P.S.R.ENGINEERING COLLEGE
(An Autonomous Institution, Affiliated to Anna University, Chennai)
Sevalpatti (P.O), Sivakasi - 626140.
Tamilnadu State

REGULATIONS FOR PG [M.E./MBA] PROGRAMME

UNDER CHOICE BASED CREDIT SYSTEM

[For the Students Admitted from the Academic Year 2016 - 2017 and Onwards]

[PG Regulation-2016]

CONTENTS

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ISO 9001:2008

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1. PRELIMINARY DEFINITIONS AND NOMENCLATURE

In these Regulations, unless the context otherwise requires:

i) "**Programme**" means UnderGraduate Degree Programme (M.E./MBA)

ii) **"Branch"** means specialization or discipline of M.E.Degree Programme like "Applied Electronics", "Structural Engineering", etc.

iii) "**Course**" means Theory or Practical subject that is normally studied in a semester.

iv) "**Head of the Institution**" means the Principal of a College / Institution who is responsible for all academic activities of the College / Institution and for implementation of relevant Rules and Regulations.

v) **"Head of the Department"** means Head of the Department concerned.

vi) "**Controller of Examinations"** means the Authority of the College who is responsible for all activities of the Examinations.

vii) "**University**" means ANNA UNIVERSITY.

viii) **"College"** or **"Institution"** means P.S.R. Engineering College.

2. ELIGIBILITY FOR ADMISSION

2.1 Students for admission to the first semester of the Post Graduate Degree Programme shall be required to have passed an appropriate qualifying Degree Examination of Anna University or any examination of any other University as equivalent thereto.

2.2 Eligibility conditions for admission such as class obtained, number of attempts in qualifying examination and physical fitness will be as prescribed from time to time.

2.3 Any other examinations as notified by the Government of Tamilnadu

2.4 The Part-Time students should satisfy other conditions regarding experience,

Sponsorship etc, prescribed by the AICTE / Anna University.

3. PROGRAMMES OFFERED& MODE OF STUDY

3.1 Programmes Offered

A student may be offered admission to any one of the following PG programme of study being offered in this college. The medium of instruction is English.

1. M.E. Computer Science and Engineering
2. M.E. Applied Electronics
3. M.E. Structural Engineering
4. M.E. Power Electronics and Drives
5. M.E. Engineering Design
6. Master of Business Administration (MBA)

3.2 Modes Of Study

3.2.1 Full Time

- Students admitted under 'Full-Time' should be available in the College during the entire duration of working hours for the curricular, co-curricular and extra-curricular activities.

- The Full-time students should not attend any other Full-time programme(s) / course(s) or take up any Full-Time job / Part-Time job during working hours in any Institution or company during the period of Full- Time programme. Violation of the above rules will result in cancellation of admission to the PG programme.

3.2.2 Part Time

In this mode of study, the students are required to attend classes conducted along with the Full Time students as per the curriculum.

4. STRUCTURE OF THE PROGRAMMES

4.1 Categorization of Courses

Every Post Graduate Degree Programme will have a curriculum with syllabi consisting of theory and practical courses that shall be categorized as follows:

i) **Foundation Courses (FC)** may include Mathematics or other basic courses

iv) **Programme Core (PC)** courses include the core courses relevant to the chosen specialization/branch, Project Work.

v) **Open Core (OC)** courses include the core courses relevant to the chosen specialization / branch which a student of other programmes can choose as an elective.

vi) **Programme Elective (PE)** courses include the elective courses relevant to

the chosen specialization/ branch.

vii) **Open Elective (OE)** courses include the courses relevant to the chosen specialization / branch which a student can choose from the curriculum of other M.E.

viii) **Employability Skill Enhancement Courses (EEC)**include Internship, Seminar, Industrial/PracticalTraining, etc.

4.2 Credit Assignment

- One credit for each lecture period allotted per week
- One credit for two tutorial periods allotted per week
- One credit for each seminar/practical session of two periods per week.

4.3 Project Work

The Project work is an important component of Post-Graduate programmes. The Project work for M.E. consists of Phase – I and Phase – II. The Phase – I is to be undertaken during III semester and Phase – II, which is a continuation of Phase – I is to be undertaken during IV semester. For M.B.A. programme, the Project Work has to be undertaken in the final semester.

4.3.1 The Project work for M.E. (for Phase II Project work) and M.B.A, shall be pursued for a minimum of 16 weeks during the final semester.

4.3.2 The Project work shall be carried out under the supervision of a "qualified teacher" in the Department concerned. In this context "qualified teacher" means a faculty member possessing (i) PG degree with a minimum of 3 years of teaching experience or (ii) Ph.D. degree.

4.3.3 A student may, however, in certain cases, be permitted to work on projects in an Industrial / Research Organization, on the recommendations of the Head of the Department. In such cases, the Project work shall be jointly guided by a supervisor of the department and an expert as joint supervisor from the organization and the student shall be instructed to meet the supervisor periodically and to attend the review committee meetings for evaluating theprogress.

4.4 Self Study Courses

Students may be permitted to credit one Self Study course with the approval of Departmental Consultative Committee.

The Department may offer self study courses. The purpose of the course is to permit the student to study a course / topic of the student's choice. The students shall study on their own under the guidance of a faculty member. No formal lectures need be delivered. The syllabus of the course and mode of assessments shall be approved by the Departmental Consultative Committee

and formal approval of the course by the BOS/ Academic Council, preferably before the commencement of the semester. The self study course of 3 credits can be considered as one elective course. One Faculty member approved by the Head of the Department shall be responsible for the periodic monitoring and evaluation of the course.

5. DURATION OF THE PROGRAMMES

5.1 The minimum and maximum period for the completion of the P.G. Programmes are given below:

Programme	Min. No. of Semesters	Max. No. of Semesters
M.E. (Full-Time)	4	8
M.E. (Part Time)	6	12
MBA (Full Time)	4	8

5.2 Each semester shall normally consist of 90 teaching days (including examination days). The Head of the Department shall ensure that every faculty member imparts instruction as per the number of periods specified in the syllabus covering the full content of the syllabus for the course being taught.

5.3 The total duration for completion of the programme reckoned from the commencement of the first semester to which the student was admitted shall not exceed the maximum duration specified in clause 5.1 irrespective of the period of break of study (vide clause 18) or prevention (vide clause 7.3) in order that the student may be eligible for the award of the degree (vide clause 13).

5.4 The students shall complete the minimum prescribed credits required as per the curriculum of his/her programme for the award of the degree.

6. COURSE ENROLLMENT AND REGISTRATION

6.1 The students on admission have to register and study the courses prescribed in the curriculum in the student's first Semester of study.

6.2 Each student shall be assigned to a Faculty Advisor who shall advice and counsel the student about the details of the academic programme and the choice of courses considering the students' academic background and career objectives.

6.3 Every student shall enroll for the course of the succeeding semester before the last working day of the current semester as notified by the Principal. However, the student shall confirm the enrollment by registering for the courses within the first three working days after the commencement of the concerned semester.

6.4 If the student wishes, he/she may drop or add courses (from II to IV semesters only) within threeworking days after the commencement of the concerned semester and

complete the registration process duly authorized by the Faculty Advisor. Total number of credits of such courses cannot exceed 6. However the maximum number of credits the student can register in a particular semester cannot exceed 30 credits (including courses for which the student has done reappearance registration).

6.5 No course shall be offered by a Department unless a minimum of 5 students register for that course.

6.6 The student shall register for the project work in the semester as specified in the curriculum.

6.7 After registering for a course, a student shall attend the classes, satisfy the attendance requirements, earn Continuous Assessment marks and appear for the End Semester Examinations.

6.8 If the student wishes, the student shall register for theory courses in which the student has failed in the subsequent semesters when they are offered next (Reappearance Registration). The attendance requirement (vide clause 7) is not compulsory for such courses.

6.9 A student who has already appeared for a course in a semester and passed the examination is not entitled to reappear in the same course for improvement of letter grades / marks.

7. ATTENDANCE REQUIREMENTS FOR APPEARING SEMESTER EXAMINATION

A student who has fulfilled by the following conditions shall be deemed to have satisfied the requirements for appearing end semester examination of a particular course.

7.1 A student will be permitted to appear for the end semester examination of a course, only if he/she secures not less than 75% of attendance taking into account the number of periods required for that course as specified in the curriculum.

7.2 If a student secures attendance between 65% and less than 75% in any course in the current semester of his / her studies due to medical reasons (hospitalization / accident / specific illness) or due to participation in the College / University / State / National / International level Sports events with prior permission from the Head of the Department concerned and Principal. The student shall be given exemption from the prescribed attendance requirement and the student shall be permitted to appear for the end semester examination of that course. In all such cases, the students should submit the required documents on joining after the absence.

7.3 Students who do not satisfy clause 7.1 and 7.2 and who secure less than 65%attendance in a course will not be permitted to write the End-Semester Examination of that course. The student has to register and repeat this course in a

subsequent semester when it is offered next.

7.4 In the case of reappearance registration for a course, the attendancerequirement as mentioned in Clauses 7.1 - 7.3 is not applicable. However, the student has toregister for examination in that course by paying the prescribed fee.

8. ASSESSMENT PROCEDURE FOR AWARDING MARKS

All (M.E. / MBA) Programmes consist of Theory Courses, Practical Courses and Skill Enhancement Courses. Appearance in End Semester Examination is mandatory for all courses including Theory, Practical and Project work. Performance in each course of study shall be evaluated based on (i) Internal Assessments throughout the semester and (ii) End Semester Examination at the end of the semester. Each course shall be evaluated for a maximum of 100 marks as shown below:

Category	Internal Assessment	End Semester Examination
Theory Courses	30	70
Practical Courses	30	70
Project Work	30	70
Employability Skill Enhancement Courses (EEC)	100	Nil

8.1 **Internal Assessment For Theory Courses**

The criteria for determining the internal assessment marks are:

i) **Internal Tests [60% weightage]**

Three tests each carrying sixty (60) marks shall be conducted by the department / Institution. The total marks obtained in all tests put together out of 180, shall be reduced to 60 marks and rounded to nearest integer (this implies equal weight to all the three tests). However retest at the discretion of the head of the department may be conducted for the deserving candidates.

ii) **Assignment or Miniproject [20% weightage]**

A student has to carry out either an assignment or miniproject.

- An assignment normally requires work of average 5 to 6 hours of study and written work of average 5 to 6 hours which has to be submitted to the course tutor for evaluation.
- A mini project shall be in hardware or software. The student has to submit a report before the end of the semester. Mini project will be assessed based on the model presentation and report as decided by the department.

iii) **Seminar [10% weightage]**

The student has to make seminar on the topics related to the course. The students are expected to submit a report of his / her presentation. The seminar will be assessed by the course tutor with common parameters as described by the department.

iv) **Attendance [10% weightage]**

(refer clause 8.5)

8.2 **Internal Assessment For Practical Courses**

Every practical exercise / experiment shall be evaluated based on conduct of exercise / experiment and records maintained. There shall be at least one test. The criteria for determining the internal assessment marks are:

Experiment / Record / Average

Practical classes' performance: 60% weightage

Practical Test: 30% weightage

Attendance (refer clause 8.5): 10% weightage

8.3 **Internal and External Assessment For Project Works**

There shall be three assessments during the semester by a review committee. The students shall make presentation on the progress made before the committee. The criteria for arriving the internal assessment marks and external marks for the project work are:

Project Work	Internal (30)			External (70)			
	Review-1	Review-2	Review-3	Thesis Evaluation	Viva-voce		
					Supervisor	External	Internal
Phase-I	10	10	10	40	10	10	10
Phase-II	10	10	10	40	10	10	10

In all the above cases, the internal marks awarded for 100 marks shall be reduced to 30 Marks.

8.4 **Internal Assessment For Seminar / Employability Skill Enhancement Courses**

The courses under Skill Enhancement are evaluatedby Continuous Assessments only.The seminar / Case study shall carry 100 marks and shall be evaluated through continuous assessment only. Every student is expected to present a minimum of 2 seminars per semester before the evaluation committee and for each seminar, marks can be equally apportioned. The three member committee appointed by Head of the Department will evaluate the seminar and at the end of the semester the marks can be consolidated and taken as the final mark. The evaluation shall be based on the seminar paper / report (40%), presentation (40%) and response to the questions asked

during presentation (20%).The Course Committee (vide clause 16) shall devise a common evaluation procedure.

8.5 **Awarding Marks for Attendance**

% of Attendance	Below 75	75	76-80	81-85	86-90	Above 90
Marks	0	2	4	6	8	10

The student on doing reappearance registration has to appear for the assessments along with the current batch of students and earn internal assessment marks again.

9. PASSING REQUIREMENTS

- For each course the examination will be conducted for 100 marks. A candidate who secures not less than 50% of the total marks in the end semester examinations and internal assessment put together in both theory and practical courses, including project work, subject to securing a minimum of 50% in the end-semester examination, wherever applicable, shall be declared to have passed the examination in that subject.
- When the mark secured for 100 in end-semester examination is converted to 70, minimum 35 marks must be secured for pass.

10 AWARD OF LETTER GRADES

The performance of a student will be reported using letter grades, each carrying certain points as detailed below:

Marks Scored	**Letter Grade**	**Grade Points**	**Description**
90 - 100	O	10	Outstanding
80 - 89	A +	9	Excellent
70 - 79	A	8	Very Good
60 - 69	B +	7	Good
55 - 59	B	6	above Average
50 - 54	C	5	Average
0 - 49	RA	0	Reappearance
Incomplete	SA / AB	0	Shortage of Attendance / Absent

'RA' denotes Reappearance registration is required for that particular course.

'SA' denotes shortage of attendance (as per Clause 7) and hence prevented from writing end semester examination.

11 GPA AND CGPA CALCULATION

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

- the list of courses registered during the semester and the grades scored.
- the Grade Point Average (GPA) for the semester and
- the Cumulative Grade Point Average (CGPA) of all courses registered from first semesteronwards.

During each semester, the list of courses registered and the grades scored in each course areused to compute the Grade Point Average (GPA). GPA is the ratio of the sum of the productsof the number of credits of courses registered and the grade points corresponding to thegrades scored in those courses, taken for all the courses, to the sum of the number of credits ofall the courses in the semester.

$$GPA = \frac{\sum_{i=1}^{n} C_i GP_i}{\sum^{n} C_i}$$

Where,

Ci - is the Credits assigned to the course

GPi - is the grade point corresponding to the letter grade obtained for each course

n - is number of all Courses successfully cleared during the particular semester in thecase of GPA and during all the semesters in the case of CGPA.

CGPA will be calculated in a similar manner, considering all the courses enrolled from first semester. "RA" and "SA" grades will be excluded for calculating GPA and CGPA.

11.2 If a student studies more number of electives (PE/OE) than required as per the student's programme curriculum, the courses with higher grades alone will be considered for calculation of CGPA.

12 EXAMINATION PROCEDURE

End Semester examination shall be conducted by the office of the Controller of Examination of the College as per the prescribed rules and regulation on examinations of the college.

12.1 **Issue of Mark Sheet**

Individual mark sheet for each semester will be issued to the students, through the head of the department concerned, after the publication of the result.

The mark sheet will contain credit, grade, grade point and result status for the course concerned.

12.2 **Malpractice**

If a student indulges in malpractices in any of the end semester examination, he/she shall be liable for punitive action as prescribed by the Anna University, Chennai from time to time.

12.3 **Revaluation**

i) Copies of answer script for the theory course(s) can be obtained from the Office of the Controller of Examinations on payment of a prescribed fee specified for this purpose through proper application.

ii) A candidate can apply for revaluation of his/her examination answer paper in a theory course, within a week from the declaration of results, on payment of a prescribed fee through proper application to the Office of the Controller of Examinations, as per the prescribed norms of the College. Revaluation is not permitted for practical course and for project work.

iii) Re totaling is permissible for all arrear and current theory courses.

12.4 **Challenging Valuation**

In case the student is not satisfied with the outcome of the revaluation the student can apply for 'Challenge Valuation'. The highest marks obtained by the student in all of the above will be considered for grading.

