam

COURSE OBJECTIVES:

1. To learn the principles of and relations of stress and strain
2. To understand the concept of stress and strain analysis
3. To develop an understanding on equations of elasticity
4. To study the basics in torsion of prismatic bars
5. To understand the concept of plastic deformation

COURSE OUTCOMES: At the end of the course,

1. Students will be able to understand the basic concepts of stress and strain
2. Students will be able to solve simple problems of elasticity and plasticity
3. Students will be familiar to the concept of elastic analysis of plane stress and plane strain problems
4. Students will know about the torsion of prismatic bars
5. They will also have sufficient knowledge in various theories of failure and plasticity

UNIT I INTRODUCTION TO ELASTICITY**9**

Displacement, Strain and Stress Fields, Constitutive Relations, Cartesian Tensors and Equations of Elasticity.

UNIT II STRAIN AND STRESS FIELD**9**

Elementary Concept of Strain, Strain 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, Co-axiality of the Principal Directions. Plane Stress and Plane Strain Problems, Airy's stress Function, Two-Dimensional Problems in Polar Coordinates.

UNIT IV TORSION OF PRISMATIC BARS**9**

Saint Venant's Method, Prandtl's Membrane Analogy, Torsion of Rectangular Bar, Torsion of Thin Tubes.

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, Isotropic Hardening.

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.
6. Solid Mechanics, Kazimi S. M. A., Tata McGraw Hill, 2001.
7. nptel.ac.in/courses/105106049
8. Vision of the Future of Solid Mechanics by Zdeněk P. Bažant

COURSE OBJECTIVES:

1. Understanding that when IPR would take important place in growth of individuals & nation,
2. To impart knowledge and skills required for Problem formulation, analysis and solutions.
3. To provide a thorough knowledge in Technical paper writing / presentation without violating professional ethics
4. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D.
5. To analyze and interpret data using statistical analysis

COURSE OUTCOMES:

At the end of the course, the students have the

1. Ability to formulate research problem
2. Ability to carry out research analysis
3. Ability to follow research ethics
4. Ability to understand about IPR and filing patents in R & D.
5. Apply statistical and other research tools to analyze and interpret data

UNIT I INTRODUCTION**9**

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research 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 of Biological 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 , “Industrial Design”, McGraw Hill.
5. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “Intellectual Property in New Technological Age”, 2016.
6. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008
7. Devore, J.L., Probability and statistics for Engineering and the Sciences, Cengage Learning, ebook, 8th edition, 2010

COURSE OBJECTIVES:

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.
4. To use membrane theory to analyze the solution of shells
5. To get introduced to various plate theories, governing equations for bending of plates and shells with various boundary conditions.

COURSE OUTCOMES:

At the end of the course, students will be able to

1. At the end of the course, the students will be able to
2. Familiarize about various plate theories.
3. Analyze rectangular plates using Navier's solution, Levy's solution.
4. Analyze circular plates for the given boundary conditions.
5. Analyze the shells using membrane theory.
6. Analyze different types of plates and shells under different boundary connections by various classical methods and approximate methods.

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. www.nptel.ac.in
6. Non-linear vibrations of shell-type structures: a review with bibliography, F Moussaoui, R Benamar - Journal of sound and vibration, 2002 – Elsevier

22MEST1E02 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:

To impart knowledge on

1. Classify the composite materials.
2. Understand the behavior of materials subjected to loads.
3. Recommend cement composites as alternative to conventional materials.
4. Define the mechanical behavior under combined stresses.
5. The applications of composites.
6. The behavior of composite materials and to investigate the failure and fracture characteristics

COURSE OUTCOMES:

At the end of the course, the students will be able to

1. Formulate constitutive behavior of composite materials – Ferrocement, SIFCON and Fibre Reinforced Concrete - by understanding their strain- stress behavior.
2. Classify the materials as per orthotropic and anisotropic behavior.
3. Estimate strain constants using theories applicable to composite materials.
4. Suggest cement composites as an alternative to traditional materials.
5. Explain the various failure criteria and fracture mechanics of composites
6. Explain the various types of composites and its constituents

UNIT I INTRODUCTION:**9**

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

UNIT II MECHANICAL BEHAVIOUR:**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 behaviour, Constitutive relationship, Elastic Constants.

UNIT V ANALYSIS AND DESIGN OF CEMENT COMPOSITE STRUCTURAL ELEMENTS**9**

Ferro cement, SIFCON and Fibre Reinforced Concrete.

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, 1993

Instruction Hours/ Week: L:3 T:0 P:0

Marks: Internal-40, External-60; Total-100

End Sem. Exam-3 Hrs.

COURSE OBJECTIVES:

To impart knowledge on

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.
4. To enumerate the lateral buckling, lateral torsional buckling and flexural torsional buckling of beams.
5. To study various numerical techniques and energy methods for buckling of thin plates.
6. To study the concept of buckling and analysis of structural element

COURSE OUTCOMES:

At the end of the course, the 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 using classical and stiffness methods.
4. Calculate lateral buckling, torsional buckling, flexural torsional buckling of various beams and non-circular sections.
5. Evaluate buckling of thin plates using energy methods and various numerical techniques.
6. Analyze the inelastic buckling of columns and plates

UNIT I	CRITERIA FOR DESIGN OF STRUCTURES	9
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Stability, Strength, and Stiffness, Classical Concept of Stability of Discrete and Continuous Systems, Linear and nonlinear behavior.

