ANNA UNIVERSITY : : CHENNAI - 600 025

AFFILIATED INSTITUTIONS

REGULATIONS 2017

CHOICE BASED CREDIT SYSTEM

COMMON TO ALL POST GRADUATE PROGRAMMES

The following Regulations is applicable to the students admitted to M.E / M.Tech., M.C.A and M.B.A. Programmes at all Engineering Colleges affiliated to Anna University, Chennai (other than Autonomous Colleges) and to all the University Colleges of Engineering of Anna University, Chennai from the academic year 2017-2018.

1 PRELIMINARY DEFINITIONS AND NOMENCLATURE

In these Regulations, unless the context otherwise requires:

i. "**Programme**" means Post graduate Degree Programme e.g. M.E., M.Tech. Degree Programme.

ii. "**Branch**" means specialization or discipline of M.E. / M.Tech. Degree Programme like "Structural Engineering", "Engineering Design", etc.

iii. "**Course**" means Theory or Practical subject that is normally studied in a semester, like Applied Mathematics, Advanced Thermodynamics, etc.

iv. **"Director, Academic Courses"** means the authority of the University who is responsible for all academic activities of the University for implementation of relevant Rules and Regulations.

v. **"Chairman"** means the Head of the Faculty.

vi. **"Head of the Department"** means Head of the Department concerned.

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

viii. "**Controller of Examinations"** means the Authority of the University who is responsible for all activities of the University Examinations.

ix. "**University**" means ANNA UNIVERSITY, CHENNAI.

2 PROGRAMMES OFFERED, MODES OF STUDY AND ADMISSION REQUIREMENTS

2.1 P.G. PROGRAMMES OFFERED:

1. M.E
2. M.Tech.
3. M.B.A.
4. M.C.A.

2.2 MODES OF STUDY:

2.2.1 **Full-Time:**

Candidates admitted under 'Full-Time' should be available in the College / Institution during the entire duration of working hours (From Morning to Evening on Full-Time basis) for the curricular, co-curricular and extra-curricular activities assigned to them.

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

2.2.2 **Part-Time Mode:**

In this mode of study, the students are required to attend classes conducted in the evenings and complete the course in three years.

2.2.3 Conversion from one mode of study to the other is not permitted.

2.3 ADMISSION REQUIREMENTS:

2.3.1 Candidates for admission to the first semester of the Post-Graduate Degree Programme shall be required to have passed an appropriate Under-Graduate Degree **Examination of Anna University** or equivalent as specified under qualification for admission as per the Tamil Nadu Common Admission (TANCA) criteria.

Note: TANCA releases the updated criteria during the admissions every academic year.
Admission shall be offered only to the candidates who possess the qualification prescribed against each programme.

Any other relevant qualification which is not prescribed against each programme shall be considered for equivalence by the committee constituted for the purpose. Admission to such degrees shall be offered only after obtaining equivalence to such degrees.

2.3.2 However, the Syndicate of the University may decide to restrict admission in any particular year to candidates having a subset of qualifications prescribed at the time of admission.

2.3.3 Notwithstanding the qualifying examination the candidate might have passed, he/she shall have a minimum level of proficiency in the appropriate programme / courses as prescribed by the Syndicate of the University from time to time.

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

2.3.5 All Part-Time candidates should satisfy other conditions regarding Experience, Sponsorship etc. that may be prescribed by the Syndicate from time to time.

3 STRUCTURE OF THE PROGRAMMES

3.1 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

ii. **Professional Core (PC)** courses include the core courses relevant to the chosen specialization/branch.

iii. **Professional Elective (PE)** courses include the elective courses relevant to the chosen specialization/ branch.

iv. **Employability Enhancement Courses (EEC)** include Project Work and/or Internship, Seminar, Professional Practices, Summer Project, Case Study and Industrial / Practical Training.

Instead of two electives in the curriculum, the student may be permitted to choose a maximum of 2 courses from other PG programmes with the approval of the Head of the Department offering such courses.

3.2 Courses per Semester

Curriculum of a semester shall normally have a blend of lecture courses and practical courses including Employability Enhancement Courses. Each course may have credits assigned as per clause 3.3.

3.3 Credit Assignment

Each course is assigned certain number of credits based on the following:

Contact period per week	**CREDITS**
1 Lecture Period	1
2 Tutorial Periods	1
2 Practical Periods (Laboratory / Seminar / Project Work etc.)	1

The Contact Periods per week for Tutorials and Practical can only be in multiples of 2.

3.4 Project Work

3.4.1 The project work for M.E. / M.Tech. Programmes consist 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.

3.4.2 In case of candidates of M.E. / M.Tech. Programmes not completing Phase-I of project work successfully, the candidates can undertake Phase-I again in the subsequent semester. In such cases the candidates can enroll for Phase-II, only after successful completion of Phase-I.

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

3.4.4 A candidate 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 Concerned. In such cases, the Project work shall be jointly supervised by a supervisor of the department and an expert, as a 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 the progress.

3.4.5 The Project work (Phase II in the case of M.E/M.Tech.) shall be pursued for a minimum of 16 weeks during the final semester.

3.6 The deadline for submission of final Project Report is 60 calendar days from the last working day of the semester in which project / thesis / dissertation is done. However, the Phase-I of the Project work in the case M.E. / M.Tech. Programmes shall be submitted within a maximum period of 30 calendar days from the last working day of the semester as per the academic calendar published by the University.

3.7 Industrial Training / Internship

The students may undergo Industrial training for a period as specified in the curriculum during summer / winter vacation. In this case the training has to be undergone continuously for the entire period.

The students may undergo Internship at Research organization / University (after due approval from the Department Consultative Committee) for the period prescribed in the curriculum during summer / winter vacation, in lieu of Industrial training.

3.8 Value Added Courses

The Students may optionally undergo Value Added Courses and *the credits earned through the Value Added Courses shall be over and above the total credit requirement prescribed in the curriculum for the award of the degree.* One / Two credit courses shall be offered by a Department **of an institution with the prior approval from the Head of the Institution.** The details of the syllabus, time table and faculty may be sent to the Centre for Academic Courses and the Controller of Examinations after approval from the **Head of the Institution** concerned atleast one month before the course is offered. **Students can take a maximum of two one credit courses / one two credit course** during the entire duration of the Programme.

3.9 Online Courses

3.9.1 Students may be permitted to credit only one online course of 3 credits with the approval of **Head of the Institution** and Centre for Academic Courses.