12.5 **Supplementary Examinations**

i) Supplementary Examinations is applicable only for the Reappearance (RA) courses.

ii) Supplementary Examinations may be conducted at weekends during the Semester.

iii) Absent and Withdrawal candidates are also eligible to write Supplementary Examination.

iv) The application for supplementary examination has to be recommended and forwarded by the concerned HOD after due verification.

13 ELIGIBILITY FOR THE AWARD OF DEGREE

A student shall be declared eligible for the award of the M.E. / MBA degree provided the student has

i) Successfully gained the required number of total credits as specified in the curriculum corresponding to the student's programme within the stipulated time.

ii) Successfully completed the course requirements and has passed all the prescribed examinations in all the 4 semesters within a maximum period of 4 years from the commencement of first semester to which the student was admitted.

iii) Successfully passed any additional courses prescribed by the Director, Academic Courses whenever readmitted under regulations other than R-2016

iv) No disciplinary action pending against the student.

v) Approval by the University for the Award of degree.

14 CLASSIFICATION OF DEGREE

14.1 First Class With Distinction

A student who satisfies the following conditions shall be declared to have passed the examination in First class with Distinction:

- Should have passed the examination in all the courses of all the four semesters in First Appearance within threeyears, which includes authorized break of study of one year. Withdrawal from examination (vide Clause 17) will not be considered as an appearance.
- Should have secured a CGPA of not less than 8.50
- Should NOT have been prevented from writing end semester examination due to lack of attendance in any of the courses.

14.2 First Class

A student who satisfies the following conditions shall be declared to have passed the examination in **First class**:

- Should have passed the examination in all the courses of all four semesters **within three years**, which includes one year of authorized break of study (if availed) or prevention from writing the End Semester Examination due to lack of attendance (if applicable).
- Should have secured a CGPA of not less than 6**.50**

14.3 Second Class

All other students (not covered in clauses 14.1 and 14.2) who qualify for the award of the degree **(**vide Clause 12) shall be declared to have passed the examination in **Second Class**.

14.4 A student who is absent in semester examination in a course/ project work after having registered for the same shall be considered to have appeared in that examination (except approved withdrawal from end semester examinations as per

clause 17) for the purpose of classification.

15 FACULTY ADVISOR

To help the students in planning their courses of study and for general advice on the academic programme, the Head of the Department of the students will attach a certain number of students to a faculty of the Department who shall function as Faculty Advisor for those students throughout their period of study. The Faculty Advisor shall advise the students in registering and reappearance registering of courses, authorizes the process, monitor their attendance and progress and counsel them periodically. If necessary, the Faculty Advisor may also discuss with or inform the parents about the progress / performance of the students concerned.

The responsibilities for the faculty advisor shall be:

- To inform the students about the various facilities and activities available to enhance the students' curricular and co-curricular activities.
- To guide student enrollment and registration of the courses.
- To authorize the final registration of the courses at the beginning of each semester.
- To monitor the academic and general performance of the students including attendance and to counsel them accordingly.

16 COURSE COMMITTEES

16.1 Common Course Committee

A theory course handled by more than one faculty member shall have a "Common Course Committee" comprising of all faculties teaching that course and some students who have registered for that course. There shall be two student representatives from each batch of that course. One of the faculty members shall be nominated as Course Coordinator by the Head of the Department duly approved by the Principal.

The first meeting of the Common Course Committee shall be held within fifteen days from the date of commencement of the semester. Two or three subsequent meetings in a semester may be held at suitable intervals**.** During these meetings, the student members shall meaningfully interact and express their opinions and suggestions of all the students to improve the effectiveness of the teaching-learning process. It is the responsibility of the student representatives to convey the proceedings of these meetings to the whole batch.

In addition the faculty members of a Common Course shall meet to ensure uniform

evaluation of continuous assessments and prepare a common question paper for the continuous assessment tests after arriving at a common scheme of evaluation for the assessments (vide clause 8). The question paper for the end semester examination is common.

16.2 Multiple Courses Committee

If course(s) handled by a single faculty member, there will be "Multiple Courses Committee". This committee comprises of all the above faculty members and two student representatives from each course. One of the above faculty members, nominated by the Head of the Department shall coordinate the activities of this committee.

The functions of this committee is similar to that of the common course committee, which is as follows:

The first meeting of the Multiple Courses Committee shall be held within fifteen days from the date of commencement of the semester. Two or three subsequent meetings in a semester may be held at suitable intervals**.** During these meetings, the student members shall meaningfully interact and express their opinions and suggestions of all the students to improve the effectiveness of the teaching-learning process. It is the responsibility of the student representatives to convey the proceedings of these meetings to all the students.

16.3 Overall Monitoring Committee

In addition, there shall be a overall monitoring committee for each semester of a programme which comprises of (i) the Course Coordinators / Course Faculty (as applicable), and (ii) Head of the Department. This overall monitoring committee shall meet periodically to discuss academic related matters, progress and status of the students of the semester concerned.

The overall monitoring committee can invite the Faculty Advisors or students for any of the committee meetings if necessary.

17 PROVISION FOR WITHDRAWAL FROM EXAMINATION

17.1 A student may, for valid reasons, (medically unfit / unexpected family situations / National / International sports) be granted permission to withdraw from appearing for the end semester examination in any course or courses in **ANY ONE** of the semester examinations during the entire duration of the degree programme. The

application shall be sent to Principal, through HOD with required documents.

17.2 Withdrawal application shall be valid only if the student is otherwise eligible to write the examination (Clause 7) and if it is made a week before the commencement of the end semester examination in that course or courses and also recommended by the Head of the Department.

17.3 Withdrawal shall not be considered as an appearance for deciding the eligibility of a student for First Class with Distinction.

17.4 Withdrawal is permitted for the end semester examinations in the final semester only if the period of study the student concerned does not exceed 3 years as per clause 14.

18 TEMPORARY BREAK OF STUDY FROM A PROGRAMME

(i) A student is not normally permitted to temporarily break the study. However if a student intends to temporarily discontinued the programme in the middle for valid reasons (such as accident or hospitalization due to prolonged ill health) and to rejoin the programme in a later than the last date for registering for the semester examinations of the semester in question, through the head of the department starting the reasons thereof.

(ii) The student permitted to rejoin the programme after the break shall be governed by the rules and regulations in force at the time of rejoining.

(iii) The duration specified for passing all the courses for the purpose of classification vide clause 14 shall be increased by the period of such break of study permitted.

(iv) The 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 8(iii) irrespective of the period of break of study in order that he/she may be eligible for the award of the degree (vide clause 13).

(v) 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 'break of study' and clause 19(iii) is not applicable for this case.

19 PROCUDURE FOR USING SCRIBER

If a student is physically handicapped (in case of accidents/ill health) at the time of examination, he/she may be permitted to use a scriber to write the examination. In such case 30 minutes, extra time will be permitted. The scriber shall be a non-engineering student/graduate.

20 DISCIPLINE

Every student is required to observe disciplined and decorous behavior both inside and outside the college and not to indulge in any activity, which will tend to bring down the prestige of the college. If an act of indiscipline reported, the principal shall constitute a disciplinary committee consisting of three senior faculty members / HODs of which one should be from the faculty of the student, to inquire into acts of indiscipline. The disciplinary action is subject to review by the Principal in case the student represents to the Principal. Any expulsion of the student from the college shall be with prior concurrence from directorate of technical education / university.

21 RESPONSIBILITIES OF A COURSE TUTOR

- Every course tutor member is required to maintain an 'Attendance and Assessment Record' for every semester which consists of attendance marked in each Theory / Practical / Skill Enhancement, the assessment marks and the record of class work (topics covered), separately for each course handled by the them. This should be submitted to the Head of the Department periodically (at least three times in a semester) for checking the syllabus coverage and the records of assessment marks and attendance. The Head of the Department will affix his/her signature and date after due verification.
- At the end of the semester, the record should be verified by the Head of the Department who shall keep this document in safe custody (for six years).
- The records of attendance and assessment of both current and previous semesters should be available for inspection.
- The assessments on Course Outcomes (CO), Programme Outcomes (PO) and Programme Educational Objectives also should be carried out and submitted to Programme Coordinator / HOD.

22 REVISION OF REGULATION AND CURRICULUM

The College may from time to time revise, amend or change the Regulations, Curriculum, Syllabus and Scheme of examinations through the Academic Council of the College.

23 ANY OTHER RULES AND PROCEDURE

Any other rules and procedure which are not covered under the above clauses shall be discussed and framed by the Standing Committee of the college. Implementation of the Standing Committee resolutions is based on the approval / ratification by the Academic Council / Board of Management.

REGULATION – 2016

M.E. STRUCTURAL ENGINEERING

CURRICULUM- I TO IV SEMESTER (FULL TIME)

SEMESTER- I

Sl. No.	Subject Code	Course Title	L	T	P	C
Theory						
1	162SE11	Applied Mathematics	3	2	0	4
2	162SE12	Matrix Methods of Structural Analysis	3	0	0	3
3	162SE13	Advanced Concrete Structures	2	2	0	3
4	162SE14	Theory of Elasticity and Plasticity	3	2	0	4
5	--	Elective-I	3	0	0	3
6	--	Elective-II	3	0	0	3
		TOTAL	**17**	**6**	**0**	**20**

SEMESTER – II

Sl. No.	Subject Code	Course Title	L	T	P	C
Theory						
1	162SE21	Finite Element Analysis	3	2	0	4
2	162SE22	Structural Dynamics	3	2	0	4
3	162SE23	Advanced Steel Structures	3	0	0	3
4	162SE24	Stability of Structures	3	0	0	3
5	--	Elective-III	3	0	0	3
6	--	Elective-IV	3	0	0	3
Practical						
7	162SE27	Advanced Structural Engineering Laboratory	0	0	4	2
		TOTAL	**18**	**4**	**4**	**22**

SEMESTER – III

Sl. No.	Subject Code	Course Title	L	T	P	C
Theory						
1	--	Elective-V	3	0	0	3
2	--	Elective-VI	3	0	0	3
3	--	Elective-VII	3	0	0	3
Practical						
4	162SE34	Practical Training (3 Weeks)	-	-	-	1
5	162SE35	Project Work (Phase - I)	0	0	12	6
		TOTAL	**9**	**0**	**12**	**16**

SEMESTER – IV

Sl. No.	Subject Code	Course Title	L	T	P	C
Practical						
1	162SE41	Project Work (Phase - II)	0	0	24	12
		TOTAL	**0**	**0**	**24**	**12**

TOTAL NO.OF CREDITS = 70

REGULATION – 2016
M.E. STRUCTURAL ENGINEERING
CURRICULUM- I TO VI SEMESTER (PART TIME)

SEMESTER- I

Sl. No.	Subject Code	Course Title	L	T	P	C
Theory						
1	162SE11	Applied Mathematics	3	2	0	4
2	162SE12	Matrix Methods of Structural Analysis	3	0	0	3
3	162SE13	Advanced Concrete Structures	2	2	0	3
		TOTAL	**8**	**4**	**0**	**10**

SEMESTER – II

Sl. No.	Subject Code	Course Title	L	T	P	C
Theory						
1	162SE21	Finite Element Analysis	3	2	0	4
2	162SE22	Structural Dynamics	3	2	0	4
3	162SE23	Advanced Steel Structures	3	0	0	3
		TOTAL	**9**	**4**	**0**	**11**

SEMESTER – III

Sl. No.	Subject Code	Course Title	L	T	P	C
Theory						
1	162SE14	Theory of Elasticity and Plasticity	3	2	0	4
2	--	Elective-I	3	0	0	3
3	--	Elective-II	3	0	0	3
		TOTAL	**9**	**2**	**0**	**10**

SEMESTER – IV

Sl. No.	Subject Code	Course Title	L	T	P	C
Theory						
1	162SE24	Stability of Structures	3	0	0	3
2	--	Elective-III	3	0	0	3
3	--	Elective-IV	3	0	0	3
Practical						
4	162SE27	Advanced Structural Engineering Laboratory	0	0	4	2
		TOTAL	**9**	**0**	**4**	**11**

SEMESTER – V

Sl. No.	Subject Code	Course Title	L	T	P	C
Theory						
1	--	Elective-V	3	0	0	3
2	--	Elective-VI	3	0	0	3
3	--	Elective-VII	3	0	0	3
Practical						
4	162SE34	Practical Training (3 Weeks)	-	-	-	1
5	162SE35	Project Work (Phase - I)	0	0	12	6
		TOTAL	**9**	**0**	**12**	**16**

SEMESTER – VI

Sl. No.	Subject Code	Course Title	L	T	P	C
Practical						
1	162SE41	Project Work (Phase - II)	0	0	24	12
		TOTAL	**0**	**0**	**24**	**12**

TOTAL NO.OF CREDITS = 70

M.E. (STRUCTURAL ENGINEERING)

LIST OF ELECTIVES - (Regulations 2016)

Code No	Course Title	L	T	P	C
162SEE01	Advanced Concrete Technology	3	0	0	3
162SEE02	Experimental Techniques and Instrumentation	3	0	0	3
162SEE03	Earthquake Analysis and Design of Structures	3	0	0	3
162SEE04	Optimization of Structures	3	0	0	3
162SEE05	Corrosion and Durability Studies	3	0	0	3
162SEE06	Theory of Plates	3	0	0	3
162SEE07	Design of Bridges	3	0	0	3
162SEE08	Design of Steel Concrete Composite Structures	3	0	0	3
162SEE09	Offshore Structures	3	0	0	3
162SEE10	Design of Shell and Spatial Structures	3	0	0	3
162SEE11	Design of Tall Buildings	3	0	0	3
162SEE12	Wind and Cyclone Effects on Structures	3	0	0	3
162SEE13	Soil Structure Interaction	3	0	0	3
162SEE14	Mechanics of Composite Materials	3	0	0	3
162SEE15	Maintenance and Rehabilitation of Structures	3	0	0	3
162SEE16	Industrial Structures	3	0	0	3
162SEE17	Research Methodology	3	0	0	3
162SEE18	Prefabricated Structures	3	0	0	3
162SEE19	Prestressed Concrete Structures	3	0	0	3
162SEE20	Advanced Construction Materials	3	0	0	3
162SEE21	Solid And Hazardous Waste Management	3	0	0	3
162SEE22	Sub – Structure Design	3	0	0	3
162SEE23	Cracks And Crack Control In Concrete Structures	3	0	0	3
162SEE24	Non - Linear Analysis Of Structures	3	0	0	3
162SEE25	Construction Safety And Management	3	0	0	3

162SE11	APPLIED MATHEMATICS				L-T-P-C
					4-0-0-4
Programme:	M.E. Structural Engineering	**Sem:**	**I**	**Category:**	**Core**
AIM:	To familiarize the student in the field of differential and elliptic equations to solve boundary value problems associated with engineering applications. To obtain solutions for buckling, dynamic response, heat and flow problems of one and two dimensional conditions. To find Eigen values by various methods. To expose the students to various formulation and numerical integration techniques and their applications.				
Course Outcomes:					
COE 1: Apply the field of differential and elliptic equations to solve boundary value problems associated with engineering applications. COE 2: Obtain the solutions for buckling, dynamic response, heat and flow problems of one and two dimensional conditions using transforms. COE 3: Be familiar with the methods for finding Eigen values. COE 4: Apply the various formulation and numerical integration techniques in various fields.					

UNIT–I ONE DIMENSIONAL WAVE AND HEAT EQUATIONS 12 hrs

Laplace transform methods for one-dimensional wave equation – Displacements in a long string – longitudinal vibration of an elastic bar – Fourier transform methods for one-dimensional heat conduction problems in infinite and semi-infinite rods.

UNIT–II ELLIPTIC EQUATION 12 hrs

Laplace equation – Properties of harmonic functions – Solution of Laplace's equation by means of Fourier transforms in a half plane, in an infinite strip and in a semi-infinite strip – Solution of Poisson equation by Fourier transforms method.

UNIT–III CALCULUS OF VARIATIONS 12 hrs

Concept of variation and its properties – Euler's equation – Functional dependant on first and higher order derivatives – Functionals dependant on functions of several independent variables – Variational problems with moving boundaries – Direct methods – Ritzand Kantorovich methods.