UNIT II STABILITY OF COLUMNS: 9

Axial and Flexural Buckling, Lateral Bracing of Columns, Combined Axial, Flexural and Torsion Buckling.

UNIT III STABILITY OF FRAMES 9

Member Buckling versus Global Buckling, Slenderness Ratio of Frame Members.

UNIT IV	STABILITY OF BEAM AND PLATES	9
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Lateral torsion buckling, axial flexural buckling, shear flexural buckling, buckling under combined loads.

UNIT V INELASTIC BUCKLING 9

Introduction to Inelastic Buckling, Dynamic Stability.

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, WF Chen, EM Lui
4. A lemma in the theory of structural stability of differential equations, P Hartman - Proceedings of the American Mathematical Society, Structural stability on two-dimensional manifolds, MM Peixoto
5. Statistical aspects in the theory of structural stability, VV Bolotin - Dynamic stability of structures

**22MEST1E04 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:

To impart knowledge on

- 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 serve them well towards tackling various problems in the discipline.
- 3.Introduce numerical methods to solve engineering problems, using numerical methods and computer programming.
- 4.Understand the fundamentals of numerical methods/algorithms to solve systems of different mathematical equations (e.g. linear/ non-linear algebraic equations) will be introduced.
- 5.Develop the use of matrix algebra techniques that is needed by engineers for practical applications
- 6.To solve the mathematical problem by using computer algorithms.

COURSE OUTCOMES:

At the end of the course, the students will be able to

1. To solve ordinary and partial differential equations in structural mechanics using numerical methods.
2. Solve engineering problems involving Linear and non-linear equations.
3. Hands-on experience will be provided to apply these computer programs to solve problems in different areas of chemical engineering e.g. fluid flow, heat and mass transfer, etc.
4. Acquire skills in handling situations involving linear/ non-linear algebraic equations, ordinary /partial differential equations
5. Solving actual chemical engineering problems through computer programming and coding.
6. To write a program to solve a mathematical problem.

UNIT I FUNDAMENTALS OF NUMERICAL METHODS 9

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

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

Instruction Hours/ Week: L:3 T:0 P:0

Marks: Internal-40, External-60; Total-100

End Sem. Exam-3 Hrs.

COURSE OBJECTIVES:

To impart knowledge on

1. To access the errors in measurement and learn the principles of measurement using various electronic and physical testing machines.
2. To familiarize with vibrating measuring instruments and digital and electronic display using different sensors.
3. To access the wind flow measurement and pressure measurement and scale different models using direct model study and indirect model study.
4. To measure the distress in concrete structures using various electrical and electronic machineries.
5. To test various civil engineering structures using Non-Destructive Testing methodologies.
6. Diagnosis the distress in the structure understanding the causes and factors.

COURSE OUTCOMES:

At the end of the course, the students will be able to

1. Perform force and strain measurement by selecting appropriate tools and technique.
2. Use various vibration measuring instruments and analyze the structures using digital display unit.
3. Apply model analysis as an effective experimental technique.
4. Measure distress in the structures using various electronic equipment.
5. Carry out load test on structures and perform advanced NDT methods in accessing the quality of structures
6. They will be able to analyze the structure by non-destructive testing methods and model analysis.

UNIT I STRUCTURAL HEALTH

9

Factors affecting Health of Structures, Causes of Distress, Regular Maintenance.

UNIT II STRUCTURAL HEALTH MONITORING

9

Concepts, Various Measures, Structural Safety in Alteration.

UNIT III STRUCTURAL AUDIT

9

Assessment of Health of Structure, Collapse and Investigation, Investigation Management, SHM Procedures.

UNIT IV STATIC AND DYNAMIC FIELD TESTING

9

Types of Static Tests, Simulation and Loading Methods, sensor systems and hardware requirements, Static Response Measurement. Types of Dynamic Field Test, Stress History Data, Dynamic Response Methods, Hardware for Remote Data Acquisition Systems, Remote Structural Health Monitoring.

UNIT V INTRODUCTION TO REPAIRS AND REHABILITATIONS OF STRUCTURES

9

Case Studies (Site Visits), piezo– electric materials and other smart materials, electro–mechanical impedance (EMI) technique, adaptations of EMI technique.

SUGGESTED READINGS:

1. Structural Health Monitoring, Daniel Balageas, Claus Peter Fritzen, Alfredo Güemes, John Wiley and Sons, 2006.
2. Health Monitoring of Structural Materials and Components Methods with Applications, Douglas E Adams, John Wiley and Sons, 2007.
3. Structural Health Monitoring and Intelligent Infrastructure, Vol1, J. P. Ou, H. Li and Z. D. Duan, Taylor and Francis Group, London, UK, 2006.
4. Structural Health Monitoring with Wafer Active Sensors, Victor Giurgutiu, Academic Press Inc, 2007.
5. Health monitoring of civil infrastructure, PC Chang, A Flatau, SC Liu
6. Structural health monitoring in mainland China: review and future trends, J Ou, H Li –
7. Structural Health Monitoring Vibration based condition monitoring: a review, EP Carden, P Fanning
8. nptel.ac.in/courses/114106035/36
9. nptel.ac.in/syllabus/syllabus_pdf/112104160.pdf
10. nptel.ac.in/courses/112104160/pdf_lectures/lecture13.pdf