3.9.2 Students may be permitted to credit one online course (which are provided with certificate) subject to a maximum of three credits. The approved list of online courses will be provided by the Centre for Academic courses from time to time. The student needs to obtain certification or credit to become eligible for writing the End Semester Examination to be conducted by Controller of Examinations, Anna University. The details regarding online courses taken up by students should be sent to the Controller of Examinations, Anna University and Centre for Academic Courses one month before the commencement of end Semester Examination.

3.10 Medium of Instruction

The medium of instruction is English for all courses, examinations, seminar presentations and project / thesis / dissertation reports.

4 DURATION AND STRUCTURE OF THE PROGRAMMES:

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

Programme	Min. No. of Semesters	Max. No. of Semesters
M.E. / M.Tech. (Full-Time)	4	8
M.E. / M.Tech. (Part Time)	6	12
M.C.A. (Full Time)	6	12
M.B.A. (Full Time)	4	8
M.B.A. (Part Time)	6	12

4.2 The Curriculum and Syllabi of all the P.G. Programmes shall be approved by the Academic Council of Anna University. The number of Credits to be earned for the successful completion of the programme shall be as specified in the Curriculum of the respective specialization of the P.G. Programme

4.3 Each semester shall normally consist of 75 working days or 540 periods of each 50 minutes duration, for full-time mode of study or 250 periods for part-time mode of study. The Head of the Institution shall ensure that every teacher imparts instruction as per the number of periods specified in the syllabus and that the teacher teaches the full content of the specified syllabus for the course being taught. For the purpose of calculation of attendance requirement for writing the end semester examinations (as per clause 9) by students, following method shall be used.

$$\text{Percentage of Attendance} = \frac{\text{Total no. of periods attended in all the courses per semester}}{\text{(No.of periods / week as prescribed in the curriculum) x 15 taken together for all courses of the semester}} \times 100$$

End Semester Examinations conducted by the University will be scheduled after the last working day of the semester.

4.4 The minimum prescribed credits required for the award of the degree shall be within the limits specified below:

Programme	Prescribed Credit Range
M.E. / M.Tech.	70 to 75

Programme	Prescribed Credit Range
M.C.A.	115 - 120
M.B.A.	86 - 90

5. COURSE REGISTRATION

5.1 The Institution is responsible for registering the courses that each student is proposing to undergo in the ensuing semester. Each student has to register for all courses to be undergone in the curriculum of a particular semester (with the facility to drop courses to a maximum of 6 credits (vide clause 5.2). The student can also register for courses for which the student has failed in the earlier semesters. In such cases the student shall do **reappearance registration** for those courses for which the attendance requirement is not compulsory. However, the student have the option to take up some other professional elective or open elective that he has

failed to pass. **But, the total number of credits that a student is allowed to register per semester cannot exceed 36.** The registration details of the candidates may be approved by the Head of the Institution and forwarded to the Controller of Examinations. This registration is for undergoing the course as well as for writing the End Semester Examinations. No Elective course shall be offered by any department of any institution unless a minimum 5 students register for the course. However, if the students admitted in the associated Branch and Semester is less than 5, this minimum will not be applicable.

The courses that a student registers in a particular semester may include

- **i.** Courses of the current semester.
- **ii.** The core (Theory/Lab /EEC) courses that the student has not cleared in the previous semesters.
- **iii.** Elective courses which the student failed (either the same elective or a different elective instead)

5.2 Flexibility to Drop courses

5.2.1 A student has to earn the total number of credits specified in the curriculum of the respective Programme of study in order to be eligible to obtain the degree.

5.2.2 From the II to Final semesters, the student has the option of dropping existing courses in a semester during registration. Total number of credits of such courses cannot exceed 6 for PG (Full Time) programmes and cannot exceed 3 for PG (Part Time) programmes.

6 EVALUATION OF PROJECT WORK

The evaluation of Project Work for Phase-I & Phase-II in the case of M.E. / M.Tech. and project work of M.B.A and M.C.A shall be done independently in the respective semesters and marks shall be allotted as per the weightages given in Clause 6.1.

6.1 There shall be three assessments (each 100 marks) during the Semester by a review committee. The Student shall make presentation on the progress made before the Committee. The Head of the Institution shall constitute the review committee for each branch of study. The total marks obtained in the three assessments shall be reduced to 20 marks and rounded to the nearest integer (as per the Table given below). There will be a vice-voce Examination during End Semester Examinations conducted by a Committee consisting of the supervisor, one internal examiner and one external examiner. The internal examiner and the external examiner shall be appointed by the Controller of Examination. The distribution of marks for the internal assessment and End semester examination is given below:

Internal Assessment (20 Marks)			**End Semester Examination (80 Marks)**			
Review - I	**Review - II**	**Review - III**	**Thesis Submission (30 Marks)**	**Viva – Voce (Rounded to 50 Marks)**		
			External Examiner	Internal Examiner	External Examiner	Supervisor Examiner
5	7.5	7.5	30	15	20	15

6.2 The Project Report prepared according to approved guidelines as given by Director, Academic Courses and duly signed by the supervisor(s) and the Head of the Department concerned shall be submitted to the Head of the Institution.

6.3 If the candidate fails to obtain 50% of the internal assessment marks in the Phase–I and Phase–II / final project, he/she will not be permitted to submit the report for that particular semester and has to re-enroll for the same in the subsequent semester.

If a candidate fails to submit the project report on or before the specified deadline, he/she is deemed to have failed in the Project Work and shall re-enroll for the same in a subsequent semester. This applies to both Phase–I and Phase–II in the case of M.E. / M.Tech. Project Work and the Final Project work of M.B.A. / M.C.A.

If a candidate fails in the end semester examinations of Phase–I, he/she has to resubmit the Project Report within 30 days from the date of declaration of the results. If he / she fails in the End semester examination of Phase–II of Project work of M.E. / M.Tech. or the Final Project work of M.B.A. / M.C.A, he/she shall resubmit the Project Report within 60 days from the date of declaration of the results. The resubmission of a project report and subsequent viva-voce examination will be considered as reappearance with payment of exam fee. For this purpose the same Internal and External examiners shall evaluate the resubmitted report.

6.3.1 A copy of the approved Project Report after the successful completion of viva-voce examinations shall be kept in the library of the college / institution.