UNIT–IV EIGEN VALUE PROBLEMS 12 hrs

Methods of solutions: Faddeev –Leverrier Method, Power Method with deflation– Approximate Methods: Rayleigh – Ritz Method

UNIT–V NUMERICAL INTEGRATION 12 hrs

Gaussian Quadrature –One and Two Dimensions –Gauss Hermite Quadrature – MonteCarlo Method Multiple Integration by using mapping function

TOTAL: 60 hrs

TEXT BOOKS:

1. Sankara Rao, K., "Introduction to Partial Differential Equations", Prentice Hall of India Pvt. Ltd., New Delhi, 1997.
2. Andrews, L.C. and Shivamoggi, B.K., "Integral Transforms for Engineers", Prentice Hall of India Pvt. Ltd., New Delhi, 2003.
3. Haberman, Richard, "Elementary Applied Partial Differential Equations", Prentice Hall International., INC, 1998.

REFERENCE BOOKS:

1. Gupta, A.S., "Calculus of Variations with Applications", Prentice Hall of India Pvt. Ltd., New Delhi, 1997.
2. Rajasekaran.S, "Numerical Methods in Science and Engineering A Practical Approach", A.H.Wheeler and Company Private Limited, 1986.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3						1						2			
CO2		2														2
CO3	2				3		2							1		
CO4		1					3								3	
CO5	3															

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162SE12	MATRIX METHODS OF STRUCTURAL ANALYSIS				L-T-P-C
					3-0-0-3
Programme:	M.E. Structural Engineering	**Sem:**	**I**	**Category:**	**Core**
AIM:	To understand the energy concepts, analysis of structures by stiffness and flexibility approaches.				

Course Outcomes:

The Students will be able to

CO1: Able to apply fundamental characteristics of elements and system by evaluation of its flexibility and stiffness matrices

CO2: Impart knowledge about analysis of system through direct and element approach of flexibility method

CO3: Able to analysis the structures by direct and element approach of stiffness method is to be included

CO4:Understand the Programming techniques for simple problems and use of standard programmes to be practiced

CO5: Impart Knowledge about use of advanced techniques of matrix methods

UNIT–I BASIC CONCEPTS 9 hrs

Indeterminacy – Static, Kinematic – Generalized measurements – Degrees of freedom – Constrained measurements – Behaviour of Structures – Principle of Superposition – Equilibrium, Compatibility and Force displacement relations.

UNIT–II STIFFNESS AND FLEXIBILITY 9 hrs

Stiffness and Flexibility matrices in single, two and n-cooridinates; Structures with constrained measurements; stiffness and flexibility coefficients – basic stiffness and flexibility method applied to spring models.

UNIT-III ENERGY CONCEPTS AND TRANSFORMATION OF INFORMATION 9 hrs

Strain energy: stiffness and flexibility matrices for strain energy – Betti's law and its applications – Properties of stiffness and flexibility matrices – Contra gradient law – Co-ordinate transformations – Transformation of element matrices to structure matrices – orthogonal transformations.

UNIT–IV STIFFNESS METHOD 9 hrs

Development of the method – Structure stiffness matrix for beams, frames and trusses using displacement transformation matrix – Internal forces due to thermal expansion and lack of fit – Direct stiffness methods – Static condensation – Transfer matrix method – Symmetry and anti-symmetry of structures – Reanalysis technique – Analysis by substructures using stiffness method-Develop computer programs for simple problems (beams, frames and trusses).

UNIT–V FLEXIBILITY METHOD 9 hrs

Flexibility method applied to statically determinate and indeterminate structures; Choice of redundant; Primary structure – General formulation – Structures flexibility matrix using force transformation matrix – Internal forces due to thermal expansion and lack of fit - Development of computer programs.

TOTAL: 45 hrs

TEXT BOOKS:

1. Devdas Menon, “Advanced Structural Analysis”, Narosa Publishing House, Daryagang, New Delhi, 2009.
2. Moshe.F.Rubinstein, “Matrix Computer Analysis of Stuctures”, Prentice Hall, 1986.

REFERENCES:

1. Rajasekaran.S, Sankarasubramanian.G, "Computational Structural Mechanics", Prentice Hall of India Pvt Ltd, New Delhi - 110 001, First Edition, 2001.
2. Pandit.G.S and Gupta.S.P, “Structural Analysis – a matrix Approach”, Tata Mc Grew Hill Publishing Company, 2004.
3. Weaver.J.R and Gere.J.M, “Matrix Analysis of Framed Structures”, CBS Publishers, New Delhi, 1986.
4. Fleming.J.F., “Computer analysis of Structural Systems”, Mcgraw Hill Book Co., 1989.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3						1						2			
CO2		2									1					2
CO3	2				3		2	1						1		
CO4		1					3								3	
CO5	3															

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162SE13	ADVANCED CONCRETE STRUCTURES			L-T-P-C	
				3-0-0-3	
Programme:	M.E. Structural Engineering	**Sem:**	**I**	**Category:**	**Core**
Aim:	To study the behaviour, analysis and design of R.C. structures.				
Course Outcomes:					
The Students will be able to CO1: Calculate deflection and crack width of structural Elements. CO2: Design the special elements of reinforced structures like shear wall, corbels, and deep beams. CO3: Design flat slabs and flat plates according to ACI and Indian standards. CO4: Analyze and design plastic and inelastic frame structures. CO5: Detail the ductility of structures and importance of quality control of concrete.					

UNIT–I OVERALL REVIEW **9 hrs**

Review of limit state design of beams, slabs and columns according to IS Codes. Calculation of deflection and crack width according to IS and ACI Codes

UNITII DESIGN OF SPECIAL RC ELEMENTS **9 hrs**

Design of slender columns-Design of RC walls-ordinary and shear walls. Strut and tie method of analysis for corbels and deep beams, Design of corbels, Deep-beams and grid floors.

UNIT–III FLAT SLABS AND YIELD LINE THEORY **9 hrs**

Design of Column-Supported Slabs (with/without Beams) under Gravity Loads - Direct design method - Equivalent frame method - Shear in Column - Supported two-way slabs - Design of spandrel beams - Yield line theory and Hillerborg's strip method of design of slabs

UNIT-IV PLASTIC DESIGN **9 hrs**

Limit analysis - Moment redistribution - Codal recommendations for Moment redistribution - Baker's method of plastic design - Design of cast-in-situ joints in frames.

UNIT–V DETAILING AND FIELD PRACTICE **9 hrs**

Detailing for ductility - Measures of ductility - Flexural yielding in frames and walls - Flexural members in ductile frames - Columns and frame members subject to bending and axial load - Joints in ductile frames - shear walls - Fire resistance of structural members – Code requirements - Quality control of concrete.

TOTAL: 45 hrs

TEXT BOOKS:

1. Unnikrishna Pillai and Devdas Menon "Reinforced concrete Design', Tata McGraw Hill Publishers Company Ltd., New Delhi, 2006.
2. Varghese, P.C., "Limit State Design of Reinforced Concrete", Prentice Hall of India, 2007.
3. Varghese, P.C, "Advanced Reinforced Concrete Design", Prentice Hall of India, 2005.

REFERENCES:

1. Purushothaman, P, "Reinforced Concrete Structural Elements: Behaviour Analysis and Design", Tata McGraw Hill, 1986
2. Sinha.N.C. and Roy S.K., "Fundamentals of Reinforced Concrete", S.Chandand Company Limited, New Delhi, 2003.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3						1						2			
CO2		2									2					2
CO3	2				3		2	2						1		
CO4		1					3			1					3	
CO5	3															

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162SE14	THEORY OF ELASTICITY AND PLASTICITY				L-T-P-C
					4-0-0-4
Programme:	M.E. Structural Engineering	**Sem:**	**I**	**Category:**	**Core**
AIM:	To understand the concept of 3D stress, strain analysis and its applications to simple problems.				

Course Outcomes:

The Students will be able to

CO1: Explain the theory of elasticity including strain/displacement and Hooke's law relationships.

CO2: Solve the two dimensional problems in Cartesian and polar co-ordinates

CO3: Derive the torsion of thin walled open and closed sections

CO4: Apply the Principle of Virtual work and energy theorems.

CO5: Explain the plastic stress strain relationship and thick cylinders

UNIT–I ELASTICITY **12 hrs**

Analysis of stress and strain, Equilibrium equations - Compatibility equations – stress strain relationship. Generalized Hooke's law.

UNIT–II ELASTICITY SOLUTION **12 hrs**

Plane stress and plane strain - Simple two dimensional problems in Cartesian and polar co-ordinates.

UNIT–III TORSION OF NON-CIRCULAR SECTION **12 hrs**

St.venant's approach - Prandtl's approach – Membrane analogy - Torsion of thin walled open and closed sections.

UNIT–IV ENERGY METHODS **12 hrs**

Strain energy – Principle of virtual work – Energy theorems – Rayleigh Ritz method – Finite difference method – Application to elasticity problems.

UNIT–V PLASTICITY **12 hrs**

Physical Assumptions – Yield criteria - Plastic stress strain relationship. Elastic plastic problems in bending – torsion and thick cylinder.

TOTAL: 60 hrs

TEXT BOOK

1. Sadhu Singh, "Theory of Elasticity", Khanna Publishers, New Delhi 1988.
2. Ernest E.Sechler "Elasticity in Engineering" Dover Publications, New York, 1968.

REFERENCES

1. Slater R.A.C, “Engineering Plasticity”, John Wiley and Son, New York, 1977.
2. Chou P.C. and Pagano, N.J. "Elasticity Tensor, Dyadic and Engineering Approaches”, D.Van Nostr and Co., Inc., London, 1967.
3. Timoshenko, S and GoodierJ.N. "Theory of Elasticity", McGraw Hill BookCo., Newyork, 1988.
4. Hearn , E.J. “Mechanics of Materials”, Vol.2, Pergamon Press, Oxford, 1985
5. Irving H.Shames and James, M.Pitarresi, “Introduction to Solid Mechanics”, Prentice Hall of India Pvt. Ltd., New Delhi -2002.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2										3	2	1	
CO2	3		2	2						1				2	1	
CO3	3	2	2				1					2	3	2	1	
CO4	3		2			2							3	2		
CO5	3		2		3							3	3		1	

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162SE21	FINITE ELEMENT ANALYSIS				L-T-P-C
					4-0-0-4
Programme:	M.E. Structural Engineering	**Sem:**	**I**	**Category:**	**Core**
AIM:	To study the energy principles, finite element concept, stress analysis, meshing, nonlinear problems and applications.				
Course Outcomes:					
The Students will be able to CO1: Define the theoretical basis of the weighted residual Finite Element Method. CO2: Implement the Galerkin residual weak formulation into the Finite Element Method for the solution of Ordinary and Partial Differential Equations CO3: Select appropriate elements and formulate the structure accordingly to reproduce the real behaviour. CO4: Compute the stiffness values of an 8-noded element. CO5: Perform finite element analysis using 2-D triangular and rectangular elements.					

UNIT–I FUNDAMENTAL CONCEPTS 12 hrs

Introduction – stresses and equilibrium – boundary conditions (Strain displacement relations) – Stress strain relations (potential energy and equilibrium) – Weighted integral and weak formulation – Variational approach – Rayleigh ritz method.

UNIT–II ONE DIMENSIONAL PROBLEMS 12 hrs

Introduction (Finte element modeling, coordinates and shape functions) – The potential energy approach – Assembly of gobal stiffness matrix and load vector – Properties of k, finite element equations and treatment of boundary conditions – One dimentional prolems – Quadratic shape functions.

UNIT–III TRUSSES 12 hrs

Introduction (Plane trusses) – Local and global coordinate systems – Element stiffness matrix – Stress calculations – Problems in finding stresses in truss members – Introduction to three dimensional trusses (space structures).

UNIT–IV TWO DIMENSIONAL PROBLEMS 12 hrs

Introduction (Finte element modeling of two dimensional problems) – Constant strain triangle (Isoparametric representation) – Potential energy approach (Element stiffness matrix and Force terms) – Stress calculations – Problems in two dimensional stress field - Isoparametric elements – Four node quadrilateral (Shape functions and element stiffness matrix) – Eight and nine node quadrilateral – One and two point formula- Two dimensional integral – Problems in numerical integration using gauss quadrature formula.

UNIT–V MISCELLANCEOUS TOPICS 12 hrs

Higher order elements – plate bending and shell elements – FEM for dynamic problems – Error evaluation- Auto Adaptive Mesh Generation Techniques – Introduction to three dimensional problems - FEM software.

TOTAL: 60 hrs

TEXT BOOKS

1. S. S. Bhavikatti, “Finite Element Analysis”, New Age Publishers, 2007.
2. C. S. Krishnamoorthy, “Finite Element Analysis: Theory and Programming”, Tata McGraw-Hill, 1995
3. David Hutton, “Fundamentals of Finite Element Analysis”, Tata McGraw HillPublishing Company Limited, New Delhi, 2005.

REFERENCES

1. Bathe, K.J., “Finite Element Procedures in Engineering Analysis”, PrenticeHall Inc., 1996.
2. Zienkiewicz, O.C. and Taylor, R.L., “The Finite Element Method”, McGraw – Hill, 1987.
3. Tirupathi R. Chandrupatla, and Ashok D. Belegundu, “Introduction to Finite Elements in Engineering”, Prentice Hall of India, 1997.
4. Moaveni, S., “Finite Element Analysis Theory and Application with ANSYS”, Prentice Hall Inc., 1999.
5. Rajasekaran.S, “Finite Element Analysis in Engineering Design”, S.Chand and Company Ltd., 2003.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3		2		1								1			
CO2	3		2		1		1			2				3		
CO3	3	2		3	2		1					2			2	
CO4	3		2		1								1			
CO5	3	2		3	2							3				3

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162SE22	STRUCTURAL DYNAMICS				L-T-P-C
					4-0-0-4
Programme:	M.E. Structural Engineering	**Sem:**	**II**	**Category:**	**Core**
AIM:	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:					
The Students will be able to CO1: Discuss the various elements of vibration and its characteristics. CO2: Analyze vibrations in Two Degree of Freedom System. CO3: Analyze MDOF vibrations and its elements. CO4: Explain dynamic analysis of continuous system and its application. CO5: identify the practical application of dynamic calculations in various fields.					

UNIT–I PRINCIPLES OF DYNAMICS **12 hrs**

Vibration and its importance to structural engineering problems – Simple harmonic motion - Mathematical modelling of dynamic systems - Degree of freedom – Equation of motion for S.D.O.F - Damped and undamped free vibrations – Undamped forced vibration – Critical damping – Response to harmonic excitation – Damped or undamped.

12 hrs

UNIT–II TWO DEGREE OF FREEDOM SYSTEMS

Equations of Motion of two degree of freedom systems - Damped and undamped free vibrations – Undamped forced vibration - Normal modes of vibration - Applications.

UNIT–II DYNAMIC ANALYSIS OF MDOF **12 hrs**

Multidegree of freedom system- undamped free vibrations - Orthogonality relationship - Approximate methods - Holzer - Rayleigh - Rayleigh-Ritz - mode superposition technique - Numerical integration procedure- Central Difference – Newmark's method.

UNITIV DYNAMIC ANALYSIS OF CONTINUOUS SYSTEMS **12 hrs**

Free and forced vibration of continuous systems- axial vibration of a beam- Flexural vibration of a beam - Rayleigh – Ritz method –Formulation using Conservation of Energy – Formulation using Virtual Work.

UNIT–V PRACTICAL APPLICATIONS **12 hrs**

Idealisation and formulation of mathematical models for wind, earthquake, blast and impact loading, aerodynamics, gust phenomenon - Base isolation techniques – Earthquake Resistant Design.

TOTAL: 60 hrs

TEXT BOOKS

1. Paz, Structural Dynamics: “Theory and Computation”, Kluwer Academic Publication, 2004.
2. Anil K.Chopra, “Dynamics of Structures”, Pearson Education, 2001.
3. Manicka Selvam K., “Elementary structural dynamics”, Dhanpatrai and sons, Newdelhi, 2001.