COURSE OBJECTIVES:

To impart knowledge on

1. To introduce the fundamentals of optimization concepts and their applications in the structural engineering field.
2. To study the linear programming methods of the optimization.
3. To know the constrained and unconstrained variables of the various structural engineering problems.
4. To know the various methods of optimality involving geometric and dynamic programming.
5. To have an exposure on the various advanced techniques in the structural optimization.
6. Variational principle for optimization

COURSE OUTCOMES:

At the end of the course, the students will be able to

1. Apply the basic ideas in optimization to make the structures as lightly as possible.
2. Use linear programming techniques 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 Artificial Neural Networks in structures.
6. Apply optimization techniques to structural steel and concrete members.

UNIT I INTRODUCTION**9**

Simultaneous Failure Mode and Design, Classical External Problems.

UNIT II CALCULUS OF VARIATION:**9**

Variational Principles with Constraints

UNIT III LINEAR PROGRAMMING**9**

Integer Programming, Nonlinear Programming, Dynamic Programming, Geometric Programming and Stochastic Programming.

UNIT IV APPLICATIONS**9**

Structural Steel and Concrete Members, Trusses and Frames.

UNIT V DESIGN**9**

Frequency Constraint, Design of Layouts.

SUGGESTED READINGS:

1. Elements of Structural Optimization, Haftka, Raphael T., Gürdal, Zafer, Springer, 2014
2. Variational methods for Structural optimization, Cherkasov Andrej, Springer, 2012
3. Structural optimization using sensitivity analysis and a level-set method, G Allaire, F Jouve, AM Toader - Journal of computational physics

4. A new structural optimization method based on the harmony search algorithm, KS Lee, ZW Geem - Computers & structures,
5. Mixed variable structural optimization using firefly algorithm, AH Gandomi, XS Yang, AH Alavi - Computers & Structures
6. Reliability-based structural optimization using neural networks and Monte Carlo, simulation, M Papadrakakis, ND Lagaros
7. nptel.ac.in/courses/112108211/25
8. nptel.ac.in/syllabus/syllabus_pdf/112108094.pdf
9. www.nptel.ac.in/syllabus/105108127/

COURSE OBJECTIVES:

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.
4. A detailed report on the work done shall be submitted by individual student in the form of a report and presentation
5. To Prepare the complete structural drawings using computer software

COURSE OUTCOMES:

At the end of the course, students will be able to

1. Plan a layout of a structure
2. Calculate loads using IS codes and various computational tools
3. Analyze the structure for various loads and load combination according to the relevant IS codes
4. Design and detail structures using computer software/tools and check the correctness using manual approximate methods
5. Prepare the complete structural drawings using computer software
6. Apply the concept of design and detailing

LIST OF EXPERIMENTS

Design and detailed drawing of complete G+ 3 structures by individual student using latest relevant IS codes.

SUGGESTED READINGS:

1. Manual for Detailing of Steel Structures by S. Kanthimathinathan, 24 Nov 2014

COURSE OBJECTIVES:

1. To perform advanced laboratory experiments that emphasizes the structure- property relationship, 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 testing based on specification
4. To study the behavior of beams

COURSE OUTCOMES:

At the end of the course, the students will be able to

1. Illustrate the behavior of reinforced concrete and steel beam by carrying out experimental study. Explain the dynamic behavior of cantilever steel beam.
2. Proportion the concrete mix to archive desired strength and quality of concrete.
3. Design high grade concrete and study the parameters affecting its performance.
4. Conduct Non-Destructive Tests on existing concrete structures.
5. Know the permeability characteristics of concrete.

LIST OF EXPERIMENTS / ASSIGNMENTS:

1. Study of stress-strain curve of high strength concrete, Correlation between cube strength, cylinder strength, split tensile strength and modulus of rupture.
2. Effect of cyclic loading on steel.
3. Non-Destructive testing of existing concrete members.
4. Behavior of Beams under flexure, Shear and Torsion.

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.

COURSE OBJECTIVES:

To impart knowledge on

1. To acquire knowledge on formulation of boundary value problems.
2. To gain knowledge on stress analysis.
3. To be familiar with meshing using various mesh generation methods.
4. To understand dynamic analysis.
5. To understand the behavior of plate and shell elements.
6. Use Finite Element Method for structural analysis.

COURSE OUTCOMES:

At the end of the course, the students will be able to

1. Formulate boundary value problems of finite element method.
2. Discretize the structure and determine interpolation functions using various elements.
3. Apply direct stiffness method as FEA tool.
4. Analyze complex structural problems using iso - parametric and axis-symmetric formulations.
5. Perform FEA by standard software.
6. Solve continuum problems using finite element analysis

UNIT I INTRODUCTION**9**

History and Applications. Spring and Bar Elements, Minimum Potential Energy Principle, Direct Stiffness Method, Nodal Equilibrium equations, Assembly of Global Stiffness Matrix, Element Strain and Stress.

UNIT II BEAM ELEMENTS**9**

Flexure Element, Element Stiffness Matrix, Element Load Vector.