6.3.2 Practical / Industrial Training, Summer Project if specified in the Curriculum shall not exceed the maximum duration of 4 weeks and should be organized by the Head of the Department for every student.

6.3.3 At the end of Practical / Industrial Training, Summer Project the candidate shall submit a certificate from the organization where he/she has undergone training and also a brief report. The evaluation for 100 marks will be carried out internally based on this report and a Viva-Voce Examination will be conducted by a Departmental Committee constituted by the Head of the Institution. Certificates submitted by the students shall be attached to the mark list sent by the Head of the Institution to the Controller of Examination.

7 CLASS ADVISER

There shall be a class advisor for each class. The class advisor will be one among the (course-instructors) of the class. He / She will be appointed by the Head of the department concerned. The class advisor is the ex-officio member and the Convener of the class committee. The responsibilities for the class advisor shall be:

- To act as the channel of communication between the HoD and the students of the respective class.
- To collect and maintain various statistical details of students.
- To help the chairperson of the class committee in planning and conduct of the class committee meetings.
- To monitor the academic performance of the students including attendance and to inform the class committee.
- To attend to the students' welfare activities like awards, medals, scholarships and industrial visits.

8 CLASS COMMITTEE

8.1 A Class Committee consists of teachers of the concerned class, student representatives and a chairperson who is not teaching the class. It is like the 'Quality Circle' (more commonly used in industries) with the overall goal of improving the teaching-learning process. The functions of the class committee include:

- Solving problems experienced by students in the class room and in the laboratories.
- Clarifying the regulations of the programme and the details of rules therein.
- Informing the student representatives, the "academic schedule" including the dates of assessments and the syllabus coverage for each assessment period.
- Informing the student representatives, the details of regulations regarding the weightage used for each assessment. In the case of practical courses (laboratory / project work / seminar etc.) the breakup of marks for each experiment/ exercise/ module of work, should be clearly discussed in the class committee meeting and informed to the students.
- Analyzing the performance of the students of the class after each test and finding the ways and means of improving the Students Performance
- Identifying the weak students, if any, in any specific subject and requesting the teachers concerned to provide some additional help or guidance or coaching to such weak students as frequently as possible.

8.2 The class committee for a class under a particular programme is normally constituted by the Head of the Department. However, if the students of different programmes are mixed in a class, the class committee is to be constituted by the Head of the Institution.

8.3 The class committee shall be constituted on the first working day of any semester or earlier.

8.4 At least 2 student representatives (usually 1 boy and 1 girl) shall be included in the class committee.

8.5 The chairperson of the class committee shall invite the Class adviser(s) and the Head of the Department to the meeting of the class committee.

8.6 The Head of the Institution may participate in any class committee of the institution.

8.7 The Chairperson of be Class Committee is required to prepare the minutes of every meeting, submit the same to the Head of the Institution within two days of the meeting and arrange to circulate among the concerned students and teachers. If there are some points in the minutes requiring action by the management, the same shall be brought to the notice of the management by the Head of the Institution.

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

9 COURSE COMMITTEE FOR COMMON COURSES

Each common course offered to more than one group of students shall have a "Course Committee" comprising all the teachers teaching the common course with one of them nominated as Course Coordinator. The nomination of the course Coordinator shall be made by the Head of the Department / Head of the Institution depending upon whether all the teachers teaching the common course belong to a single department or to several departments. The 'Course committee' shall meet as often as possible and ensure uniform evaluation of the tests and arrive at a common scheme of evaluation for the tests. Wherever it is feasible, the course committee may also prepare a common question paper for the Assessment Test(s).

10 ATTENDANCE REQUIREMENTS FOR COMPLETION OF A SEMESTER

10.1 A candidate who has fulfilled the following conditions shall be deemed to have satisfied the attendance requirements for completion of a semester.

Ideally every student is expected to attend all classes and earn 100% attendance. However in order to allow provision for certain unavoidable reasons such as prolonged hospitalization / accident / specific illness the student is expected to earn a minimum of 75% attendance to become eligible to write the End-Semester Examinations.

Therefore, every student shall secure not less than 75% of overall attendance in that semester as per clause 4.3.

10.2 However, a candidate who secures overall attendance between 65% and 74% in that current semester due to medical reasons (prolonged hospitalization / accident / specific illness / participation in sports events) may be permitted to appear for the current semester examinations subject to the condition that the candidate shall submit the medical certificate / sports participation certificate to the Head of the Institution. The same shall be forwarded to the Controller of Examinations for record purposes.

10.3 Candidates who could secure less than 65% overall attendance and **Candidates who do not satisfy the clauses 10.1 & 10.2** will not be permitted to write the end-semester examination of that current semester and are not permitted to go to next semester. They are required to repeat the incomplete semester in the next academic year.

11 PROCEDURES FOR AWARDING MARKS FOR INTERNAL ASSESSMENT(IA)

The maximum marks assigned to different courses shall be as given below:
Each of the theory and practical courses (including project work) shall carry a maximum of 100 marks of which 20 marks will be through internal assessment and the End Semester Examination (ESE) will carry 80 marks.

11.1 The marks for the continuous assessment shall be awarded as per the procedure given below:

(i) Theory Courses:

Three tests each carrying 100 marks shall be conducted during the semester by the Department / College concerned. The total marks obtained in all tests put together out of 300, shall be proportionately reduced for 20 marks and rounded to the nearest integer (This also implies equal weightage to all the three tests).

(ii) Practical Courses:

The maximum marks for Internal Assessment shall be 20 in case of practical courses. Every practical exercise / experiment shall be evaluated based on conduct of experiment / exercise and records maintained. There shall be at least one test. The criteria for arriving at the Internal Assessment marks of 20 is as follows: 75 marks shall be awarded for successful completion of all the prescribed experiments done in the Laboratory and 25 marks for the test. The total mark shall be reduced to 20 and rounded to the nearest integer.

(**iii**) **Theory Courses with Laboratory component:**

The maximum marks for Internal Assessment shall be 20 in case of theory courses with Laboratory component. For a theory course with Laboratory component, there shall be three assessments: the first two assessments (each with a maximum of 100 marks) will be from theory portions and the third assessment (maximum marks 100) will be for laboratory component. The sum of marks of all three assessments shall be reduced to 20 marks and rounded to the nearest integer.

(iv) Other Employability Enhancement Courses

(a) The seminar / Case study is to be considered as purely INTERNAL (with 100% internal marks 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 Institution 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 (40%), presentation (40%) and response to the questions asked during presentation (20%).