REFERENCES

1. Clough, R.W. and Penzien.J, “Dynamics of structure”, McGraw Hill, New York, 1993.
2. Berg.Glen., “Element of structure dynamics”, Prentice hall Englewood Cliffs, New jersy, 1989.
3. William Thomson, “Theory of vibration and its applications”, George Allen Pub.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1		2											2		3	
CO2	3		3					3								1
CO3	2	3												2		
CO4	3		2				2			1						1
CO5	2	1													2	

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162SE23	ADVANCED STEEL STRUCTURES				L-T-P-C
					3-0-0-3
Programme:	M.E. Structural Engineering	**Sem:**	**II**	**Category:**	**Core**
AIM:	To study the behaviour of members and connections, analysis and design of steel towers, chimneys. Study the design of with cold formed steel and plastic analysis of structures.				
Course Outcomes:					
The Students will be able to CO1: Discuss the basic loads, types and methods of analyzing steel structures. CO2: Design the various types of connections with respect to the appropriate place CO3: Analyze and design steel towers by different kind of methods CO4: Analyze steel structures by plastic method. CO5: Design of light gauge steel structures.					

UNIT–I GENERAL 9 hrs

Design of members subjected to lateral loads and axial loads, Analysis and design of Industrial Buildings and bents, Sway and non-sway frames, Design of Purlins, Louver rails, Gable column and Gable wind girder - Design of Moment Resisting Base Plates – Analysis of Gable Frames.

UNIT–II DESIGN OF CONNECTIONS 9 hrs

Types of connections – Welded and riveted – Throat and Root Stresses in Fillet Welds – Seated Connections – Unstiffened and Stiffened seated Connections – Moment Resistant Connections – Clip angle Connections – Split beam Connections– Framed Connections.

UNIT–III ANALYSIS AND DESIGN OF STEEL TOWERS 9 hrs

Analysis and Design of Microwave / Transmission Line Towers - Types of bracing patterns - Sag and Tension calculations. Design of Self-supporting Chimney – Design of Base Plates, Foundations and Anchor bolts and Guyed Steel Chimney - Guy ropes- Stresses due to wind. Along with load calculation - Gust Factor Method.

UNIT–IV PLASTIC ANALYSIS OF STRUCTURES 9 hrs

Introduction, Shape factor, Moment redistribution, Combined mechanisms, Analysis of portal frames, Effect of axial force - Effect of shear force on plastic moment, Connections - Requirement – Moment resisting connections. Design of Straight Corner Connections – Haunched Connections – Design of continuous beams.

UNIT–V DESIGN OF LIGHT GAUGE STEEL STRUCTURES 9 hrs

Cold formed light gauge section – Type of cross sections – stiffened - multiple stiffened and unstiffened element - flat width ratio - effective design width – Design of light gauge compression member – Effective width for load and deflection determination - Design of tension members – Design of flexural members – Shear lag – Flange curling.

TOTAL: 45 hrs

TEXT BOOKS

1. Subramanian.N, “Design of Steel Structures”, Oxford University Press, 2008.
2. Duggal, “Limit state design of Steel structures”, Tata McGrew Hill, New Delhi, 2010.
3. Ramachandra, “Design of Steel Structures” Vol.2, Standard Publishing House, New Delhi, 2004.

REFERENCES

1. Dayaratnam.P, “Design of Steel Structures”, A.H.Wheeler, India, 2007.
2. Linton E. Grinter, “Design of Modern Steel Structures”, Eurasia Publishing House, New Delhi, 1996.
3. John E. Lothers, “Design in Structural Steel”, Prentice Hall of India, New Delhi, 1990.
4. Lynn S. Beedle, “Plastic Design of Steel Frames”, John Wiley and Sons, New York, 1990.
5. Wie Wen Yu, “Design of Cold Formed Steel Structures”, McGraw Hill Book Company, New York, 1996.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3											2				3
CO2		2		2					1					2		
CO3	2					1					2	1				
CO4		2												2	1	
CO5	3		2								3	1				

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162SE24	STABILITY OF STRUCTURES				L-T-P-C
					3-0-0-3
Programme:	M.E. Structural Engineering	**Sem:**	**II**	**Category:**	**Core**
AIM:	To study the concept of buckling and analysis of structural elements.				
Course Outcomes:					
The Students will be able to CO1: Achieve Knowledge of design and development of problem solving skills. CO2: Understand the principles of strength and stability CO3: Design and develop analytical skills. CO4: Appraise the Stability analysis by finite element approach. CO5: Understand the concepts of Lateral buckling of beams.					

UNIT I BUCKLING OF COLUMNS 9 hrs

States of equilibrium - Classification of buckling problems - concept of equilibrium, energy, imperfection and vibration approaches to stability analysis - Eigen value problem. Governing equation for columns - Analysis for various boundary conditions - using Equilibrium, Energy methods. Approximate methods - Rayleigh Ritz, Galerkins approach - Numerical Techniques - Finite difference method - Effect of shear on buckling

UNIT–II BUCKLING OF BEAM-COLUMNS AND FRAMES 9 hrs

Theory of beam column - Stability analysis of beam column with single and several concentrated loads, distributed load and end couples Analysis of rigid jointed frames with and without sway - Moment distribution - Slope deflection and stiffness method.

UNIT–III TORSIONAL AND LATERAL BUCKLING 9 hrs

Torsional buckling - Torsional and flexural buckling - Local buckling. Buckling of Open Sections. Numerical solutions. Lateral buckling of beams, pure bending of simply supported beam and cantilever.

UNIT–IV BUCKLING OF PLATES 9 hrs

Governing differential equation - Buckling of thin plates, various edge conditions - Analysis by equilibrium and energy approach - Approximate and Numerical techniques

UNIT–V INELASTIC BUCKLING 9 hrs

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

TOTAL: 45 hrs

TEXT BOOKS

1. Timoshenko, S., and Gere., "Theory of Elastic Stability", McGraw Hill Book Company, 1963.
2. H.G.Allen & P.S.Bulson, "Background to Buckling", Mc Graw Hill Co., 1980.
3. Chajes.A, "Principles of Structural Stability Theory", Prentice Hall, Inc., New Jersey, 1974.

REFERENCES

1. Chajes, A. "Principles of Structures Stability Theory", Prentice Hall, 1974.
2. Ashwini Kumar, "Stability Theory of Structures", Tata Mc Graw Hill Publishing Company Ltd., New Delhi, 1995.
3. Iyenger. N.G.R. "Structural stability of columns and plates", Affiliated East West Press, 1986.
4. Gambhir, "Stability Analysis and Design of Structures", springer, New York, 2004.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2											3			
CO2		2		2		3				1					2	
CO3				2		3	1	2				2	1			
CO4	2	3														2
CO5				1		1						3				

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162SE27	ADVANCED STRUCTURAL ENGINEERING LABORATORY	L 0	T 0	P 4	C 2

Course Outcomes:

The Students will be able to discuss about advanced testing systems of RC elements, Measure the ultimate bearing load and deflection of beam, Validate the static and dynamic load testing of steel and RC beams, Highlight impotent procedures and methodology of advanced testing systems of concrete elements and Conduct NDT test and analyse the quality of concrete structures.

List of Experiments

1. Concrete Mix Design-I.S. and ACI Code Method
2. Tests on Self Compacting Concrete using Slump Flow,L-Box,J-Ring,U-Box and V-Funnel
3. Determination of Impact Resistance of Concrete
4. Flexure beaviour of simply supported reinforced concrete beam.
5. Flexure behavior of simply supported steel beam.
6. Test on reinforced concrete column subjected to concentric and eccentric loading.
7. Static cyclic testing of single bay two storied steel frames and evaluate
   a) Drift of the frame.
   b) Stiffness of the frame.
   c) Energy dissipation capacity of the frame.
8. Determination of in-situ strength and quality of concrete using
   i) Rebound hammer and
   ii)Ultrasonic Pulse Velocity Tester

LABORATORY EQUIPMENTS REQUIREMENTS

1. Strong Floor
2. Loading Frame
3. Hydraulic Jack
4. Load Cell
5. Proving Ring
6. Demec Gauge
7. Electrical Strain Gauge with indicator
8. Rebound Hammer
9. Ultrasonic Pulse Velocity Tester
10. Dial Gauges
11. Clinometer
12. Vibration Exciter
13. Vibration Meter

162SEE01	ADVANCED CONCRETE TECHNOLOGY			L-T-P-C	
				3-0-0-3	
Programme:	M.E. Structural Engineering	**Sem:**	-	**Category:**	**Elective**
AIM:	To study the properties of materials, tests and mix design for concrete.				
Course Outcomes:					
The Students will be able to CO1: Discuss importance of concrete making materials and its quality conctrol CO2: Analysis the properties of fresh and harden concrete with respect to Indian Standards. CO3: Design mix of concrete for various grades in order to fill the requirements.. CO4: Differentiate ordinary and special concrete properties and its applications. CO5: Analyse the principles of concreting methods for different situation.					

UNIT–I CONCRETE MAKING MATERIALS 9 hrs

Cement - Manufacturing - Types and grades of cement – Chemical composition – Hydration of cement - micro structure of hydrated cement - Testing of cement – Special cements - Aggregates - classifications – IS specifications - Properties - Grading and specified grading - Methods of combining aggregates – Testing of aggregates - Water – Physical and chemical properties - Admixtures – chemical & mineral admixtures – Mineral additives

UNIT–II PROPERTIES OF CONCRETE 9 hrs

Properties and Tests on fresh and Hardened concrete – Structural properties – Strength, factors affecting the strength of concrete - Maturity of concrete, modulus of elasticity, creep-shrinkage, factors affecting creep and shrinkage of concrete – Microstructure of concrete - Micro cracking - Testing of existing and aged structures using NDT - Variability of strength in concrete - Durability of concrete – Chemical attack on concrete.

UNIT–III QUALITY CONTROLE AND CONCRETE MIX DESIGNS 9 hrs

Factors causing variations in the quality of concrete – Field control – Advantages of Quality control – Application – Quality management in Concrete Construction. Principles of mix design - Methods of concrete mix design - Factors influencing mix proportions - IS, ACI and British methods of mix design – Statistical quality control – Sampling and acceptance criteria.

UNIT–IV SPECIAL CONCRETE 9 hrs

Light weight concrete and types – Fly ash concrete – Fibre reinforced
concrete types & applications - Sulphur concrete - Sulphur impregnated concrete - Polymer concrete & its types - Super plasticized and hyper plasticized concretes - Epoxy resins and screeds, properties - Their applications in rehabilitation works - High performance concrete, high performance fibre reinforced concrete - Roller compacted concrete - Self-compacting concrete and its applications - Bacterial concrete – Recycled aggregate concrete - Smart concrete – Ferro cement and its applications.

UNIT–V CONCRETING METHODS 9 hrs

Concrete manufacturing process - Stages of manufacturing - Transportation, placing and curing methods - Extreme weather concreting - Special concreting methods - Vacuum dewatering - Underwater concreting - Special form work types.

TOTAL: 45 hrs

TEXT BOOKS

1. Shetty M.S., Concrete Technology, S.Chand and Company Ltd. Delhi, 2015.
2. Gambhir M.L., Concrete Technology,Theory and Practice, McGraw Hill Education(India)Private Limited, New Delhi, 2015.

REFERENCES

1. Neville, A.M., Properties of Concrete, Prentice Hall, 2015, London.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1		1										2				3
CO2		2	2	2					1					3		
CO3			1			1		1			2	1				2
CO4		2		2								2		1	2	
CO5		3	2								3	1				1

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162SEE02	EXPERIMENTAL TECHNIQUES AND INSTRUMENTATION				L-T-P-C
					3-0-0-3
Programme:	M.E. Structural Engineering	**Sem:**	-	**Category:**	**Elective**
AIM:	To learn the principles of measurements of static and dynamic response of structures and carryout the analysis of results.				
Course Outcomes:					
The Students will be able to CO1: Discuss about forces and strain measurement in multi stage testing systems. CO2: Measure the basic elements of vibration using different aids CO3: Get idea of acoustics and wind flow measuring systems with modeling techniques. CO4: Compute the value of corrosion of reinforcement and distress measurements. CO5: Differentiate application of Destructive Testing methods from other systems.					

UNIT I FORCES AND STRAIN MEASUREMENT 9 hrs

Choice of Experimental stress analysis methods, errors in measurements – Strain gauge - principle - types, performance and uses- Hydraulic jacks and pressure gauges – Electronic load cells – Proving Rings – Calibration of Testing Machines – Long-term monitoring – Vibrating wire sensors– Fibre optic sensors.

UNIT II VIBRATION MEASUREMENTS 9 hrs

Characteristics of structural vibrations – Linear variable differential Transformer (LVDT) – Transducers for velocity and acceleration measurements - Vibration meter – Seismographs – Vibration Analyzer – Display and recording of signals – Cathode Ray Oscilloscope – XY Plotter – Chart Plotters – Digital data Acquisition systems.

UNIT III ACOUSTICS AND WIND FLOW MEASURES 9 hrs

Principles of Pressure and flow measurements – Pressure transducers – sound level meter – Venturimeter and flow meters – Wind tunnel and its use in structural analysis - structural modeling – Direct Model Study and Indirect Model study.

UNIT IV DISTRESS MEASUREMENTS AND CONTROL 9 hrs

Diagnosis of distress in structures – Crack observation and measurements – Corrosion of reinforcement in concrete – Half cell, construction and use – Damage assessment – Controlled blasting for demolition – Techniques for residual stress measurements.

UNIT V NON DESTRUCTIVE TESTING METHODS 9 hrs

Load testing on structures, buildings, bridges and towers – Rebound Hammer – Acoustic emission – Ultrasonic testing principles and application – Holography – Use of laser for structural testing – Brittle coating, Advanced NDT methods – Ultrasonic pulse echo, Impact echo, impulse radar techniques, GECOR - Ground penetrating radar (GPR).

TOTAL: 45 hrs

TEXT BOOKS

1. Sadhu Singh, "Experimental Stress Analysis", Khanna Publishers, New Delhi,1996
2. Srinath.L.S, Raghavan.M.R, ingaiah.K, Gargesha.G, Pant.B and Ramachandra.K, "Experimental Stress Analysis", Tata McGraw Hill Company, New Delhi, 1984.

REFERENCES

1. Dalley.J.WandRiley.W.F, "Experimental Stress Analysis", McGraw Hill Book Company, N.Y. 1991.
2. Sirohi.R.S.,Radhakrishna.H.C, "Mechanical Measurements", New Age International (P) Ltd. 1997.
3. Ganesan T.P., "Model Analysis of Structures", Universities Press (India) Ltd 2005.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1		3												3		
CO2	2	2									1	2	2			
CO3	2	3			3			1		1		1		1		
CO4	2	2					3					1			2	
CO5	2						3							1	2	

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162SEE03	EARTHQUAKE ANALYSIS AND DESIGN OF STRUCTURES				L-T-P-C
					3-0-0-3
Programme:	M.E. Structural Engineering	**Sem:**	-	**Category:**	**Elective**
AIM:	To study the effect of earthquakes, analysis and design of earthquake resistant Structures.				
Course Outcomes:					
The Students will be able to CO1: Discuss about elements of earthquake and ground motion with instrumentation. CO2: Mention the effects of earthquake on structures by SDOFS and MDOFS CO3: Design masonry structures in order to resist earthquake force and its consequences. CO4: Design framed structures in order to resist earthquake force and its consequences. CO5: Analyse the principles of Base isolation and mathematical modelling concepts.					

UNIT–I EARTHQUAKES GROUND MOTION 9 hrs

Engineering Seismology - elastic rebound theory - plate tectonic theory - Seismic waves - earthquake size - measurement of earthquakes - strong ground motions - Tsunami - Seismic zoning map of India Information on some disastrous earthquakes.

UNIT–II EARTHQUAKE ANALYSIS AND DESIGN CONCEPTS 9 hrs

Response spectra - introduction to methods of seismic analysis – Equivalent static analysis IS 1893 provisions – Response spectrum method – Time history method – Push over analysis - Mathematical modeling of multi-storey RC Building - Design methodology –Architectural consideration - geotechnical consideration - structural design consideration - Capacity design - Techniques of aseismic design.