UNIT III METHOD OF WEIGHTED RESIDUALS**9**

Galerkin Finite Element Method, Application to Structural Elements, Interpolation Functions, Compatibility and Completeness Requirements, Polynomial Forms, Applications.

UNIT IV TYPES**9**

Triangular Elements, Rectangular Elements, Three-Dimensional Elements, Isoparametric Formulation, Axis-Symmetric Elements, Numerical Integration, Gaussian Quadrature.

UNIT V APPLICATION AND COMPUTATION TECHNIQUE**9**

Plane Stress, CST Element, Plane Strain Rectangular Element, Isoparametric Formulation of the Plane Quadrilateral Element, Axi-Symmetric Stress Analysis, Strain and Stress Computations. Computer techniques of FEM procedure, Pre-Processing, Solution, Post-Processing, Use of Commercial FEA Software.

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 Behaviour 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
7. Finite Element Modelling Of Structures Including Piezoelectric Active Devices Jaehwan Kim ,Vasundara V. Varadan , Vijay K. Varadan

COURSE OBJECTIVES:

To impart knowledge on

1. To understand the response of structural systems to time-varying dynamic loads and displacements.
2. To learn the behavior and response of linear and non-linear two degree of freedom structures.
3. To study the behavior and response of MDOF structures with various dynamic loading.
4. To impart knowledge on dynamic analysis of continuous systems.
5. To get introduced to advanced topics in dynamics.
6. To expose the students the principles and methods of dynamic analysis of structures and to prepare them for designing the structures for wind, earthquake and other dynamic loads.

COURSE OUTCOMES:

At the end of the course, the students will be able to

1. Evaluate the response of structural systems to dynamic loads and displacements.
2. Analyze the behavior of linear and non-linear SDOF and MDOF structures with various dynamic loading.
3. Analyze the response of MDOF structures with various dynamic loading.
4. Analyze the continuous system subjected to dynamic loading.
5. Analyze the dynamic effects due to wind load vibration caused by traffic, blasting and pile driving.
6. Design the structures subjected to dynamic loads

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.

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
6. nptel.ac.in/courses/105101006/
7. https://onlinecourses.nptel.ac.in/noc16_ce08

COURSE OBJECTIVES:

To impart knowledge on

1. To be thorough with the design of industrial components such as purlins, girts, rafter, tie runner, side runner, Eaves strut, truss members and vierendeel girder.
2. To get accustomed to various connections such as welded, riveted and seated connections (Unstiffened and Stiffened connections).
3. To focus on the study and design of various steel towers and steel chimneys.
4. To study the plastic analysis of steel structures.
5. To study the design concepts of light gauge steel structures
6. To design steel structures/ components by different design processes.

COURSE OUTCOMES:

At the end of the course, the students will be able to

1. Design various components of industrial structure such as purlins, girts, tie runner, side runner and vierendeel girder.
2. Design different types of steel connections and joints.
3. Design high rise steel structures subjected to wind load.
4. Apply plasticity approach in steel design.
5. Perform design of light gauge steel structures.
6. Analyze and design beams and columns for stability, strength, and drift.

UNIT I PROPERTIES OF STEEL**9**

Mechanical Properties, Hysteresis, Ductility. Hot Rolled Sections: compactness and non-compactness, slenderness, residual stresses.

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 METHOD OF DESIGNS**9**

Allowable Stress Design, Plastic Design, Load and Resistance Factor Design;

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 CONNECTIONS**9**

Welded, Bolted, Location Beam Column, Column Foundation, Splices.

SUGGESTED READINGS:

1. Design of Steel Structures - Vol. II, Ramchandra. Standard Book House, Delhi, 2010
2. Design of Steel Structures - Arya A. S., Ajmani J. L., Nemchand and Bros., Roorkee, 2014.
3. IS 800: 2007 – General Construction in Steel - Code of Practice, BIS, 2007.
4. SP – 6 - Handbook of Structural Steel Detailing, BIS, 1987
5. nptel.ac.in/courses/IIT-MADRAS/Design_Steel_Structures_II/index.php
6. nptel.ac.in/downloads/105106113/
7. Advanced analysis of steel building frames, M.JClarke R.QBridge G.JHancock N.STrahair
8. Advanced analysis for structural steel building design, Wai Fah Chen
9. Steel foam for structures: A review of applications, manufacturing and material properties, B.H. Smith | S. Szyniszewski | J.F. Hajjar | B.W. Schafer | S.R. Arwade
10. Strengthening of steel structures with fiber-reinforced polymer composites, J.G. Teng | T.Yu | D. Fernando

COURSE OBJECTIVES:

1. To impart knowledge on formwork materials
2. Design the form work for Beams, Slabs, columns, Walls and Foundations.
3. Design the form work for Special Structures.
4. Understand the working of flying formwork.
5. Judge the formwork failures through case studies.

COURSE OUTCOMES:

At the end of the course, students will be able to

1. Explain materials and behavior of formwork
2. Discuss the design of foundation, wall and column formwork
3. Describe the design the formwork for beam, slab, bridges and special structures
4. Demonstrate the design of Flying Formwork slipform techniques
5. Discuss the design of formwork for supports – Scaffolds and precast concrete
6. Select proper formwork, accessories and material.