(b) The Industrial / Practical Training shall carry 100 marks and shall be evaluated through internal assessment only. At the end of Industrial / Practical training / internship / Summer Project, the candidate shall submit a certificate from the organization where he / she has undergone training and a brief report. The evaluation will be made based on this report and a Viva-Voce Examination, conducted internally by a three member Departmental Committee constituted by the Head of the Institution. Certificates submitted by the candidate shall be attached to the mark list sent by the Head of the Department.

11.2 **Assessment for Value Added Course**

The one / two credit course shall carry 100 marks and shall be evaluated through **continuous assessments only**. Two Assessments shall be conducted during the semester by the Department concerned. The total marks obtained in the tests shall be reduced to 100 marks and rounded to the nearest integer. A committee consisting of the Head of the Department, staff handling the course and a senior Faculty member nominated by the Head of the Institution shall monitor the evaluation process. The list of students along with the marks and the grades earned may be forwarded to the Controller of Examinations for appropriate action at least one month before the commencement of End Semester Examinations

11.3 **Assessment for Online Courses**

Students may be permitted to credit one online course (which are provided with certificate) subject to a maximum of three credits. The approved list of online courses will be provided by the Centre for Academic courses from time to time. **This online course of 3 credits can be considered instead of one elective course**. The student needs to obtain certification or credit to become eligible for writing the End Semester Examination to be conducted by Anna University. **The course shall be evaluated through the End Semester Examination only conducted by Controller of Examinations, Anna University.**

11.4 Internal marks approved by the Head of the Institution shall be displayed by the respective HODs within 5 days from the last working day.

11.5 Every teacher is required to maintain an 'ATTENDANCE AND ASSESSMENT RECORD' which consists of attendance marked in each lecture or practical or project work class, the test marks and the record of class work (topics covered), separately for each course. 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 test marks and attendance. The Head of the department will put his signature and date after due verification. At the end the semester, the record should be verified by the Head of the institution who will keep this document in safe custody (for five years). The university or any inspection team appointed by the University may inspect the records of attendance and assessments of both current and previous semesters.

12 REQUIREMENTS FOR APPEARING FOR SEMESTER EXAMINATION

12.1 A candidate shall normally be permitted to appear for the University examinations of the current semester if he/she has satisfied the semester completion requirements as per clause 10.1 & 10.2 and has registered for examination in all courses of the current semester.

12.2 Further, registration is mandatory for all the courses in the current semester as well as for arrear(s) course(s) for the university examinations failing which, the candidate will not be permitted to move to the higher semester.

12.3 A student who has passed all the courses prescribed in the curriculum for the award of the degree shall not be permitted to re-enroll to improve his/her marks in a course or the aggregate marks / CGPA.

13 UNIVERSITY EXAMINATIONS

13.1 There shall be an End- Semester Examination of 3 hours duration in each lecture based course.

The examinations shall ordinarily be conducted between October and December during the odd semesters and between April and June in the even semesters.

For the practical examinations (including project work), both internal and external examiners shall be appointed by the University.

13.2 **WEIGHTAGE**

The following will be the weightage for different courses.

i) Lecture or Lecture cum Tutorial based course:

Internal Assessment	-	20%
End Semester Examination	-	80%

ii) Laboratory based courses

Internal Assessment	-	20%
End Semester Examination	-	80%

iii) Project work

Internal Assessment	-	20%
Evaluation of Project Report by external examiner	-	30%
Viva-Voce Examination	-	50%

iv) Practical training / summer project / seminar

Internal Assessment	-	100%

14 PASSING REQUIREMENTS

14.1 A candidate who secures not less than 50% of total marks prescribed for the course with a minimum of 50% of the marks prescribed for each of the course of the End-Semester University Examination in both theory and practical courses shall be declared to have passed in the course and acquired the relevant number of credits.

14.2 If a student fails to secure a pass in a theory course (except electives), **the student shall do reappearance registration only along with regular students** for that course in the subsequent semester, when offered next, earn continuous assessment marks and attend the end semester examination.

14.3 If the course, in which the student has failed, is a professional elective or an open elective, the student may be permitted to register for the **same course**, earn continuous assessment marks and attend the End Semester Examination or **any other** professional elective or open elective course in the subsequent semesters, attend the classes and fulfill the attendance requirements as per Clause 10.

14.4 If a student fails to secure a pass in a laboratory course, **the student shall register** for the course again, when offered next.

14.5 If a student fails to secure a pass in project work even after availing clause (6.3), **the student shall register** for the course again, when offered next.

14.6 The passing requirement for the courses which are assessed only through purely internal assessment (EEC courses except project work), is 50% of the internal assessment marks only.

14.7 If a student has failed in the final semester examination he/ she may be allowed to register for the course in the next semester itself.

14.8 A student can apply for revaluation of the student's semester examination answer paper in a theory course, within 2 weeks from the declaration of results, on payment of a prescribed fee along with prescribed application to the COE through the Head of the Institution. The COE will arrange for the revaluation and the results will be intimated to the student concerned through the Head of the Institution. Revaluation is not permitted for laboratory course and project work.

15 AWARD OF LETTER GRADES

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

Letter Grade	Grade Points	Marks Range
O (Outstanding)	**10**	**91 - 100**
A + (Excellent)	**9**	**81 - 90**
A (Very Good)	**8**	**71 – 80**
B + (Good)	**7**	**61 – 70**
B (Average)	**6**	**50 - 60**
RA	**0**	**<50**
SA (Shortage of Attendance)	**0**	
W	**0**	

A student is deemed to have passed and acquired the corresponding credits in a particular course if he/she obtains any one of the following grades: "O", "A+", "A", "B+","B".

'SA' denotes shortage of attendance (as per clause 10.3) and hence prevention from writing the end semester examinations. 'SA' will appear only in the result sheet.

"RA" denotes that the student has failed to pass in that course. "**W**" denotes **withdrawal** from the exam for the particular course. The grades RA and W will figure both in Marks Sheet as well as in Result Sheet). In both cases the student has to earn Continuous Assessment marks and appear for the End Semester Examinations.
If the grade W is given to course, the attendance requirement need not be satisfied.
If the grade RA is given to a core **theory course**, the attendance requirement need not be satisfied, but if the grade RA is given to a **Laboratory Course/ Project work / Seminar and any other EEC course,** the attendance requirements (vide clause 10) should be satisfied.