UNIT–III EARTHQUAKE DESIGN OF MASONRY BUILDINGS 9 hrs

Guidelines for earthquake resistant earthen buildings and masonry buildings - Design considerations.

UNIT–IV EARTHQUAKE RESISTANT DESIGN OF RC STRUCTURES 9 hrs

Earthquake Resistant Design of R.C.C. Buildings - Material properties - Lateral load analysis - Design and detailing – Rigid Frames – Shear wall – Coupled Shear wall.

UNIT–V SPECIAL TOPICS 9 hrs

Liquefaction, vibration control - Tuned mass dampers – Principles and application, Basic concept of seismic base Isolation – Various systems- Case studies

TOTAL: 45 hrs

TEXT BOOKS

1. S K Duggal, “Earthquake Resistant Design of Structures”, Oxford University Press, 2007.
2. Paulay,T and Priestly, M.N.J., “Aseismic Design of Reinforced Concrete and Masonry buildings”, John Wiley and Sons, 1991.
3. Bruce A Bolt, “Earthquakes” W H Freeman and Company, New York, 2004.
4. Bungale S.Taranath "Structural Analysis and Design of Tall Buildings - McGraw Hill Book Company, New York, 1999.

REFERENCES

1. Course Notes "Design of Reinforced Concrete Buildings", IIT Kanpur, June1999.
2. PankajAgarwal and Manish Shrikhande, “Earthquake Resistant Design of Structures”, Prentice Hall of India, 2006.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3											2				3
CO2		2		2					1					2		
CO3	2					1					2	1				
CO4		2												2	1	
CO5	3		2								3	1				

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162SEE04	OPTIMIZATION OF STRUCTURES				L-T-P-C
					3-0-0-3
Programme:	M.E. Structural Engineering	**Sem:**	-	**Category:**	**Elective**
AIM:	To study the optimization methodologies applied to structural engineering				
Course Outcomes:					
The Students will be able to CO1: Apply the basic ideas in optimization to make the structures as lightly as possible. CO2: Apply the linear programming techniques in engineering optimization. CO3: Solve the unconstrained and constrained optimization problems in structural design. CO4: Understand the methods in solving the problems related to geometric and dynamic Programming. CO5: Have knowledge in advanced techniques of optimization such as genetic algorithm and Artificial Neural Networks.					

UNIT–I BASIC PRINCIPLES AND CLASSICAL OPTIMIZATION TECHNIQUES 9 hrs

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

UNIT–II LINEAR AND NON-LINEAR PROGRAMMING 9 hrs

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

NON LINEAR PROGRAMMING: One Dimensional minimization methods: Uni dimensional - Uni modal function – Exhaustive and unrestricted search - Dichotomous search - Fibonacci Method - Golden section method - Interpolation methods. Unconstrained optimization Techniques.

UNIT–III GEOMETRIC PROGRAMMING 9 hrs

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

UNIT–IV DYNAMIC PROGRAMMING 9 hrs

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

UNIT–V STRUCTURAL APPLICATIONS 9 hrs

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

TOTAL: 45 hrs

TEXT BOOKS

1. Rao,S.S. “Optimization theory and applications”, Wiley Eastern (P) Ltd.,1984
2. Uri Krish, “Optimum Structural Design”, McGraw Hill Book Co. 1981

REFERENCES

1. Spunt, “Optimization in Structural Design”, Civil Engineering and Engineering Mechanics Services, Prentice-Hall, New Jersey 1971.
2. Iyengar.N.G.R and Gupta.S.K, “Structural Design Optimisation”, Affiliated East West Press Ltd, New Delhi, 1997.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1		3		2	1								3			
CO2		2		2	3					1				2		
CO3	2	1	3				1					2			1	
CO4			2			3										2
CO5												3			3	

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162SEE05	CORRODION AND DURABILITY STUDIES				L-T-P-C
					3-0-0-3
Programme:	M.E. Structural Engineering	**Sem:**	-	**Category:**	**Elective**
AIM:	The aim of this course is to make the students to have knowledge about corrosion and Durability of concrete structures.				
Course Outcomes:					
The students will be able to CO1: Identify the necessity of corrosion studies with respect to places. CO2: Monitor the rate of corrosion in steel and concrete of RCC and pre stressed structures. CO3: Explain testing methodology and standards of corrosion at various conditions. CO4: Illustrate the process of polarization and its techniques. CO5: Discuss the concepts of electro less plating and anodizing.					

UNIT I CORROSION 9 hrs

Introduction of corrosion of steel in concrete – factors responsible for corrosion of steel in concrete –transport mechanisms of ions in concrete – corrosion of reinforced and prestressed concrete – corrosion of blended cement concrete - expressions for corrosion rate, emf and galvanic series , merits and demerits, Pourbaix diagram for iron, magnesium and aluminium - Forms of corrosion, Uniform, pitting, intergranular, stress corrosion – Corrosion fatigue - Dezincification - Erosion corrosion - Crevice corrosion - Cause and remedial measures, Pilling Bed worth ratio, High temperature oxidation.

UNIT II CORROSION MONITORNG AND TESTING ON R.C.C 9 hrs

Corrosion monitoring in R.C.C. and pre-stressed concrete structures –special steels and concretes – coating to concrete – coatings to steel – repairing of corroded concrete structures – repair materials – residual life estimation – deterioration of concrete. Purpose of corrosion testing, classification, humidity and porosity tests, accelerated weathering tests - Chloride ion test and impedance analysis - ASTM standards for corrosion testing.

UNIT III POLARIZATION 9 hrs

Polarization - Exchange current density, Activation polarization, Tafel Equation, Passivating metals and nonpassivating metals, Effect of oxidizing agents. Coating based on cements – cathodic protection of concrete structures – sacrificial anodes – impressed current cathode.

UNIT IV DURABILITY OF CONCRETE 9 hrs

Durability of concrete - causes for inadequate durability of concrete chloride diffusion - Carbonation of concrete - Sulphate attack - Acid attack on concrete – Alkali - Silica reaction - Abrasion resistance - Fire resistance - Erosion resistance – Cavitations - Flame resistance - corrosion resistance - Chemical resistance of concrete and other durability tests methods on concrete.

UNIT V CRACKS, CRACK DETECTION AND CONTROL 9 hrs

Classifications of cracks in plain and reinforced concrete - Types of cracks Shear cracking- Moment cracking - Torsional cracking - Settlement cracks - Cracks due to force transfer - Cracking due to earthquake forces and cracking due to other factors. Long term effects of cracking - Material and loading effects- Creep effect – Bond - Slip theory - Straight line theory - Flexural stiffness - Computation of crack width and crack spacings. Crack detection - Crack measuring techniques - Control of cracking in plain and reinforced concrete beams and columns - Crack control by material selection - Advanced crack control and repair techniques.

TOTAL: 45 hrs

TEXT BOOKS

1. Fontana and Greene., Corrosion Engineering, McGraw Hill Book Co, New York, 1983.
2. Raj Narayan ., An Introduction to Metallic Corrosion and its prevention, Oxford and IBH, New Delhi, 1983.

REFERENCES

1. Budinski, K.G., Surface Engineering for Wear Resistance, Prentice Hall Inc., Engelwood Cliff, New Jersey, USA, 1988.
2. Uhlig, H.H ., Corrosion and Corrosion Control , John Wiley and Sons, New York, USA, 1985

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3											1			2
CO2		1			2		1			1						
CO3	2		3			3	1					2	2			
CO4	3	3	2											3		1
CO5		1			2					1		3	2			

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162SEE06	THEORY OF PLATES			L-T-P-C	
				3-0-0-3	
Programme:	M.E. Structural Engineering	**Sem:**	-	**Category:**	**Elective**
AIM:	To study the behaviour and analysis of thin plates and the behavior of anisotropic and thick plates..				
Course Outcomes:					
The Students will be able to CO1: Develop the concept of plate theory CO2: Design rectangular plates for various edge conditions. CO3: Analyze of circular plates. CO4: Apply the knowledge in special and approximate methods CO5: Discuss about Orthotropic plates and grids.					

UNIT–I INTRODUCTION TO PLATES THEORY 9 hrs

Thin and thick plates - Small and large - Deflection theory of thin plate -assumptions - Moment curvature relations - stress resultants, governing - Differential equation for bending of plates - various boundary conditions.

UNIT–II RECTANGULAR PLATES 9 hrs

Navier's Solution - Simply supported rectangular plates subjected to UDL and varying loads on entire area - Parabolic loads, sinusoidal loads - partly loaded plates - concentrated loads and couples - Distributed Couples - Symmetric and Antisymmetric Loadings.

Levy's Solution - Plates subjected to UDl and varying loads, sinusoidal parabolic loads between the supported edges - Conditions for other two edges – Simply supported, fixed, free and Elastically restrained.

UNIT–III CIRCULAR PLATES 9 hrs

Bending of circular plates with clamped and simply supported edges - plate with central hole - uniformly distributed and varying loads - conical loads, Distributed couples - Ring loads - Semi circular plates - Asymmetrically loaded plates.

UNIT–IV FINITE DIFFERENCE METHOD 9 hrs

Solution of plate problems – Deviation of Delta / Pattern / Stencil for biharmonic form for a rectangular mesh - Two stage solutions - Solutions for various loadings and boundary conditions - Use of Symmetry and Anti – symmetry - extrapolation formula - Introduction to improved finite difference technique.

UNIT–V ENERGY METHODS

9 hrs

Use of potential energy principle - solution of rectangular plates with various boundary conditions and loadings.

TOTAL: 45 hrs

TEXT BOOKS

1. Timoshenko, S. and Krieger S.W. “Theory of Plates and Shells”, McGraw Hill Book Company, New York, 1990.
2. Bairagi, “Plate Analysis”, Khanna Publishers, 1999.

REFERENCES

1. Reddy J N, “Theory and Analysis of Elastic Plates and Shells”, McGraw Hill Book Company, 2006.
2. Szilard, R., “Theory and Analysis of Plates”, Prentice Hall Inc., 1995.
3. Chandrashekahara, K. Theory of Plates, University Press (India) Ltd., Hyderabad, 2001.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3										1	1			2
CO2		1			2					1						
CO3	2		3			3	1					2	2			
CO4	3	3	2											3		1
CO5		1			2			1		1		3	2			

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162SEE07	DESIGN OF BRIDGES				L-T-P-C
					3-0-0-3
Programme:	M.E. Structural Engineering	**Sem:**	-	**Category:**	**Elective**
AIM:	To study the loads, forces on bridges and design of several types of bridges.				
Course Outcomes:					
The Students will be able to CO1: Understand the design theories for super structure and substructure of bridges CO2: Design Culvert, R.C.C T beam bridge. CO3: Understand the behaviour of continuous bridges, box girder bridges. CO4: Possess the knowledge to design prestressed concrete bridges. CO5: Design Railway bridges, Plate girder bridges, different types of bearings, abutments, piers and various types of foundations for Bridges.					

UNIT–I INTRODUCTION 9 hrs

Classification, investigations and planning, choice of type, I.R.C.specifications for road bridges, standard live loads, other forces acting on bridges, Theories of Lateral Load distribution, general design considerations.

UNIT–II SHORT SPAN BRIDGES 9 hrs

Load distribution theories, analysis and design of slab culverts, tee beam and slab bridges.

UNIT–III LONG SPAN GIRDER BRIDGES 9 hrs

Design principles of continuous bridges, box girder bridges, balanced cantilever bridges.

UNIT–IV DESIGN OF PRESTRESSED BRIDGES 9 hrs

Flexural and torsional parameters – Courbon's theory – Distribution co-efficient by exact analysis – Design of girder section – maximum and minimum prestressing forces – Eccentricity – Live load and dead load shear forces – Cable Zone in girder – check for stresses at various sections – check for diagonal tension – Diaphragms – End block – short term and long term deflections.

UNIT–V DESIGN OF PLATE GIRDER BRIDGES, BEARINGS AND SUBSTRUCTURES 9 hrs

Design of riveted and welded plate girder bridges for highway and railway loading – wind effects – main section, splicing, curtailment, stiffeners – Different types of bearings – Design of bearings – Design of masonry and concrete piers and abutments – Types of bridge foundations – Design of foundations.

TOTAL: 45 hrs

TEXT BOOKS

1. Ponnuswamy, S., “Bridge Engineering”, Tata McGraw Hill, 2008.
2. Johnson Victor, D. “Essentials of Bridge Engineering”, Oxford & IBH Publishing Co. New Delhi.

REFERENCES

1. Jagadeesh.T.R. andJayaram.M.A., “Design of Bridge Structures”, PrenticeHall of India Pvt. Ltd. 2004.
2. Raina V.K.” Concrete Bridge Practice” Tata McGraw Hill Publishing Company, New Delhi, 1991.
3. Rabinson J.R. (1996), “Piers abutments and form work for bridges”, B.I.Publications, Bombay.
4. Krishnaraju N (1998), “Design of bridges”, Oxford and IBH Publishing house, New Delhi.
5. Taylor, F.W., Thomson, S.E., and Smulski E., “Reinforced Concrete Bridges”, John Wiley and Sons, New York, 1955.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2		1		1							2			
CO2	1		2									2		1		
CO3	3	2		2		2		1							2	
CO4	3	2		1		3		2		1						2
CO5		1		2		3		1				1		1	3	

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162SEE08	DESIGN OF STEEL CONCRETE COMPOSITE STRUCTURES				L-T-P-C
					3-0-0-3
Programme:	M.E. Structural Engineering	**Sem:**	-	**Category:**	**Elective**
AIM:	To develop an understanding of the behaviour and design study of Steel concrete composite elements and structures.				

Course Outcomes:

The Students will be able to

CO1: Explain the terminology related to concrete composite construction

CO2: Design the steel concrete composite beam, slab, column and trusses

CO3: Design of connections in the composite structures

CO4: Design concepts of composite box girder bridges

CO5:Explain case studies on steel concrete composite structures

UNIT–I INTRODUCTION **9 hrs**

Introduction to steel concrete composite construction – Theory of composite structures (Modular ratio and transformed section , sectional property like moment of inertia, composite action – no interaction – full interaction , Slip calculation, Stress block, Ultimate moment capacity) .

UNIT–II DESIGN OF COMPOSITE MEMBERS **9 hrs**

Design of composite beams, slabs, columns, beam – columns - design of composite trusses.

UNIT–III DESIGN OF CONNECTIONS **9 hrs**

Types of connections, Design of connections in the composite structures - shear connections. Degree of shear connection – Partial shear interaction.

UNIT–IV COMPOSITE BOX GIRDER BRIDGES **9 hrs**

Introduction - behaviour of box girder bridges - design concepts.

UNIT–V GENERAL

9 hrs

Case studies on steel - concrete composite construction in buildings - seismic behaviour of composite structures.

TOTAL : 45 hrs

TEXT BOOKS

1. Johnson R.P., "Composite Structures of Steel and Concrete", Blackwell Scientific Publications, UK, 2004.

REFERENCES

1. Oehlers D.J. and Bradford M.A., "Composite Steel and Concrete Structural Members, Fundamental behaviour", Pergamon press, Oxford, 1995.
2. Proceedings of Workshop on "Steel Concrete Composite Structures", Anna University, 2007.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3												3			
CO2		2		3		3		3						2	3	
CO3	3									2			3		3	
CO4		3		2				2						3		
CO5	3			1		1							3		2	

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162SEE09	OFFSHORE STRUCTURES				L-T-P-C
					3-0-0-3
Programme:	M.E. Structural Engineering	**Sem:**	-	**Category:**	**Elective**
AIM:	The aim to study the concept of wave theories, forces and design of jacket towers, pipes and cables.				
Course Outcomes:					
The Students will be able to CO1: Develop the concept of wave theories, forces CO2: Construct offshore structure and modelling CO3: Analysis of Static and dynamic approach CO4: Apply the knowledge in foundation Modelling CO5: Design of jackets, towers, pipes and Cables					

UNIT–I WAVE THEORIES 9 hrs

Wave generation process, small and finite amplitude wave theories.