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, Slab 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 Management Issues –Pre- and Post-Award.

UNIT V FORMWORK FAILURES 9

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

SUGGESTED READINGS:

1. Formwork for Concrete Structures, Peurify, Mc Graw Hill India, 2015.
2. Formwork for Concrete Structures, Kumar NeerajJha, Tata McGraw Hill Education, 2012.
3. IS 14687: 1999, False workfor Concrete Structures - Guidelines, BIS.
4. nptel.ac.in/courses/105103093/pdf/concrete_uc.pdf
5. nptel.ac.in/courses/105105104/1

COURSE OBJECTIVES:

To impart knowledge on

1. To introduce various aspects of planning of tall buildings and know about different types of loads.
2. To introduce various structural systems for high rise buildings with their behaviour and analysis.
3. To impart knowledge about analysis involved in tall structures.
4. To know about sectional shapes and design for differential movement, creep and shrinkage effects.
5. To impart knowledge about stability analysis of various systems and to know about advanced topics.
6. To Analyze, design and detail the tall buildings subjected to different loading conditions using relevant codes.

COURSE OUTCOMES:

At the end of the course, the 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.
6. Analyze, design and detail Transmission/ TV tower, Mast and Trestles with different loading conditions.

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 soil strata.

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. Fire fighting 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., SouthAsian 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.
5. nptel.ac.in/courses/105106113/3_multi_storey/

COURSE OBJECTIVES:

To impart knowledge on

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.
4. Introduce the concepts of Prestressed masonry.
5. Apply elastic and inelastic analysis methods to predict masonry behavior under failure.
6. Analysis of Reinforced Masonry Members.

COURSE OUTCOMES:

At the end of the course, the students will be able to

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

UNIT I INTRODUCTION**9**

Historical Perspective, Masonry Materials, Masonry Design Approaches, Overview of Load Conditions, Compression Behaviour of Masonry, Masonry Wall Configurations, Distribution of Lateral 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.
3. nptel.ac.in/syllabus/105102088/
4. nptel.ac.in/courses/105105110/pdf/m4106.pdf

COURSE OBJECTIVES:

To impart knowledge on

1. To understand the basic design concepts based on limit states.
2. To gain knowledge in designing special concrete structures such as grid floor, deep beam, slender column and corbel.
3. To be familiar with the design concept of yield line theory and designing flat slabs.
4. To understand plastic analysis and design of concrete structures.
5. To get familiar with the concepts like fire resistance of concrete, quality control at site and ductility
6. Explain the concepts of ductile detailing of R.C. members as per IS Codes

COURSE OUTCOMES:

At the end of the course, the students will be able to

1. Design structural elements for serviceability as per IS code.
2. Design RC special elements like slender columns, deep beams and corbels.
3. Design flat slab and apply yield line theory.
4. Adapt plastic design concept as per codal provisions.
5. Explain the practical issues in adapting detailing as a professional engineer.
6. Analyse the special structures by understanding their behaviour.

UNIT I INTRODUCTION AND DESIGN PHILOSOPHY**9**

Design philosophy, Modeling of Loads, Material Characteristics.

UNIT II ADVANCE CONCRETE DESIGN IN RC BEAM**9**

Stability Design, Pure, Flexural and Lateral, Design of Beam, Reinforced Concrete P-M, M-phi Relationships, Strut-and- Tie Method, Design of Deep Beam and Corbel

UNIT III SPECIAL STRUCTURES**9**

Types of power plants – Containment structures - Cooling Towers - Bunkers and Silos - Pipe supporting structures.

UNIT IV DESIGN OF RC COLUMN**9**

Columns, Fatigue Resistant Design, IS code, AISC Standards and Eurocode.

UNIT V SHEAR WALL**9**

Design of Shear Walls, Compression Field Theory for Shear Design, Design for Torsion; IS, ACI and Eurocode.

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, New Delhi, 2008
3. Unified Theory of Concrete Structures, Hsu T. T. C. and Mo Y. L., John Wiley & Sons, 2010.
4. nptel.ac.in/downloads/105105104/
5. https://onlinecourses.nptel.ac.in/noc17_ce23

6. Performance-based design in earthquake engineering: state of development, A Ghobarah Engineering structures
7. Developments and advanced applications of concrete-filled steel tubular (CFST) structures: Members, LH Han, W Li, R Bjorhovde

22MEST2E06 ADVANCED DESIGN OF FOUNDATION 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:

To impart knowledge on

1. Elucidate 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.
4. Exposure to well foundations and tunnels.
5. Introduce the suitability of miscellaneous foundations like cofferdams
6. Decide the suitability of soil strata for different projects.

COURSE OUTCOMES:

At the end of the course, the students will be able to

1. Decide 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.
6. Understand analysis methods for well foundation.

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, Sheet piling and Bracing Systems 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.
3. nptel.ac.in/syllabus/105105039/
4. Structural design of isolated column footings, Fathi Abdrabbo Zaki I. Mahmoud

COURSE OBJECTIVES:

To impart knowledge on to

1. Make students understand soil structure.
2. Understand stress-strain characteristics of soils.
3. The mechanism of failure, the factors that affects the shear strength.
4. Structural behavior with soils.
5. Evaluate soil structure interaction for different types of structure under various conditions of loading and subsoil characteristics.
6. Prepare comprehensive design-oriented computer programs for interaction problems based on theory of sub grade reaction such as beams, footings, rafts etc.