15.2 The grades O, A+, A, B+, B obtained for the one credit course shall figure in the Mark sheet under the title **'Value Added Courses'**. The Courses for which the grades are RA, SA **will not figure in the mark sheet.**

15.3 GRADE SHEET

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

- The college in which the candidate has studied.
- The list of courses enrolled 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 enrolled from first semester onwards.

GPA for a semester is the ratio of the sum of the products of the number of credits for courses acquired and the corresponding points to the sum of the number of credits for the courses acquired in the semester. CGPA will be calculated in a similar manner, considering all the courses registered from first semester. RA grades will be excluded for calculating GPA and CGPA.

$$\text{GPA / CGPA} = \frac{\sum_{i=1}^{n} C_i \, GP_i}{\sum_{i=1}^{n} C_i}$$

where

C_i is the number of credits assigned to the course
GP_i is the Grade point corresponding to the grade obtained for each Course
n is number of all Courses successfully cleared during the particular semester in the case of GPA and during all the semesters in the case of **CGPA.**

16 ELIGIBILITY FOR THE AWARD OF THE DEGREE

16.1 A student shall be declared to be eligible for the award of the PG Degree (M.E./ M.Tech., M.C.A., M.B.A.) 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. **a. M.E./ M.Tech., M.B.A.(Full Time)**
Successfully completed the course requirements, appeared for the End-Semester examinations and passed all the subjects prescribed in all the 4 semesters within a maximum period of 4 years reckoned from the commencement of the first semester to which the candidate was admitted.

b. M.E./ M.Tech., M.B.A.(Part Time) and M.C.A.(Full Time)
Successfully completed the course requirements, appeared for the End-Semester examinations and passed all the subjects prescribed in all the 6 semesters within a maximum period of 6 years reckoned from the commencement of the first semester to which the candidate was admitted.

iii. Successfully passed any additional courses prescribed by the Director, Academic Courses whenever readmitted under regulations other than R-2017 (vide clause **19.3**)

iv. No disciplinary action pending against the student.

v. The award of Degree must have been approved by the Syndicate of the University.

17 CLASSIFICATION OF THE DEGREE AWARDED

17.1 FIRST CLASS WITH DISTINCTION:

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

M.E. / M.Tech. M.B.A.(Full Time)

- Should have passed the examination in all the courses of all the four semesters in the student's First Appearance within **three** years, which includes authorised break of study of one year (if availed). Withdrawal from examination (vide Clause 18) 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.

M.E. / M.Tech. M.B.A.(Part Time) and M.C.A (Full Time)

- Should have passed the examination in all the courses of all the six semesters in the student's First Appearance within **four** years, which includes authorised break of study of one year (if availed). Withdrawal from examination (vide Clause 18) 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.

17.2 **FIRST CLASS:**

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

M.E. / M.Tech. M.B.A.(Full Time)

- 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 **7.00**

M.E. / M.Tech. M.B.A. (Part Time) and M.C.A (Full Time)

- Should have passed the examination in all the courses of all six semesters **within four 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 **7.00**

17.3 **SECOND CLASS:**

All other students (not covered in clauses 17.1 and 17.2) who qualify for the award of the degree **(**vide Clause 16.1) shall be declared to have passed the examination in **Second Class**.

17.4 A student who is absent in End 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 18) for the purpose of classification.

17.5 **Photocopy** / **Revaluation**

A candidate can apply for photocopy of his/her semester examination answer paper in a theory course, within 2 weeks from the declaration of results, on payment of a prescribed fee through proper application to the Controller of Examinations through the Head of Institutions. The answer script is to be valued and justified by a faculty member, who handled the subject and recommend for revaluation with breakup of marks for each question. Based on the recommendation, the candidate can register for the revaluation through proper application to the Controller of Examinations. The Controller of Examinations will arrange for the revaluation and the results will be intimated to the candidate concerned through the Head of the Institutions. Revaluation is not permitted for practical courses and for project work.

A candidate can apply for revaluation of answer scripts for not exceeding 5 subjects at a time.

17.6 **Review**

Candidates not satisfied with Revaluation can apply for Review of his/ her examination answer paper in a theory course, within the prescribed date on payment of a prescribed fee through proper application to Controller of Examination through the Head of the Institution.

Candidates applying for Revaluation only are eligible to apply for Review.

18 PROVISION FOR WITHDRAWAL FROM EXAMINATION:

18.1 A student may, for valid reasons, (medically unfit / unexpected family situations / sports approved by Chairman, sports board and HOD) 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 Director, Student Affairs through the Head of the Institutions with required documents.

18.2 Withdrawal application is valid if the student is otherwise eligible to write the examination (Clause 10) and if it is made within TEN days prior to the commencement of the examination in that course or courses and recommended by the Head of the Institution and approved by the Controller of Examinations.

18.2.1 Notwithstanding the requirement of mandatory 10 days notice, applications for withdrawal for special cases under extraordinary conditions will be considered on the merit of the case.

18.3 In case of withdrawal from a course / courses (Clause 12) the course will figure both in Marks Sheet as well as in Result Sheet. **Withdrawal essentially requires the student to register for the course/courses** The student has to register for the course, fulfill the attendance requirements (vide clause 10), earn continuous assessment marks and attend the end semester examination. However, withdrawal shall not be construed as an appearance for the eligibility of a candidate for First Class with Distinction.

18.4 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 17.1.

19 AUTHORIZED BREAK OF STUDY FROM A PROGRAMME

19.1 A student is permitted to go on break of study for a maximum period of one year as a single spell.

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

19.3 The candidates permitted to rejoin the programme after break of study / prevention due to lack of attendance, shall be governed by the Curriculum and Regulations in force at the time of rejoining. The students rejoining in new Regulations shall apply to the Director, Academic Courses in the prescribed format through Head of the Institution at the beginning of the readmitted semester itself for prescribing additional courses, if any, from any semester of the regulations in-force, so as to bridge the curriculum in-force and the old curriculum.

19.4 The authorized break of study would not be counted towards the duration specified for passing all the courses for the purpose of classification (vide Clause 17.1).

19.5 The total period for completion of the Programme reckoned from, the commencement of the first semester to which the candidate was admitted shall not exceed the maximum period specified in clause 4.1 irrespective of the period of break of study in order that he/she may be eligible for the award of the degree.