UNIT–II FORCES OF OFFSHORE STRUCTURES 9 hrs

Wind forces, wave forces on vertical, inclined cylinders, structures - current forces and use of Morison equation.

UNIT–III OFFSHORE SOIL AND STRUCTURE MODELLING 9 hrs

Different types of offshore structures, foundation modeling, structural modeling.

UNIT–IV ANALYSIS OF OFFSHORE STRUCTURES 9 hrs

Static method of analysis, foundation analysis and dynamics of offshore structures.

UNIT–V DESIGN OF OFFSHORE STRUCTURES

9 hrs

Design of platforms, helipads, Jacket tower and mooring cables and pipe lines.

TOTAL: 45 hrs

TEXT BOOKS

1. Chakrabarti, S.K. “Hydrodynamics of Offshore Structures”, Computational Mechanics Publications, 1987.
2. Dawson.T.H., “Offshore Structural Engineering”, Prentice Hall Inc Englewood Cliffs, N.J. 1983.

REFERENCES

3. Brebia, C.A and Walker, S., “Dynamic Analysis of Offshore Structures”, New Butter worths, U.K. 1979.
4. API, Recommended Practice for Planning, Designing and Constructing Fixed Offshore Platforms, American Petroleum Institute Publication, RP2A, Dalls, Tex, 2000.
5. Reddy, D.V. and Arockiasamy, M., “Offshore Structures”, Vol.1 and Vol.2, Krieger Publishing Company, Florida, 1991.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1		3		2	1								3			
CO2		2		2	3					1				2		
CO3	2	1	3				1					2			1	
CO4			2			3										2
CO5												3			3	

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162SEE10	DESIGN OF SHELL AND SPATIAL STRUCTURES				L-T-P-C
					3-0-0-3
Programme:	M.E. Structural Engineering	**Sem:**	-	**Category:**	**Elective**
AIM:	The aim to study the behaviour and design of shells, folded plates, space frames and application of FORMIAN software.				
Course Outcomes:					
The Students will be able to CO1: Apply the structural mechanics approximations of membrane, plates and shells CO2: Examine the equilibrium theories for analysis of plates and shell structures in Civil Engineering applications CO3: Perform critical Analysis and Design of Typical Shell Structures CO4: Defined the various methods for analyzing grids for roofs and bridges. CO5: Determine the static, dynamic, and non-linear motion of membrane, plate and shell structures.					

UNIT–I SHELL CLASSIFICATION AND ANALYSIS 9 hrs

Classification of shells - Structural actions – Membrane theory - Analysis of spherical dome – Cylindrical shells – Folded plates

UNIT–II DESIGN OF SHELLS 9 hrs

Design of circular domes - Conical roofs - Circular cylindrical shells

UNIT–III FOLDED PLATES 9 hrs

Folded plate structures - Structural behaviour – Types - Design - Pyramidal roof.

UNIT–IV INTRODUCTION TO SPACE FRAME 9 hrs

Space frames - Configuration - Types of nodes - General principles of design Philosophy - Behaviour

UNIT–V FINITE ELEMENT ANALYSIS 9 hrs

Finite element application on cylindrical shells - Introduction to shell elements- Flat elements - Axisymmetric elements- Degenerated elements - General shell element

TOTAL: 45 hrs

TEXT BOOKS

1. Billington.D.P, “Thin Shell Concrete Structures”, McGraw Hill Book Co., New York, 1982.
2. Santhakumar.A.R and Senthil.R, “Proceedings of International Conference onSpace Structures”, Anna University, Chennai, 1997.

REFERENCES

1. Subramanian.N ,”Principles of Space Structures”, Wheeler Publishing Co.1999.
2. Ramasamy, G.S., “Design and Construction of Concrete Shells Roofs”, CBS Publishers, 1986.
3. ASCE Manual No.31, “Design of Cylindrical Shells”

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1		3		2	1								3			
CO2		2		2	3					1				2		
CO3	2	1	3				1					2			1	
CO4			2			3										2
CO5												3			3	

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162SEE11	DESIGN OF TALL BUILDINGS				L-T-P-C
					3-0-0-3
Programme:	M.E. Structural Engineering	**Sem:**	-	**Category:**	**Elective**
AIM:	To study the behaviour, analysis and design of tall structures.				
Course Outcomes:					
The Students will be able to CO1. Describe the development of high rise building structures. CO2. Apply the behavior of shear walls under lateral loading. CO3. Explain the design of flat slab building structures and tubular system. CO4. Examine the approximate design of Rigid Frame buildings. CO5. Describe the deep beam systems and high rise suspension system of building structures.					

UNIT–I DESIGN PRINCIPLES AND LOADING 9 hrs

General - Factors affecting growth, height and structural form - Design philosophy - Loading - Gravity loading - Wind loading - Earthquake loading - Combinations of loading - Strength and Stability - Stiffness and drift limitations - Human comfort criteria- Creep effects - Shrinkage effects - Temperature effects - Fire - Foundation settlement – Soil structure interaction, Material.

UNIT–II BEHAVIOUR OF VARIOUS STRUCTURAL SYSTEMS 9 hrs

Factors affecting growth, Height and Structural form - High rise behaviour, Rigid frames, braced frames, Infilled frames, shear walls, coupled shear walls, wall-frames, tubulars, cores, futrigger - braced and hybrid mega systems.

UNIT–III ANALYSIS OF TALL BUILDINGS 9 hrs

Modeling for analysis - Assumptions - Modeling for approximate analyses - Modeling for accurate analysis - Reduction techniques - Dynamic analysis - Response to wind loading - Along-wind response - Across-wind response - Estimation of natural frequencies & damping - Types of excitation - Design to minimise dynamic response - Response to earthquake motions - Response to ground accelerations - Response spectrum analysis - Estimation of natural frequencies and damping - Human response to building motions.

UNIT–IV STRUCTURAL ELEMENTS 9 hrs

Sectional shapes, properties and resisting capacity, design, deflection, cracking, prestressing, shear flow, Design for differential movement, creep and shrinkage effects, temperature effects and fire resistance.

UNIT–V STABILITY OF TALL BUILDINGS 9 hrs

Overall buckling analysis of frames, wall-frames, Approximate methods, second order effects of gravity of loading, P-Delta analysis, simultaneous first-order and P- Delta analysis, Translational, Torsional instability, out of plumb effects, stiffness of member in stability, effect of foundation rotation.

TOTAL: 45 hrs

TEXT BOOKS

1. Bryan Stafford Smith and Alexcoull, "Tall Building Structures - Analysis and Design", John Wiley and Sons, Inc., 1991.
2. Taranath B.S., "Structural Analysis and Design of Tall Buildings", Mc Graw Hill, 1988.

REFERENCES

1. Gupta.Y.P.,(Editor), Proceedings of National Seminar on High Rise Structures- Design and Construction Practices for Middle Level Cities, New Age International Limited, New Delhi,1995.
2. Lin T.Y and Stotes Burry D, "Structural Concepts and systems for Architects and Engineers", John Wiley, 1988.
3. Beedle.L.S., "Advances in Tall Buildings", CBS Publishers and Distributors, Delhi, 1986.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3			2	2								2			
CO2				2			2	2				1				3
CO3	2	2	3													2
CO4	3			2	2						2				3	
CO5		2			2		2			1		1	2			

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162SEE12	WIND AND CYCLONE EFFECTS ON STRUCTURES				L-T-P-C
					3-0-0-3
Programme:	M.E. Structural Engineering	**Sem:**	-	**Category:**	**Elective**
AIM:	To study the concept of wind effects, analysis and design of structures.				
Course Outcomes:					
The Students will be able to CO1: Understand the basics of wind development and various aspects. CO2: Understand the various effects of winds on the structures. CO3: Design the roofs, chimneys as per IS Code. CO4: Apply the knowledge on effect of strong wind. CO5: Design the Structures as cyclone resistant.					

UNIT–I INTRODUCTION **9 hrs**

Introduction, Spectral studies, Gust factor, Wind velocity, Method of measurement, variation of speed with height, shape factor, aspect ratio and drag effects.

UNIT–II WIND TUNNEL STUDIES **9 hrs**

Wind Tunnel Studies, Types of tunnels, Modeling requirements, Interpretation of results, Aero-elastic models.

UNIT–III EFFECT OF WIND ON STRUCTURES **9 hrs**

Wind on structures, Rigid structures, Flexible structures, Static and dynamic effects, Tall buildings, chimneys.

UNIT–IV IS CODES AND SPECIAL STRUCTURES **9 hrs**

Application to design, IS 875 code method, Buildings, Chimneys, Roofs, Shelters

UNIT–V CYCLONE EFFECTS **9 hrs**

Cyclone effect on structures, cladding design, window glass design.

TOTAL: 45 hrs

TEXT BOOKS

1. Cook.N.J., “The Designer's Guide to Wind Loading of Building Structures”, Butter worths, 1989.
2. Kolousek.V, Pirner.M, Fischer.O and Naprstek.J, “Wind Effects on Civil Engineering Structures”, Elsevier Publications, 1984.

REFERENCES

1. Peter Sachs, “Wind Forces in Engineering”, Pergamon Press, New York, 1972.
2. Lawson T.V., “Wind Effects on Building Vol. I and II”, Applied Science Publishers, London, 1980.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3			2	2								2			
CO2				2			2	2				1				3
CO3	2	2	3													2
CO4	3			2	2										3	
CO5		2			2		2			2		1	2			

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162SEE13	SOIL STRUCTURE INTERACTION				L-T-P-C
					3-0-0-3
Programme:	M.E. Structural Engineering	**Sem:**	-	**Category:**	**Elective**
AIM:	To get exposed to the behavioral aspects of structures when it is founded on different soils with different characteristics.				
Course Outcomes:					
The Students will be able to CO1: To develop an idea about soil-foundation interaction CO2: To understand the solid models CO3: Numerical analysis of finite plates CO4: To familiarize with elastic analysis of pile CO5: Load - deflection predication for laterally loaded piles					

UNIT–I SOIL-FOUNDATION INTERACTION 9 hrs

Introduction to soil-Foundation interaction problems, soil behaviour, Foundation behaviour, Interface behaviour, Scope of soil foundation interaction analysis, soil response models, Winkler, Elastic continuum, Two parameter elastic models, Elastic plastic behaviour and Time dependent behavior.

UNIT–II BEAM ON ELASTIC FOUNDATION-SOIL MODELS 9 hrs

Infinite beam, Two parameters, Isotropic elastic half space, Analysis of breams of finite length, Classification of finite beams in relation to their stiffness.

UNIT–III PLATE ON ELASTIC MEDIUM 9 hrs

Infinite plate, Winkler, Two parameters, isotropic elastic medium, Thin and thick plates, Analysis of finite plates, rectangular and circular plates, Numerical analysis of finite plates, simple solutions.

UNIT–IV ELASTIC ANALYSIS OF PILES 9 hrs

Elastic analysis of single pile, Theoretical solutions for settlement and load distributions, analysis of pile group, Interaction analysis, Load distribution in groups with rigid cap.

UNIT–V LATERALLY LOADED PILE

9 hrs

Load deflection prediction for laterally loaded piles, subgrade reaction and elastic analysis, Interaction analysis, Pile raft system, Solutions, through influence charts.

TOTAL : 45 hrs

TEXT BOOKS

1. Selva durai, A.P.S, "Elastic Analysis of Soil Foundation Interaction", Elsevier, 1979.
2. Poulos, H.G, and Davis, E. H, "Pile Foundation Analysis and Design", John Wiley, 1980.

REFERENCES

1. Scott, R.F, "Foundation Analysis", Prentice Hall, 1981.
2. "Structure Soil Interaction-State of Art Report", Institution of Structural Engineers. 1978. 336.2R-88: Suggested Analysis and Design Procedures for Combined Footings and Mats (Reapproved 2002).

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3												3			
CO2		2		3		3		3						2	3	
CO3	3									2			3		3	
CO4		3		2				2						3		
CO5	3			1		1							3		2	

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162SEE14	MECHANICS OF COMPOSITE MATERIALS				L-T-P-C
					3-0-0-3
Programme:	M.E. Structural Engineering	**Sem:**	-	**Category:**	**Elective**
AIM:	To study the behaviour of composite materials and to investigate the failure and fracture characteristics.				
Course Outcomes:					
The Students will be able to CO1: Explain the terminology related to concrete composite materials CO2: Explain Concepts in solid mechanics CO3: Analysis of laminated composite materials CO4: Design failure and fracture of composites and stress strain behavior CO5: Design and application of metal and ceramic matrix composites					

UNIT–I INTRODUCTION 9 hrs

Introduction to Composites, Classifying composite materials, Commonly used fiber and matrix constituents, Composite Construction, Properties of Unidirectional Long Fiber Composites, Short Fiber Composites.

UNIT–II STRESS STRAIN RELATIONS 9 hrs

Concepts in solid mechanics, Hooke's law for orthotropic and anisotropic materials, Linear Elasticity for Anisotropic Materials, Rotations of Stresses, Strains, Residual Stresses

UNIT–III ANALYSIS OF LAMINATED COMPOSITES 9 hrs

Governing equations for anisotropic and orthotropic plates. Angle-ply and cross ply laminates. Static, dynamic and stability analysis for simpler cases of composite plates. Inter laminar stresses.

UNIT–IV FAILURE AND FRACTURE OF COMPOSITES 9 hrs

Netting Analysis, Failure Criterion, Maximum Stress, Maximum Strain, Fracture Mechanics of Composites, Sandwich Construction.

UNIT–V APPLICATIONS AND DESIGN 9 hrs

Metal and Ceramic Matrix Composites, Applications of Composites, Composite Joints, Design with Composites, Review, Environmental Issues.

TOTAL : 45 hrs

TEXT BOOKS

1. Daniel and Ishai, "Engineering Mechanics of Composite Materials", Oxford University Press, 2005.
2. Jones R.M., "Mechanics of composite materials", McGraw-Hill, Kogakusha Ltd., Tokyo, 1975.

REFERENCES

1. Agarwal.B.D. and Broutman.L.J., "Analysis and Performance of fiber composites", John-Wiley and Sons, 1980.
2. Michael W.Hyer, "Stress Analysis of Fiber-Reinforced Composite Materials", McGraw Hill, 1999.
3. Mukhopadhyay.M, "Mechanics of Composite Materials and Structures", University Press, India, 2004.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3						3		3				2		3	
CO2		3	2		3							2		3		
CO3	2					2					1		3			
CO4			2				3		2					2	3	
CO5	3	3			3		3			1		1	2		2	

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162SEE15	MAINTENANCE AND REHABILITATION OF STRUCTURES				L-T-P-C
					3-0-0-3
Programme:	M.E. Structural Engineering	**Sem:**	-	**Category:**	**Elective**
AIM:	The aim of this course is to make the students to study about damages, repair rehabilitation of structures.				
Course Outcomes:					
The Students will be able to CO1: Assess and evaluate the damaged structure and causes for deterioration. CO2: Check the quality of concrete and effect due to environmental factors CO3: Explain the materials used for repair of structures CO4: Summarize the repairing techniques due to earthquake CO5: Identify the suitable repair and demolition techniques					

UNIT–I MAINTENANCE AND REPAIR STRATEGIES 9 hrs

Maintenance - repair and rehabilitation - facets of maintenance, importance of maintenance - various aspects of inspection - assessment procedure for evaluating a damaged structure - causes of deterioration

UNIT–II SERVICEABILITY AND DURABILITY OF CONCRETE 9 hrs

Quality assurance for concrete - concrete properties- strength - permeability - thermal properties and cracking – Effects due to climate – temperature - chemicals - corrosion – Design and construction errors – Effects of cover thickness and cracking

UNIT–III MATERIALS FOR REPAIR 9 hrs

Special concretes and mortar - concrete chemicals - special elements for accelerated strength gain - Expansive cement - Polymer concrete - sulphur infiltrated concrete - Ferro cement - Fibre reinforced concrete.

UNIT–IV TECHNIQUES FOR REPAIR AND DEMOLITION 9 hrs

Rust eliminators and polymers coating for rebars during repair - foamed concrete, mortar and dry pack - vacuum concrete - Gunite and Shotcrete - Epoxy injection - Mortar repair for cracks - shoring and underpinning. Methods of corrosion protection - corrosion inhibitors - corrosion resistant steels - coatings and cathodic protection - Engineered demolition techniques for dilapidated structures – Case studies.