COURSE OUTCOMES:

At the end of the course, the 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. Predict the behavior of the pile under static and dynamic loads.
5. Demonstrate the behavior of the laterally loaded piles.
6. Understand soil structure interaction concept and complexities involved.

UNIT I INTRODUCTION**9**

Critical Study of Conventional Methods of Foundation Design, Nature and Complexities of Soil Structure Interaction.

UNIT II ADVANCED APPLICATION**9**

Application of Advanced Techniques of Analysis such as FEM and Finite Difference Method. Relaxation and Interaction for the Evaluation of Soil Structure Interaction for Different

UNIT III SUBSOIL CHARACTERISTICS**9**

Structure under various Conditions of Loading and Subsoil Characteristics.

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 Characteristics

UNIT V PILE FOUNDATION**9**

Determination of Pile Capacities and Negative Skin Friction, Action of Group of Piles Considering Stress-Strain Characteristics of Real Soils, Anchor Piles and Determination of Pullout Resistance.

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., McGraw Hill 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
6. System identification for evaluating soil–structure interaction effects in buildings from strong motion recordings, JP Stewart, GL Fenves

COURSE OBJECTIVES:

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.
4. To realize the design concepts of power transmission structures.
5. To understand the basic design concepts of chimneys, bunkers and silos and their construction techniques.
6. To study the behavior of members and connections, analysis and design of Industrial buildings and roofs, chimneys. Study the design of with cold formed steel and plastic analysis of structures.

COURSE OUTCOMES:

At the end of the course, the students will be able to

1. Identify the various functional requirements of Industrial structure.
2. Design various structural elements of Industrial structure.
3. Classify and design of power plant structures.
4. Analyze and design power transmission structures.
5. Formulate the concepts in design concepts of chimneys, bunkers and silos
6. Explain the planning and functional requirements of Industrial Structures

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 from factories Act.

UNIT - II INDUSTRIAL BUILDING**9**

Roofs for Industrial Buildings- Steel and RC- folded plates and shell roofs- Gantry Girders- Design of 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
4. nptel.ac.in/courses/105106113/3
5. <https://www.springer.com/us/book/9783319908311>
6. The nature and design of post-industrial organizations, GP Hube
7. Design methodologies: Industrial and educational applications, T Tomiyama, P Gu, Y Jin, D Lutters, C Kind

COURSE OBJECTIVES:

- Understand the response of structures.
- Prepare the models.
- Understand the concept of free and forced vibrations
- To study the vibrations in different elements
- To introduce the solving of mathematical equations and finite element analysis with computational software

COURSE OUTCOMES:

At the end of the 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
6. Analyze the RC beams and slabs

LIST OF EXPERIMENTS:

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

COURSE OBJECTIVES:

1. The objective of this course is to familiarize the students with statistical techniques.
2. 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.
3. To introduce students to numerical methods used to solve engineering problems.
4. Fundamentals of numerical methods/algorithms to solve systems of different mathematical equations (e.g. linear/ non-linear algebraic equations, ordinary /partial differential equations), will be introduced.
5. The course would enable students to write their own computer programs using programming languages like C and software like Excel.
6. To understand procedure-oriented Excel concepts.

COURSE OUTCOMES: At the end of the 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.
6. Student will understand procedure-oriented Excel concepts. Student will be capable of writing C and Excel programs efficiently.

CONTENTS:

1. Find the Roots of 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 Gauss - Seidal Iteration Method.
6. Solve the System of Linear Equations Using Gauss - Jorden Method.
7. Integrate numerically using 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.

Course Objectives:

1. To Identify structural engineering problems reviewing available 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.
4. To work individually on a project involving theoretical and experimental studies related to Civil Engineering.
5. To produce a comprehensive report covering background information, literature Survey, problem statement, Project work details and conclusions.
6. To utilize the creative ability and inference capability.

Course Outcomes

At the end of the course, the student will be able to:

1. Identify structural engineering problems reviewing available 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 studies related to Civil Engineering.
5. Produce a comprehensive report covering background information, literature Survey, problem statement, Project work details and conclusions.
6. Utilize the creative ability and inference capability.

SYLLABUS:

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 available.

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.

Continuous assessment of Design Project at Mid Semester and End Semester will be monitored by the departmental committee.

COURSE OBJECTIVES:

To impart knowledge on

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.
4. To be familiar with the design of the tension and compression members and the process of pre-stressing.
5. To attain knowledge on design of pre-stressed concrete bridges.
6. To Design prestressed concrete deck slab and beam/ girders.

COURSE OUTCOMES:

At the end of the course, the 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.
6. Analyze prestressed concrete deck slab and beam/ girders.

UNIT- 1 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- 2 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- 3 TRANSMISSION OF PRESTRESS**9**

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

UNIT- 4 STATICALLY INDETERMINATE STRUCTURES**9**

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

UNIT- 5 COMPOSITE CONSTRUCTION**9**

Composite construction with precast PSC beams and cast in-situ RC slab - 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, GuyanY., Applied Science Publishers, 1972.
4. IS: 1343- Code of Practice for Prestressed Concrete
5. www.nptel.ac.in/courses/105106117/
Design of prestressed concrete precast road bridges with hybrid simulated annealing, JV
Martí, F Gonzalez-Vidoso, V Yepes, J Alcalá

COURSE OBJECTIVES:

To impart the knowledge on fundamentals of composites.