19.6 If any student is prevented for want of required attendance, the period of prevention shall not be considered as authorized 'Break of Study' (Clause 19.1)

20 DISCIPLINE

21.1 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 University / College. The Head of Institution shall constitute a disciplinary committee consisting of Head of Institution, Two Heads of Department of which one should be from the faculty of the student, to enquire into acts of indiscipline and notify the University about the disciplinary action recommended for approval. In case of any serious disciplinary action which leads to suspension or dismissal, then a committee shall be constituted including one representative from Anna University, Chennai. In this regard, the member will be nominated by the University on getting information from the Head of the Institution.

21.2 If a student indulges in malpractice in any of the University / internal examination he / she shall be liable for punitive action as prescribed by the University from time to time.

22 REVISION OF REGULATIONS, CURRICULUM AND SYLLABI

The University may from time to time revise, amend or change the Regulations, Curriculum, Syllabus and scheme of examinations through the Academic Council with the approval of Syndicate.

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ANNA UNIVERSITY, CHENNAI
AFFLIATED INSTITUTIONS
REGULATIONS – 2017
CHOICE BASED CREDIT SYSTEM
M. E. STRUCTURAL ENGINEERING

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs) :

I. To prepare students to excel in research and to succeed in Structural engineering profession through global, rigorous post graduate education

II. To provide students with a solid foundation in mathematical, scientific and engineering fundamentals required to solve structural engineering problems

III. To train students with good scientific and engineering knowledge so as to comprehend, analyze, design, and create novel products and solutions for the real life problems

IV. To inculcate students in professional and ethical attitude, effective communication skills, teamwork skills, multidisciplinary approach, and an ability to relate structural engineering issues to broader social context.

V. To provide student with an academic environment aware of excellence, leadership, written ethical codes and guidelines, and the life-long learning needed for a successful professional career

PROGRAMME OUTCOMES (POs):

On successful completion of the programme,

1. Graduates will demonstrate knowledge of mathematics, science and engineering.
2. Graduates will demonstrate an ability to identify, formulate and solve engineering problems.
3. Graduate will demonstrate an ability to design and conduct experiments, analyze and interpret data.
4. Graduates will demonstrate an ability to design a system, component or process as per needs and specifications.
5. Graduates will demonstrate an ability to visualize and work on laboratory and multidisciplinary tasks.
6. Graduate will demonstrate skills to use modern engineering tools, software and equipment to analyze problems.
7. Graduates will demonstrate knowledge of professional and ethical responsibilities.
8. Graduate will be able to communicate effectively in both verbal and written form.
9. Graduate will show the understanding of impact of engineering solutions on the society and also will be aware of contemporary issues.
10. Graduate will develop confidence for self education and ability for life-long learning.

Programme Educational Objectives	Programme Outcomes									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
I	✓	✓		✓						
II					✓	✓	✓			
III				✓	✓	✓	✓			
IV							✓	✓	✓	
V		✓	✓						✓	✓

			PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
YEAR 1	SEM 1	Advanced Mathematical Methods	✓									
		Advanced Concrete Structures				✓	✓					
		Dynamics of Structures	✓	✓	✓		✓					
		Theory of Elasticity and Plasticity	✓	✓								
		Professional Elective I										
		Professional Elective II										
	SEM 2	Advanced Steel Structures		✓		✓					✓	
		Stability of Structures		✓		✓					✓	
		Earthquake Analysis and Design of Structures		✓	✓							
		Experimental Techniques		✓	✓	✓		✓			✓	
		Finite Element Analysis of Structures	✓					✓			✓	
		Professional Elective III										
		Professional Elective IV										
		Advanced Structural Engineering Laboratory		✓		✓	✓	✓				
		Practical Training I (2 weeks)				✓			✓	✓		✓
YEAR 2	SEM 1	Earthquake Analysis and Design of Structures										
		Professional Elective V										
		Professional Elective VI										
		Practical Training II (2 weeks)				✓			✓	✓		✓
		Seminar								✓		
		Project Work (Phase I)		✓		✓			✓			✓
	SEM 2	Project Work (Phase II)		✓		✓			✓			✓
		Practical Training III (2 weeks)				✓			✓	✓		✓

Professional Electives (PE)

Course Name	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
Maintenance and Rehabilitation of Structures					✓	✓			✓	
Prefabricated Structures		✓	✓	✓					✓	✓
Offshore Structures		✓							✓	
Analysis and Design of Tall Buildings	✓	✓		✓		✓			✓	✓
Theory of Plates	✓			✓						
Matrix Methods for Structural Analysis	✓					✓				
Mechanics of Composite Materials		✓		✓	✓					
Industrial Structures		✓		✓						
Pre-stressed Concrete		✓		✓		✓			✓	✓
Wind and Cyclone Effects on Structures		✓		✓		✓			✓	✓
Nonlinear Analysis Structures			✓							
Design of Sub Structures	✓	✓		✓		✓			✓	✓
Optimization of Structures	✓					✓				
Design of Steel Concrete Composite Structures		✓		✓						
Design of Bridges		✓		✓		✓				
Design of Shell and Spatial Structures				✓		✓				
Computer Aided Analysis and Design	✓	✓	✓	✓	✓	✓				

ANNA UNIVERSITY, CHENNAI
AFFLIATED INSTITUTIONS
M.E. STRUCTURAL ENGINEERING
REGULATIONS – 2017
CHOICE BASED CREDIT SYSTEM
CURRICULA AND SYLLABI

SEMESTER I

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MA5151	Advanced Mathematical Methods	FC	4	4	0	0	4
2.	ST5101	Advanced Concrete Structures	PC	3	3	0	0	3
3.	ST5102	Dynamics of Structures	PC	3	3	0	0	3
4.	ST5103	Theory of Elasticity and Plasticity	PC	3	3	0	0	3
5.		Professional Elective I	PE	3	3	0	0	3
6.		Professional Elective II	PE	3	3	0	0	3
			TOTAL	**19**	**19**	**0**	**0**	**19**

SEMESTER II

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	ST5201	Advanced Steel Structures	PC	3	3	0	0	3
2.	ST5202	Stability of Structures	PC	3	3	0	0	3
3.	ST5203	Experimental Techniques	PC	3	3	0	0	3
4.	ST5204	Finite Element Analysis of Structures	PC	3	3	0	0	3
5.		Professional Elective III	PE	3	3	0	0	3
6.		Professional Elective IV	PE	3	3	0	0	3
PRACTICAL								
7.	ST5211	Advanced Structural Engineering Laboratory	PC	4	0	0	4	2
8.	ST5212	Practical Training I (2 weeks)	EEC	0	0	0	0	1
			TOTAL	**22**	**18**	**0**	**4**	**21**