UNIT–V REPAIRS, REHABILITATION AND RETROFITTING OF STRUCTURES 9 hrs

Repairs to overcome low member strength - Deflection, cracking, chemical disruption - weathering corrosion, wear, fire, leakage and marine exposure.

TOTAL: 45 hrs

TEXT BOOKS

1. Denison Campbell, Allen and Harold Roper, "Concrete Structures, Materials, Maintenance and Repair", Longman Scientific and Technical, UK, 1991.
2. Allen R.T and Edwards S.C, "Repair of Concrete Structures", Blakie and Sons, UK, 1987.
3. Raikar, R.N., "Learning from failures - Deficiencies in Design, Construction and Service" – R and D Centre (SDCPL), Raikar Bhavan, Bombay, 1987.

REFERENCES

1. Santhakumar A.R., "Concrete Technology" Oxford University Press, 2007Printed in India by Radha Press, New Delhi, 110 031.
2. Peter H.Emmons, "Concrete Repair and Maintenance Illustrated", Galgotia Publications pvt. Ltd., 2001.
3. Dayaratnam.P and Rao.R, "Maintenance and Durability of Concrete Structures", University Press, India, 1997.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2										1	3			2
CO2		3			2					1				2		1
CO3			3			3	1					2	1		2	3
CO4	3	3	2											3		2
CO5	3	2			1			1		1		3	2			3

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162SEE16	INDUSTRIAL STRUCTURES				L-T-P-C
					3-0-0-3
Programme:	M.E. Structural Engineering	**Sem:**	-	**Category:**	**Elective**
AIM:	To study the requirements, planning and design of Industrial structures.				
Course Outcomes:					
The Students will be able to CO1. Discuss the planning and functional requirements of Industrial structures. CO2. Discover the need to learn about the design concepts, and constructional aspects of Industrial structures. CO3. Analyse and evaluate the importance of various construction materials for Industrial constructions. CO4. Design portal frames, tower cranes and bracing system in Industrial buildings. CO5. Analyse and design structural elements used in pre-cast construction including fabrication, erection and installation.					

UNIT–I PLANNING AND FUNCTIONAL REQUIREMENTS 9 hrs

Classification of Industries and Industrial structures - planning for Layout Requirements regarding Lighting, Ventilation and Fire Safety - Protection against noise and vibration - Guidelines of Factories Act.

UNIT–II INDUSTRIAL BUILDINGS 9 hrs

Design of Single & Multi-bay Industrial Structures in Concrete & Steel - Roofs for Industrial Buildings - Gantry Girders - Design of Corbels and Nibs – Machine foundations.

UNIT–III POWER PLANT STRUCTURES 9 hrs

Types of power plants – Design of Turbo generator foundation – containment structures.

UNIT–IV POWER TRANSMISSION STRUCTURES 9 hrs

Transmission Line Towers - Substation Structures - Tower Foundations - Testing Towers.

UNIT–V AUXILLIARY STRUCTURES

9 hrs

Chimneys and cooling Towers – Bunkers and Silos – Pipe supporting structures.

TOTAL: 45 hrs

TEXT BOOKS

1. Manohar S.N, “Tall Chimneys - Design and Construction”, Tata McGraw Hill, 1985.
2. Santhakumar A.R.an d Murthy S.S., “Transmission Line Structures”, Tata Mc Graw Hill, 1992.

REFERENCES

1. Srinivasulu P and Vaidyanathan.C, “Handbook of Machine Foundations”, Tata Mc Graw Hill, 1976.
2. Jurgen Axel Adam, KatharriaHausmann, Frank Juttner, Klauss Daniel, “Industrial Buildings: A Design Manual”, Birkhauser Publishers, 2004.
3. Procs. of Advanced course on “Industrial Structures”, Structural Engineering Research Centre, Chennai, 1982.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3			2	2						3			
CO2	3	2		3		2		1				2	2			
CO3	3		2	1			2				1		3	2		
CO4	3		2		1		3							3		1
CO5	3	2		1		2			1	2		1	3			

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162SEE17	RESEARCH METHODOLOGY				L-T-P-C
					3-0-0-3
Programme:	Common to all Branches	**Sem:**	-	**Category:**	**Elective**
AIM:	The objective of this course is to develop the research skills of the students in investigating into the research problems with a view to arriving at objective findings and conclusions and interpreting the results of their investigation in the form of systematic reports.				

Course Outcomes:

The Students will be able to

CO1: Understand the basics elements in research.

CO2: Discuss the various faces of experimental design methodology.

CO3: illustrate the data collection methods with its aspects.

CO4: Apply the knowledge of multivariate statistical techniques

CO5: develop research report as a model.

UNIT–I CONCEPT OF RESEARCH AND ITS APPLICATION 9 hrs

Concept of research and its Application - types of research - Quantitative and Qualitative Research Techniques - Types of problems Encountered by the Researcher - Process of Research - Steps Involved in Research Process - Hypothesis development – Hypothesis testing with quantitative data. Research design –Purpose of the study: Exploratory, Descriptive, Hypothesis Testing.

UNIT–II EXPERIMENTAL DESIGN 9 hrs

Laboratory and the Field Experiment –Internal and External Validity –Factors affecting Internal validity. Measurement of variables –Scales and measurements of variables. Developing scales – Rating scale and attitudinal scales –Validity testing of scales –Reliability concept in scales being developed –Stability Measures.

UNIT–III DATA COLLECTION METHODS 9 hrs

Concept of Sample, Sample Size and Sampling Procedure - Various Types of Sampling Techniques - Determination and Selection of Sample Member - Types of Data: Secondary and Primary - Precautions in Preparation of Questionnaire and Collection of Data - Various Methods of Data Collection - Preparation of Questionnaire and Schedule - Types of Questions, Sequencing of Questions - Check Questions, Length of Questionnaire.

UNIT–IV ANALYSIS OF DATA 9 hrs

Data Analysis - Coding, Editing and Tabulation of Data - Various Kinds of Charts and Diagrams Used in Data Analysis - Factor Analysis –Cluster Analysis –Discriminant Analysis –Multiple Regression and Correlation –Canonical Correlation – Use of SPSS in Data Analysis - Application and Analysis of Variance (ANOVA) - Measurement and Central Tendency - Measure of Dispersion and their advantages.

UNIT–V REPORT PREPARATION 9 hrs

Report Preparation and it's Significance - Types and Layout of Research Report - Precautions in Preparing the Research Report - Integral parts of a report –Title of a report, Table of contents, Abstract, Synopsis, Introduction and Body of a report –Experimental results and discussion – recommendations and implementation - Conclusions and Scope for future work - Bibliography and Annexure.

TOTAL: 45 hrs

TEXT BOOK

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.
2. Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International. 418p.
3. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, Ess Ess Publications. 2 volumes.

REFERENCES

1. Trochim, W.M.K., 2005. Research Methods: the concise knowledge base, Atomic Dog Publishing.
2. Panneer Selvam- Research Methodology (Prentice Hall of India, Edition 2008)

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3			2	2						3			
CO2	3	2		3		2		1					2			
CO3	3		2	1			2					2	3	2		
CO4	3		2		1		3			2				3		1
CO5	3	2		1		2			1		1	2	3			

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162SEE18	PREFABRICATED STRUCTURES			L-T-P-C	
				3-0-0-3	
Programme:	M.E. Structural Engineering	**Sem:**	-	**Category:**	**Elective**
AIM:	To Study the design principles, analysis and design of elements.				
Course Outcomes:					
The Students will be able to CO1: Discuss the principles of designing the special structures. CO2: Design long and short wall at framed buildings, and beam column connections. CO3: Design floors, stairs and roofs in special condition for reduced deflection values. CO4: Detail the reinforcements in various types of walls. CO5: Design the industrial building and shell roofs.					

UNIT–I DESIGN PRINCIPLES 9 hrs

Types of prefabrication, prefabrication systems and structural schemes- Need for prefabrication – Principles – Materials - Disuniting of Prefabricates, production, transportation, erection, stages of loading and codal provisions, safety factors, material properties, Deflection control, Lateral load resistance, Location and types of shear walls.

UNIT–II PREFABRICATED COMPONENTS 9 hrs

Production, Transportation & erection- Shuttering and mould design - Dimensional tolerances - Erection of R.C. Structures, Total prefabricated buildings - Structural behaviour of precast structures – Large panel constructions – Construction of roof and floor slabs – Wall panels – Columns – Shear walls.

UNIT–III DESIGN PRINCIPLES 9 hrs

Design of cross section based on efficiency of material used – Problems in design - joint flexibility – Allowance for joint deformation - Design of construction and expansion joints.

UNIT–IV STRUCTURAL MEMBERS 9 hrs

Designing and detailing of prefabricated units - industrial structures - Multi-storey buildings - Water tanks - Dimensioning and detailing of joints for different structural connections.

UNIT–V DESIGN FOR ABNORMAL LOADS 9 hrs

Progressive collapse – Codal provisions – Equivalent design loads for considering abnormal effects such as earthquakes, cyclones - Importance of avoidance of progressive collapse.

TOTAL: 45 hrs

TEXT BOOKS

1. B.Lewicki, Building with Large Prefabricates, Elsevier Publishing Company, Amsterdam/ London/New York, 1966.
2. Koncz.T., Manual of Precast Concrete Construction, Vol.I II and III, Bauverlag, GMBH, 1971.

REFERENCES

1. Structural Design Manual, Precast Concrete Connection Details, Society for the Studies in the use of Precase Concrete, Netherland Betor Verlag, 1978.
2. LassloMokk, Prefabricated Concrete for Industrial and Public Sectors, Akademiai Kiado, Budapest, 1964.
3. Murashev.V., Sigalov.E., and Bailov.V., Design of Reinforced Concrete Structures, Mir Publishers, 1968.
4. Gerostiza. C.Z., Hendrikson, C. and Rehat D.R., Knowledge Based Process Planning for Construction and Manufacturing, Academic Press, Inc., 1989.
5. Warszawski, A., Industrialization and Robotics in Building - A managerial approach, Harper and Row, 1990

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1		3		2	1								3			
CO2		2		2	3					1				2		
CO3	2	1	3				1					2			1	
CO4			2			3										2
CO5												3			3	

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162SEE19	PRESTRESSED CONCRETE STRUCTURES			L-T-P-C	
				3-0-0-3	
Programme:	M.E. Structural Engineering	**Sem:**	-	**Category:**	**Elective**
AIM:	Principle of prestressing, analysis and design of prestressed concrete structures.				
Course Outcomes:					
The Students will be able to CO1: Explain the terminology related to pre-stressing and pre-stressing systems CO2: Analyze the sections using strength, stress load balancing concept and losses of prestressing. CO3: Design the flexural member and stress distribution in the end block. CO4: Design a prestressed concrete pipes and tanks. CO5: Analyze the stress and estimate the deflection for composite construction.					

UNIT–I PRINCIPLES OF PRESTRESSING 9 hrs

Principles of Prestressing - types and systems of prestressing, need for High Strength materials, Analysis methods losses, deflection (short-long term), camber, cable layouts.

UNIT–II ANALYSIS AND DESIGN OF MEMBERS FOR FLEXURE 9 hrs

Analysis and design of members for flexure, shear, bond and bearings. Cable layouts. Design of circular systems, domes and slabs - Design of end blocks.

UNIT–III DESIGN OF CONTINUOUS BEAMS 9 hrs

Analysis and design of continuous beams - Methods of achieving continuity - concept of linear transformations, concordant cable profile and gap cables.

UNIT–IV DESIGN OF PRE-STRESSED BRIDGES 9 hrs

Design of Pre-stressed Bridges, (Super-structure only).

UNIT–V DESIGN OF COMPOSITE MEMBERS 9 hrs

Analysis of stresses – Estimate for deflections – Flextural strength of composite members – Shear strength of composite members.

TOTAL: 45 hrs

TEXT BOOKS

1. Krishna Raju, "Prestressed Concrete", Tata McGraw Hill PublishingCo, 2000.
2. Sinha.N.C.and.Roy.S.K, "Fundamentals of Prestressed Concrete", S.Chand and Co., 1998.

REFERENCES

1. Lin.T.Y., "Design of Prestressed Concrete Structures", John Wiley and SonsInc,1981.
2. Evans, R.H. and Bennett, E.W., "Prestressed Concrete", Champman and Hall, London, 1958.
3. Rajagopalan.N, Prestressed Concrete, Narosa Publications, New Delhi, 2008.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2										1	3	2		
CO2	3	2								1			3	3	3	
CO3	3	2					1					2	3		2	
CO4	2	3			3	1								3		
CO5	2	3			3			1		1		3			3	

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162SEE20	ADVANCED CONSTRUCTION MATERIALS				L-T-P-C
					3-0-0-3
Programme:	M.E. Structural Engineering	**Sem:**	-	**Category:**	**Elective**
AIM:	To study and understand the properties of modern construction materials used in construction such as special concretes, metals, composites, water proofing compounds, non-weathering materials, and smart materials.				

Course Outcomes:

The Students will be able to

CO1: Understand the properties and application of different types of concrete.

CO2: Identify the relationship between Manufacturing process and material behavior.

CO3: Design the different structural elements.

CO4: Analyze the different types of non-weathering materials and its application.

CO5: Differentiate smart and intelligent materials.

UNIT I SPECIAL CONCRETES 9 hrs

Concretes, Behaviour of concretes –Properties and Advantages of High Strength and High Performance Concrete –Properties and Applications of Fibre Reinforced Concrete, Polymer Concrete, Self-compacting concrete, Alternate Materials to concrete on high performance & high Strength concrete.

UNIT II METALS 9 hrs

Types of Steels –Manufacturing process of steel –Advantages of new alloy steels –Properties and advantages of aluminium and its products –Types of Coatings & Coatings to reinforcement –Applications of Coatings.

UNIT III COMPOSITES 9 hrs

Types of Plastics –Properties & Manufacturing process –Advantages of Reinforced polymers –Types of FRP – FRP on different structural elements –Applications of FRP.

UNIT IV OTHER MATERIALS 9 hrs

Types and properties of Water Proofing Compounds –Types of Non-weathering Materials and its uses –Types of Flooring and Facade Materials and its application.

UNIT V SMART AND INTELLIGENT MATERIALS 9 hrs

Types & Differences between Smart and Intelligent Materials –Special features –Case studies Showing the applications of smart & Intelligent Materials.

TOTAL: 45 hrs

TEXT BOOKS

1. Ashby, M.F. and Jones.D.R.H.H. "Engineering Materials 1: An introduction to Properties, applications and designs", Elsevier Publications, 2005.
2. Deucher, K.N, Korfiatis, G.P and Ezeldin, A.S, Materials for civil and Highway Engineers, Prentice Hall Inc., 1998.
3. Mamlouk, M.S. and Zaniewski, J.P., Materials for Civil and Construction Engineers Prentice Hall Inc., 1999.

REFERENCES

1. ACI Report 440.2R-02, "Guide for the design and construction of externally bonded RP systems for strengthening concrete structures", American Concrete Institute, 2002.
2. Aitkens, High Performance Concrete, McGraw Hill, 1999.
3. Santhakumar.A.R., Concrete Technology, Oxford University press, New Delhi
4. Shan Somayaji, Civil Engineering Materials, Prentice Hall Inc., 2001.
5. Shetty M.S, Concrete Technology: Theory and Practice, S.Chand & Company Ltd 2005.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2										1	3	2		
CO2	3	2								1			3	3	3	
CO3	3	2					1					2	3		2	
CO4	2	3			3									3		
CO5	2	3			3			1		1		3			3	

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162SEE21	SOLID AND HAZARDOUS WASTE MANAGEMENT			L-T-P-C	
				3-0-0-3	
Programme:	M.E. Structural Engineering	**Sem:**	-	**Category:**	**Elective**
AIM:	To impart knowledge and skills in the collection, storage, transport, treatment, disposal and recycling options for solid wastes including the related engineering principles, design criteria, methods and equipments.				