1. To study the behavior of lamina.
2. To provide knowledge on behavior of laminate.
3. To study the effect of Hygrothermal forces on mechanical behavior of composite.
4. To get exposed to soft computing techniques.
5. To develop the computer programs for the analysis of composite plates.

COURSE OUTCOMES:

At the end of the course, the 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.
6. Analyze the rectangular composite plates using the analytical methods.

UNIT 1 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 2 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 3 SOLUTIONS**9**

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

UNIT 4 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 5 ANALYTICAL METHODS**9**

Analysis of Rectangular Composite Plates using Analytical Methods.

SUGGESTED READINGS:

1. Mechanics of Laminated Composites Plates and Shells, Reddy J. N., CRC Press.
2. [nptel.ac.in/courses/105108124/pdf/Lecture Notes/LNm5.pdf](https://nptel.ac.in/courses/105108124/pdf/Lecture%20Notes/LNm5.pdf)
3. nptel.ac.in/courses/112104168/
4. Mechanics of laminated composite plates and shells: theory and analysis, JN Reddy
5. Analysis of laminated composite plates using a higher-order shear deformation theory, ND Phan, JN Reddy

22MEST3E03 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:

To impart knowledge on

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.
4. Understand the importance of numerical modeling.
5. Introduce steel fracture.
6. Apply fracture mechanics models to high strength concrete and FRC structures.

COURSE OUTCOMES:

At the end of the course, the 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.
6. Identify and classify cracking of concrete structures based on fracture mechanics.

UNIT 1 INTRODUCTION**9**

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

UNIT 2 STRESS AT CRACK TIP**9**

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

UNIT 3 CORRECTION TO CRACK TIP**9**

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

UNIT 4 MATERIAL MODELS:**9**

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

UNIT 5 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., RILEM Report, Chapman and Hall, 1989.
4. Fracture Mechanics – Applications to Concrete, Victor, Li C., Bazant Z. P., ACI SP 118, ACI Detroit, 1989.
5. nptel.ac.in/courses/105106053/17

COURSE OBJECTIVES:

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

COURSE OUTCOMES:

At the end of the course, the student will be able to:

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

SYLLABUS:**UNIT- I Prismatic Folded****9**

Laterally loaded thin plates – governing differential equations – Simply supported and fixed- boundary conditions

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-structural actions – membrane theory

UNIT- IV Analyses and Design of Cylindrical Shells**9**

Analysis of spherical dome – cylindrical shells – folded plates

UNIT- V Approximate Design methods for Doubly Curved Shells**9**

Design of spherical dome – cylindrical shells – folded plates

SUGGESTED READINGS:

1. Theory of Plates and Shells, Timoshenko and Woinowsky-Krieger S., Tata McGraw Hill 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.
5. https://onlinecourses.nptel.ac.in/noc18_me65
6. <https://ocw.mit.edu/courses/mechanical.../2-081j-plates-and-shells>

22MEST3E05 DESIGN OF EARTHQUAKE RESISTANT STRUCTURES 3 0 0 3 100**Instruction Hours/ Week: L:3 T:0 P:0****Marks: Internal–40, External–60; Total-100
End Sem. Exam–3 Hrs.****COURSE OBJECTIVE:**

1. To understand the seismic hazard parameters
2. To understand the Indian codal provisions and interprets the suitable application of codal provisions
3. To apply earthquake forces and response of the structure
4. To create capacity design of RC structures
5. To impart knowledge in analyze and design of structures by using software

COURSE OUTCOME:

On the successful completion of the course, students will be able to

1. Determine the seismic hazard parameters
2. Calculate the effect of EQ forces and response of the structure
3. Comprehend the Indian codal provisions and interprets the suitable application of codal provisions.
4. Suggest capacity design of RC structures
5. Identify suitable configuration, Loads and perform push over analysis for Steel structures.
6. Analyse and design of structures by using software

UNIT 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-retrofitting and strengthening of structures-seismic retrofitting strategies.

COMPUTER AIDED ANALYSIS AND DESIGN: (For internal assessment only-not for theory examination) Computer aided analysis and design of building systems for earthquake loads-response spectrum-time history analysis-capacity based design-hands on session using computer software.

TOTAL HOURS:45

TEXT BOOKS

Name of the Book	Author Name	Publisher	Year
Dynamics of Structures-Theory and Applications to earthquake Engineering	Chopra A.K	Prentice-Hall of India Pvt. Ltd., New Delhi	2011
Earthquake Resistant Design of Structures	Pankaj Agarwal and Manish Shrikhande	Prentice-Hall of India Pvt. Ltd., NewDelhi	2006

REFERENCES:

Name of the Book	Author Name	Publisher	Year
Dynamics of Structures	Clough R.W., and Penzien J	McGraw Hill, INC	2011
Wind and Earthquake Resistant Buildings-structural Analysis & Design	Taranath B.S., , Marcell Decker	NewYork	2005
Earthquake Engineering Hand book	Chen W.F., & Scawthorn	CRC Press	2003
Earthquake Resistant Design of Structures	. Duggal	Oxford University Press	2007

WEB SITES:

1. www.springer.com
2. www.nptel.com
3. www.wikipedia.com
4. www.aboutcivil.com

Course Objectives:

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.
4. To understand analytics using Hadoop and Map Reduce frameworks.
5. To acquire insight on other analytical frameworks.
6. To Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

Course Outcomes

On completion of the course, the student 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. Convert any real-world decision-making problem to hypothesis and apply suitable statistical testing.
4. Write and Demonstrate simple applications involving analytics using Hadoop and MapReduce
5. Use open-source frameworks for modeling and storing data.
6. Apply suitable visualization technique using R for visualizing voluminous data.