SEMESTER III

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	ST5301	Earthquake Analysis and Design of Structures	PC	3	3	0	0	3
2.		Professional Elective V	PE	3	3	0	0	3
3.		Professional Elective VI	PE	3	3	0	0	3
PRACTICAL								
4.	ST5311	Practical Training II (2 weeks)	EEC	0	0	0	0	1
5.	ST5312	Seminar	EEC	2	0	0	2	1
6.	ST5313	Project Work (Phase I)	EEC	12	0	0	12	6
			TOTAL	**23**	**9**	**0**	**14**	**17**

SEMESTER IV

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
PRACTICAL								
1.	ST5411	Practical Training III (2 weeks)	EEC	0	0	0	0	1
2.	ST5412	Project Work (Phase II)	EEC	24	0	0	24	12
			TOTAL	**24**	**0**	**0**	**24**	**13**

TOTAL NO. OF CREDITS: 70

FOUNDATION COURSES (FC)

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	MA5151	Advanced Mathematical Methods	FC	4	4	0	0	4

PROFESSIONAL CORE (PC)

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	ST5101	Advanced Concrete Structures	PC	3	3	0	0	3
2.	ST5102	Dynamics of Structures	PC	3	3	0	0	3
3.	ST5103	Theory of Elasticity and Plasticity	PC	3	3	0	0	3
4.	ST5201	Advanced Steel Structures	PC	3	3	0	0	3
5.	ST5202	Stability of Structures	PC	3	3	0	0	3
6.	ST5203	Experimental Techniques	PC	3	3	0	0	3
7.	ST5204	Finite Element Analysis of Structures	PC	3	3	0	0	3
8.	ST5211	Advanced Structural Engineering Laboratory	PC	4	0	0	4	2
9.	ST5301	Earthquake Analysis and Design of Structures	PC	3	3	0	0	3

PROFESSIONAL ELECTIVES

SEMESTER I

ELECTIVE I & II

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	ST5001	Maintenance and Rehabilitation of Structures	PE	3	3	0	0	3
2.	ST5002	Prefabricated Structures	PE	3	3	0	0	3
3.	ST5003	Offshore Structures	PE	3	3	0	0	3
4.	ST5004	Matrix Methods for Structural Analysis	PE	3	3	0	0	3

SEMESTER II

ELECTIVE III & IV

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	ST5005	Theory of Plates	PE	3	3	0	0	3
2.	ST5006	Mechanics of Composite Materials	PE	3	3	0	0	3
3.	ST5007	Analysis and Design of Tall Buildings	PE	3	3	0	0	3
4.	ST5008	Industrial Structures	PE	3	3	0	0	3
5.	ST5009	Prestressed Concrete	PE	3	3	0	0	3
6.	ST5010	Wind and Cyclone Effects on Structures	PE	3	3	0	0	3

SEMESTER III

ELECTIVE V & VI

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	ST5011	Nonlinear Analysis of Structures	PE	3	3	0	0	3
2.	ST5012	Design of Sub Structures	PE	3	3	0	0	3
3.	ST5013	Optimization of Structures	PE	3	3	0	0	3
4.	ST5014	Design of Steel Concrete Composite Structures	PE	3	3	0	0	3
5.	ST5015	Design of Bridges	PE	3	3	0	0	3
6.	ST5016	Design of Shell and Spatial Structures	PE	3	3	0	0	3
7.	ST5017	Computer Aided Analysis and Design	PE	4	2	0	2	3

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	ST5212	Practical Training I (2 weeks)	EEC	-	-	-	-	1
2.	ST5311	Practical Training II (2 weeks)	EEC	-	-	-	-	1
3.	ST5411	Practical Training III (2 weeks)	EEC	-	-	-	-	1
4.	ST5312	Seminar	EEC	2	0	0	2	1
5.	ST5313	Project Work (Phase I)	EEC	12	0	0	12	6
6.	ST5412	Project Work (Phase II)	EEC	24	0	0	24	12

MA5151 ADVANCED MATHEMATICAL METHODS L T P C
4 0 0 4

OBJECTIVES :

- The main objective of this course is to provide the student with a repertoire of mathematical methods that are essential to the solution of advanced problems encountered in the fields of applied physics and engineering. This course covers a broad spectrum of mathematical techniques such as Laplace Transform, Fourier Transform, Calculus of Variations, Conformal Mapping and Tensor Analysis. Application of these topics to the solution of problems in physics and engineering is stressed.

UNIT I LAPLACE TRANSFORM TECHNIQUES FOR PARTIAL DIFFERENTIAL EQUATIONS 12

Laplace transform : Definitions – Properties – Transform error function – Bessel's function - Dirac delta function – Unit step functions – Convolution theorem – Inverse Laplace transform : Complex inversion formula – Solutions to partial differential equations : Heat equation – Wave equation.

UNIT II FOURIER TRANSFORM TECHNIQUES FOR PARTIAL DIFFERENTIAL EQUATIONS 12

Fourier transform : Definitions – Properties – Transform of elementary functions – Dirac delta function – Convolution theorem – Parseval's identity – Solutions to partial differential equations : Heat equation – Wave equation – Laplace and Poisson's equations.

UNIT III CALCULUS OF VARIATIONS 12

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 – Isoperimetric problems – Direct methods – Ritz and Kantorovich methods.

UNIT IV CONFORMAL MAPPING AND APPLICATIONS 12

Introduction to conformal mappings and bilinear transformations – Schwarz Christoffel transformation – Transformation of boundaries in parametric form – Physical applications : Fluid flow and heat flow problems.

UNIT V TENSOR ANALYSIS 12

Summation convention – Contravariant and covariant vectors – Contraction of tensors – Inner product – Quotient law – Metric tensor – Christoffel symbols – Covariant differentiation – Gradient - Divergence and curl.