Course Outcomes:

The Students will be able to

CO1: Understand the characteristics of different types of solid and hazardous wastes and the factors affecting variation

CO2: Define and explain important concepts in the field of solid waste management and suggest suitable technical solutions for treatment of municipal and industrial waste.

CO3: Understand the role legislation and policy drivers play in stakeholders' response to the waste and apply the basic scientific principles for solving practical waste management challenges

CO4: Design the different elements of waste management systems.

UNIT I SOURCES, CLASSIFICATION AND REGULATORY FRAMEWORK 9 hrs

Types and Sources of solid and hazardous wastes -Need for solid and hazardous waste management – Salient features of Indian legislations on management and handling of municipal solid wastes, hazardous wastes, biomedical wastes, nuclear wastes -lead acid batteries, electronic wastes, plastics and fly ash Elements of integrated waste management and roles of stakeholders -Financing and Public Private Participation for waste management-Integrated solid waste management.

UNIT II WASTE CHARACTERIZATION AND SOURCE REDUCTION 9 hrs

Waste generation rates and variation -Composition, physical, chemical and biological properties of solid wastes –Hazardous Characteristics –TCLP tests –waste sampling and characterization plan -Source reduction of wastes –Waste exchange -Extended producer responsibility -Recycling and reuse.

UNIT III STORAGE, COLLECTION AND TRANSPORT OF WASTES 9 hrs

Handling and segregation of wastes at source –storage and collection of municipal solid wastes –Analysis of Collection systems -Need for transfer and transport –Transfer stations Optimizing waste allocation– compatibility, storage, labeling and handling of hazardous wastes –hazardous waste manifests and transport.

UNIT IV WASTE PROCESSING TECHNOLOGIES 9 hrs

Objectives of waste processing–material separation and processing technologies –biological and chemical conversion technologies –methods and controls of Composting -thermal conversion technologies and energy recovery –incineration –solidification and stabilization of hazardous wastes-treatment of biomedical wastes -Health considerations in the context of operation of facilities.

UNIT V WASTE DISPOSAL 9 hrs

Waste disposal options –Disposal in landfills -Landfill Classification, types and methods – site selection - design and operation of sanitary landfills, secure landfills and landfill bioreactors – leachate and landfill gas management –landfill closure and environmental monitoring – Rehabilitation of open dumps-remediation of contaminated sites.

TOTAL: 45 hrs

TEXT BOOKS

1. George Tchobanoglous, Hilary Theisen and Samuel A, Vigil, “Integrated Solid Waste Management, Mc-Graw Hill International edition, New York, 1993.
2. CPHEEO, “Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organisation, Government of India, New Delhi, 2014.

REFERENCES

1. William A. Worrell, P. Aarne Vesilind, Solid Waste Engineering, Cengage Learning, 2012.
2. Michael D. LaGrega, Philip L Buckingham, Jeffrey C. E vans and "Environmental Resources Management, Hazardous waste Management", Mc-Graw Hill International edition, New York,2010.
3. John Pitchtel, Waste Management Practices, CRC Press, Taylor and Francis Group, 2014.
4. Frank Kreith, George Tchobanoglous, Handbook of Solid Waste management, Mc Graw Hill, 2002.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2										1	3	2		
CO2	3	2								1			3	3	3	
CO3	3	2					1					2	3		2	
CO4	2	3			3									3		

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162SEE22	SUB – STRUCTURE DESIGN				L-T-P-C
					3-0-0-3
Programme:	M.E. Structural Engineering	**Sem:**	-	**Category:**	**Elective**
AIM:	• To assess the soil condition at a given location in order to suggest suitable foundation based upon bearing capacity. • To study the design of different type of shallow foundations like isolated, raft and combined footing. • To familiarise with the design of pile foundation and pile caps. • To design well and caissons foundations. • To design various types of tower foundations				
Course Outcomes:					
The Students will be able to CO1: Attain the perception of site investigation to select suitable type of foundation based on soil category. CO2: Be capable of ensuring design concepts of shallow foundation. CO3: Be efficient in selecting suitable type of pile for different soil stratum and in evaluation of group capacity by formulation CO4: Design different types of well foundation. CO5:Deliver the design concepts for transmission line tower foundation					

UNIT I SITE INVESTIGATION, SELECTION OF FOUNDATION AND BEARING CAPACITY **9 hrs**

Objectives – Methods of exploration – Depth of exploration – Sample disturbance – Factors governing location and depth of foundation – In situ testing of Soils – Plate load test – Geophysical methods – Selection of foundation– Bearing capacity of shallow foundations by Terzaghi's theory, Meyerhof's theory, and codal provisions – Bearing capacity of footing subjected to inclined and eccentric loading – Problems – Types of shear failure – General principles of foundation design.

UNIT II DESIGN OF SHALLOW FOUNDATIONS **9 hrs**

Types of shallow foundations – General principles of design of reinforced concrete shallow foundations – Structural design of isolated and combined footing – Structural design of rafts by conventional method – Principles of design of buoyancy raft and basement (no design problems).

UNIT III PILE FOUNDATION **9 hrs**

Pile foundations – Types – General principles of design – Estimation of load capacity of piles by static and dynamic formulae – Detailing of reinforcement as per IS 2911 - Design of pile caps – Settlement analysis of pile groups – Negative skin friction – Pile load tests.

UNIT IV WELL AND CAISSON FOUNDATIONS **9 hrs**

Well and caisson foundations – Structural elements of Caisson and Well foundations – Elements of well foundation – Forces acting on Caisson and well foundations – Design of individual components of Caisson and well foundation(only forces acting and design principles) – Sinking of well – Shifts and tilts in well foundations – Preventive measures.

UNIT V FOUNDATIONS OF TRANSMISSION LINE TOWERS **9 hrs**

Introduction - Necessary information - Forces on tower foundations -
General design criteria - Choice and type of foundation - Design procedure - Types of Foundations – Design of foundation for transmission towers.

TOTAL: 45 hrs

TEXT BOOKS

1. Winterkorn. H. F., and Fang, H. Y., "Foundation Engineering Hand Book – Van Nostrard – Reinhold -1990.
2. Tomlinson. M.J. and Boorman, R., "Foundation design and construction", VI edition, ELBS Longman, 2001.

REFERENCES

1. Nayak. N.V., "Foundation design manual for practicing engineers", DhanpatRai and Sons, 1985.
2. Arora. K.R, "Soil Mechanics & Foundation Engineering", Standard Publishers & Distributors, 2005.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2										1	3	2		3
CO2	1	2								1			2	3	3	1
CO3	3	2					1					2	3		2	3
CO4	2	3			3									3		2

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162SEE23	CRACKS AND CRACK CONTROL IN CONCRETE STRUCTURES				L-T-P-C
					3-0-0-3
Programme:	M.E. Structural Engineering	**Sem:**	-	**Category:**	**Elective**
AIM:	To equip the students with a knowledge of properties and microstructure of concrete. To impose a knowledge of various durability and corrosion behavior of concrete. To classify the different types of cracks due to any type of force including earthquake force and other factors. To have a knowledge of long term effects of cracking. To impinge a knowledge of crack detection and cracking measuring techniques.				

Course Outcomes:

The Students will be able to

CO1: Gain the knowledge of properties and microstructure of concrete.

CO2: Get exposed to durability and corrosion behavior of concrete.

CO3: Familiarize with advanced knowledge of causes and propagation of cracks.

CO4: Understand long term effects of cracking.

CO5: Detect various cracks and measuring techniques for the same.

UNIT I PROPERTIES OF CONCRETE **9 hrs**

Historical note on Portland cement concrete – Basic properties of plain concrete – Microstructure – shrinkage, creep and strength of concrete – temperature effect on concrete – transport properties of concrete – tensile , shear, bend and torsional strength of plain and reinforced concrete.

UNIT II DURABILITY OF CONCRETE **9 hrs**

Durability of concrete causes for inadequate durability of concrete chloride diffusion - Carbonation of concrete - Sulphate attack - Acid attack on concrete – Alkali - Silica reaction - Abrasion resistance - Fire resistance - Erosion resistance – Cavitations - Flame resistance - corrosion resistance - Chemical resistance of concrete and other durability tests methods on concrete.

UNIT III THEORY OF CRACKS **9 hrs**

Classifications of cracks in plain and reinforced concrete - Theories of cracking and fundamental mechanics of cracking - Shear cracking- Moment cracking - Torsional cracking - Settlement cracks - Cracks due to force transfer - Cracking due to earthquake forces and cracking due to other factors.

UNIT IV PROPERTIES OF CRACKS **9 hrs**

Long term effects of cracking - Material and loading effects- Creep effect – Bond - Slip theory - Straight line theory - Flexural stiffness - Effective moment of inertia - Computation of deflection due to short term and long term - Computation of crack width and crack spacings.

UNIT V CRACK DETECTION AND CONTROL **9 hrs**

Crack detection - Crack measuring techniques - Control of cracking in plain and reinforced concrete beams and columns - Crack control by material selection - Crack reduction designs and construction practices - Advanced crack control and repair techniques.

TOTAL: 45 hrs

TEXT BOOKS:

1. Sandor Popovics, " Concrete Materials: Properties, Specifications, and Testing", Noyes Publications, 1992.
2. Prashanthkumar, "Elements of Fracture Mechanics", by Wheeler Publishing Company, New Delhi, 2009 .
3. Srinath L.S., "Advanced mechanics of Solids", TataMcgraw-hill Publishing Company Ltd, New Delhi, 2009.

REFERENCE BOOKS:

1. Parton V.N, Movozov E.M., "Elastic-plastic Fracture Mechanics", Mir publishers Moscow, 1984.
2. Kong F.K. and Evans R.H, "Reinforced and Prestressed Concrete", 3rd Ed- ELBS- Van no strand Reinhold (International), 1998.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3								2			1	3	2		
CO2									2	1						
CO3							1					2	3		2	
CO4	2	3			3									3		
CO5	2	3			3			1		1		3			3	

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162SEE24	NON - LINEAR ANALYSIS OF STRUCTURES				L-T-P-C
					3-0-0-3
Programme:	M.E. Structural Engineering	**Sem:**	-	**Category:**	**Elective**
AIM:	To study the concept of nonlinear behaviour of beams and vibrations of beams. To know the elastic analysis of statically determinate and indeterminate flexural members. To know the inelastic analysis of statically determinate and indeterminate flexural members. To study the nonlinear analysis of plates and its governing equation. To know the governing equation of circular and non-circular shells.				
Course Outcomes:					
The Students will be able to CO1: Know the basic concepts of nonlinearity and its governing equation for various boundary conditions. CO2: Understand the elastic analysis with various boundary conditions CO3: Understand the inelastic analysis with various boundary conditions of thin walled structural members CO4: Perform static and dynamic analysis of plates. CO5: Perform nonlinear analysis of shells.					

UNIT I NONLINEAR BENDING AND VIBRATION OF BEAMS **9 hrs**

Introduction - Types of nonlinearities - Nonlinear governing equation for beams - Geometrically nonlinear beam problems – Vibrations of beams with various boundary conditions – Forced vibration of beams – Post buckling-cantilever column – Behaviour of beams with material nonlinearity - Nonlinear vibration and instabilities of elastically supported beams.

UNIT II ELASTIC ANALYSIS OF FLEXURAL MEMBERS **9 hrs**

Flexural behaviour - Statically determinate and statically - Indeterminate bars - Uniform and varying thickness.

UNIT III INELASTIC ANALYSIS OF FLEXURAL MEMBERS **9 hrs**

Inelastic analysis of uniform and variable thickness members subjected to small deformations - Inelastic analysis of flexible bars of uniform and variable stiffness - Members with and without axial restraints.

UNIT IV NONLINEAR STATIC AND DYNAMIC ANALYSIS OF PLATES **9 hrs**

Introduction – Governing nonlinear equations for plates – Boundary conditions and methods of solutions – Large deflection analysis of rectangular and non-rectangular plates – Free and forced vibrations of rectangular and non-rectangular plates – Post buckling behaviour of plates – Effects of transverse shear deformations and material nonlinearity.

UNIT V NONLINEAR ANALYSIS OF SHELLS **9 hrs**

Introduction – Derivations of governing equations – Circular and noncircular cylindrical shells – Shallow cylindrical shells – Forced nonlinear vibration of shells – Post buckling of shells.

TOTAL: 45 hrs

TEXT BOOKS:

1. Sathyamoorthy, M.,"Nonlinear Analysis of Structures", CRC Press, Boca Raton, Florida, 1997.
2. Fertis, D. G.,"Nonlinear Mechanics", CRC Press, Boca Raton, Florida, 1998.
3. Reddy.J.N, "Non linear Finite Element Analysis", Oxford University Press,2008.

REFERENCE BOOKS:

1. Majid K.I., "Non Linear Structures", Butter worth Publishers, London, 1972.
2. Iyengar N G R, "Elastic Stability of Structural elements", Macmillan India Ltd ,2007.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2										1	3	2		3
CO2	1			2		1				1				2		1
CO3	3	1		2			1					2	3		2	3
CO4	2	3			3			3			3		1	3		2

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

162SEE25	CONSTRUCTION SAFETY AND MANAGEMENT				L-T-P-C
					3-0-0-3
Programme:	M.E. Structural Engineering	**Sem:**	-	**Category:**	**Elective**
AIM:	To provide comprehensive knowledge on the cause of accident and construction industry related laws. To know in detail about the safety in various aspects of construction. To have a knowledge about the preparation of accident report by analysing the key factors. To have a brief knowledge in construction management. To have a practical knowledge about the safety implementation by case studies.				

Course Outcomes:

The Students will be able to

CO1: Understand the basic mandatory procedures to be followed in the construction industry.

CO2: Know the fundamental planning and safety practices commonly implemented on construction sites.

CO3: Know the key factor for causing accidents.

CO4: Understand the requirements for compliance and inspection imposed for the safety in construction site

CO5: Understand the importance of agencies involved in rescue operation by various case studies.

UNIT I INTRODUCTION **9 hrs**

Importance – Causes of accident, safety measures- Environmental issues in construction- Construction industry related laws - Occupation Safety and Health Act (OSHA), National Safety Council (NSC) - British Safety Council (BSC) - Council of industrial safety (CIS) - Loss Prevention Association (India)- Construction safety- Elements of an effective safety programmes job-Site assessment

UNIT II PLANNING **9 hrs**

Safety aspects of building and plant-layout-Introduction to treatment and disposal on Industrial wastes & effluents-Planning and safe operations- Planning and site operations- Safe systems of storing in construction materials-Excavation-Demolition work-Blasting-Timbering- Scaffolding-Hoisting apparatus and conveyors-Manual handling- Safe use of Ladder-Safety in hand tools-Safety in use of mobile cranes-Trusses, girders and beams.

UNIT III ACCIDENT CAUSATION, REPORTING AND INVESTIGATION **9 hrs**

Accidents and Hazards control-Cost of accidents- Accident reports-Accident reporting, investigations and statistics-Identification of the key factors-Safety organization-Types-Functions-Safety committees.

UNIT IV SAFETY MANAGEMENT IN CONSTRUCTION **9 hrs**

Safety policy-safety meeting-Planning for safety and productivity-safety management techniques-Safety sampling-Safety Audit-Job safety analysis-Incident recall techniques-Safety and Health provision in the factories act.

UNIT V CASE STUDIES 9 **9 hrs**

Involvement in safety-Role of Government and voluntary agencies-Safety officers-Fire hazards and preventing methods- case studies - fire accidents.

TOTAL: 45 hrs

TEXT BOOKS:

1. Jimmie Hinze, "Construction safety", Prentice-Hall, 2013.
2. Herbert William Heinrich, "Industrial Accident Prevention", McGraw-Hill, 1959.

REFERENCE BOOKS:

1. Richard J. Coble, Jimmie Hinze and Theo C. Haupt, "Construction Safety and Health Management", Prentice Hall Inc., 2001.

Course Outcomes	Program Outcomes (POs)												Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1		3		2	1								3			
CO2		2		2	3					1				2		
CO3	2	1	3				1					2			1	
CO4			2			3										2

Enter correlation levels 1, 2 or 3 as defined below: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)