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, Visualizing and 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.

Course Objectives:

1. Summarize basics of industrial safety
2. Describe fundamentals of maintenance engineering
3. Explain wear and corrosion
4. Illustrate fault tracing
5. Identify preventive and periodic maintenance
6. To get fundamental knowledge on safe storage of chemicals.

Course Outcomes

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
6. Students would be able to create safe storage systems

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 cost & 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 grease gun, 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, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall Londo

OPEN ELECTIVES**Semester III****22MESTOE03****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:

1. Solve linear programming problem and solve using graphical method.
2. Solve LPP using simplex method
3. Solve transportation, assignment problems
4. Solve project management problems
5. Solve scheduling problems
6. Model formulation and applications that are used in solving business decision problems.

Course Outcomes

At the end of the course, the 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
6. Model the real-world problem and simulate it.

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 simplex method - sensitivity analysis - parametric programming

UNIT III NONLINEAR PROGRAMMING**9**

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

UNIT IV SCHEDULING AND SEQUENCING**9**

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - 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 Optimisation: 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

Course Objectives:

1. Summarize the costing concepts and their role in decision making
2. Infer the project management concepts and their various aspects in selection
3. Interpret costing concepts with project execution
4. Develop knowledge of costing techniques in service sector and various budgetary control techniques
5. Illustrate with quantitative techniques in cost management
6. The course focuses on the early project phases, including examples from technical projects

Course Outcomes

1. Understand the costing concepts and their role in decision making
2. Understand the project management concepts and their various aspects in selection
3. Interpret costing concepts with project execution
4. Gain knowledge of costing techniques in service sector and various budgetary control techniques
5. Become familiar with quantitative techniques in cost management
6. Create project execution plan, either in a team effort or on individual basis.

UNIT 1- INTRODUCTION**9**

Introduction and Overview of the Strategic Cost Management Process. Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

UNIT 2-PROJECT**9**

Project: meaning, Different types, why to manage, cost 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 and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process

UNIT 3- COST BEHAVIOR AND PROFIT PLANNING**9**

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning,

UNIT 4 TOTAL QUALITY MANAGEMENT**9**

Total Quality Management and Theory of constraints. Activity-Based Cost 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 5- QUANTITATIVE TECHNIQUES

9

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

SUGGESTED READINGS:

1. Cost 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 & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

Course Objectives:

1. Summarize the characteristics of composite materials and effect of reinforcement in composite materials.
2. Identify the various reinforcements used in composite materials.
3. Compare the manufacturing process of metal matrix composites.
4. Understand the manufacturing processes of polymer matrix composites.
5. Analyze the strength of composite materials.
6. To understand the basic theory and applications of modern composite materials.

Course Outcomes

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.
6. Understand the basic theory and applications of modern composite materials.

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 ply 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.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

Course Objectives:

1. Interpret the various types of wastes from which energy can be generated
2. Develop knowledge on biomass pyrolysis process and its applications
3. Develop knowledge on various types of biomass gasifiers and their operations
4. Invent knowledge on biomass combustors and its applications on generating energy
5. Summarize the principles of bio-energy systems and their features
6. Provide information on various methods of waste management.

Course Outcomes

1. Understand the various types of wastes from which energy can be generated
2. Gain knowledge on biomass pyrolysis process and its applications
3. Develop knowledge on various types of biomass gasifiers and their operations
4. Gain knowledge on biomass combustors and its applications on generating energy
5. Understand the principles of bio-energy systems and their features
6. Understand waste characterization, Segregation, Disposal etc will be made known

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.

SUGGESTED READINGS:

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

COURSE OBJECTIVES:

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:

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.

SYLLABUS:

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

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
4. On completion of the project work students will be in a position to take up any research and challenging practical problem for finding better solutions.
5. To take up any research and challenging practical problem for finding better solutions.
6. To provide a clear idea of his/her area of work and they are in a position to carry out the work in a systematic way.

COURSE OUTCOMES:

At the end of the course, the 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.
6. Manage any type of design and construction projects.

SYLLABUS:

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 for carrying out the work. The students will be evaluated through a viva-voce examination by a panel of examiners including one external examiner.

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
4. On completion of the project work students will be in a position to take up any research and challenging practical problem for finding better solutions.
5. To take up any research and challenging practical problem for finding better solutions.
6. To provide a clear idea of his/her area of work and they are in a position to carry out the work in a systematic way.

COURSE OUTCOMES:

At the end of the course, the 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.
6. Manage any type of design and construction projects.

SYLLABUS:

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 the supervisor 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-voce examination by a panel of examiners including one external examiner.