TOTAL : 60 PERIODS

OUTCOMES :

After completing this course, students should demonstrate competency in the following skills:

- Application of Laplace and Fourier transforms to initial value, initial–boundary value and boundary value problems in Partial Differential Equations.
- Maximizing and minimizing the functional that occur in various branches of Engineering Disciplines.
- Construct conformal mappings between various domains and use of conformal mapping in studying problems in physics and engineering particularly to fluid flow and heat flow problems.
- Understand tensor algebra and its applications in applied sciences and engineering and develops ability to solve mathematical problems involving tensors.
- Competently use tensor analysis as a tool in the field of applied sciences and related fields.

REFERENCES :

1. Andrews L.C. and Shivamoggi, B., "Integral Transforms for Engineers", Prentice Hall of India Pvt. Ltd., New Delhi, 2003.
2. Elsgolc, L.D., "Calculus of Variations", Dover Publications Inc., New York, 2007.
3. Kay, D. C., "Tensor Calculus", Schaum's Outline Series, Tata McGraw Hill Edition, 2014.
4. Mathews, J. H., and Howell, R.W., "Complex Analysis for Mathematics and Engineering", 5th Edition, Jones and Bartlett Publishers, 2006.
5. Naveen Kumar, "An Elementary Course on Variational Problems in Calculus ", Narosa Publishing House, 2005.
6. Ramaniah. G. "Tensor Analysis", S. Viswanathan Pvt. Ltd., 1990.
7. Saff, E.B and Snider, A.D, "Fundamentals of Complex Analysis with Applications in Engineering, Science and Mathematics", 3rd Edition, Pearson Education, New Delhi, 2014.
8. Sankara Rao, K., "Introduction to Partial Differential Equations", Prentice Hall of India Pvt. Ltd., New Delhi, 1997.
9. Spiegel, M.R., "Theory and Problems of Complex Variables and its Applications", Schaum's Outline Series, McGraw Hill Book Co., 1981.

ST5101 ADVANCED CONCRETE STRUCTURES L T P C
3 0 0 3

OBJECTIVE:

- To make the students be familiar with the limit state design of RCC beams and columns
- To design special structures such as Deep beams, Corbels, Deep beams, and Grid floors
- To make the students confident to design the flat slab as per Indian standard, yield line theory and strip method.
- To design the beams based on limit analysis and detail the beams, columns and joints for ductility.

UNIT I DESIGN PHILOSOPHY 9

Limit state design - beams, slabs and columns according to IS Codes. Calculation of deflection and crack width according to IS Code. interaction curve generation for axial force and bending

UNIT II DESIGN OF SPECIAL RC ELEMENTS 9

Design of slender columns - Design of RC 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 BASED DESIGN 9

Design of flat slabs and flat plates according to IS method – Check for shear - Design of spandrel beams - Yield line theory and Hillerborg's strip method of design of slabs.

UNIT IV INELASTIC BEHAVIOUR OF CONCRETE BEAMS AND COLUMNS 9

Inelastic behaviour of concrete beams and Baker's method, moment - rotation curves,ductility definitions, evaluation

UNIT V DUCTILE DETAILING 9

Concept of Ductility – Detailing for ductility – Design of beams, columns for ductility - Design of cast-in-situ joints in frames.

TOTAL: 45 PERIODS

OUTCOME:

- On completion of this course the students will have the confidence to design various concrete structures and structural elements by limit state design and detail the same for ductility as per codal requirements.

REFERENCES:

1. Gambhir.M. L., “Design of Reinforced Concrete Structures”, Prentice Hall of India, 2012.
2. Purushothaman, P, “Reinforced Concrete Structural Elements: Behaviour Analysis and Design”, Tata McGraw Hill, 1986
3. Unnikrishna Pillai and Devdas Menon “Reinforced Concrete Design’, Third Edition, Tata McGraw Hill Publishers Company Ltd., New Delhi, 2007.
4. Varghese, P.C, “Advanced Reinforced Concrete Design”, Prentice Hall of India, 2005.
5. Varghese, P.C., “Limit State Design of Reinforced Concrete”, Prentice Hall of India, 2007.

ST5102 DYNAMICS OF STRUCTURES L T P C
3 0 0 3

OBJECTIVE:

- 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.

UNIT I PRINCIPLES OF VIBRATION ANALYSIS 9

Mathematical models of single degree of freedom systems - Free and forced vibration of SDOF systems, Response of SDOF to special forms of excitation, Effect of damping, Transmissibility, applications-examples related to structural engineering

UNIT II TWO DEGREE OF FREEDOM SYSTEMS 9

Mathematical models of two degree of freedom systems, free and forced vibrations of two degree of freedom systems, normal modes of vibration, applications.

UNIT III DYNAMIC RESPONSE OF MULTI-DEGREE OF FREEDOM SYSTEMS 9

Mathematical models of Multi-degree of freedom systems, orthogonality of normal modes, free and forced vibrations of multi degree of freedom systems, Mode superposition technique, response spectrum method, Applications.

UNIT IV DYNAMIC RESPONSE OF CONTINUOUS SYSTEMS 9

Mathematical models of continuous systems, Free and forced vibration of continuous systems, Rayleigh – Ritz method – Formulation using Conservation of Energy – Formulation using Virtual Work, Applications.

UNIT V DIRECT INTEGRATION METHODS FOR DYNAMIC RESPONSE 9

Damping in MDOF systems, Nonlinear MDOF systems, step-by-step numerical integration algorithms, substructure technique, Applications.

TOTAL : 45 PERIODS

OUTCOME:

- After completion of the course the students will have the knowledge of vibration analysis of systems/structures with different degrees of freedom and they know the method of damping the systems.

REFERENCES:

1. Anil K.Chopra, Dynamics of Structures, Pearson Education, 2007.
2. Leonard Meirovitch, Elements of Vibration Analysis, McGraw Hill, 1986, IOS Press, 2006.
3. Mario Paz, Structural Dynamics -Theory and Computation, Kluwer Academic Publishers, 2004.
4. Roy R.Craig, Jr, Andrew J. Kurdila, Fundamentals of Structural Dynamics, John Wiley & Sons, 2011.

ST5103 THEORY OF ELASTICITY AND PLASTICITY L T P C
3 0 0 3

OBJECTIVE:

- To understand the concept of 3D stress, strain analysis and its applications.

UNIT I ELASTICITY 9

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

UNIT II 2D STRESS STRAIN PROBLEMS 9

Plane stress and plane strain - Simple two dimensional problems in Cartesian and Polar Co-ordinates.

UNIT III TORSION OF NON-CIRCULAR SECTION 9

St.Venant's approach - Prandtl's approach – Membrane analogy - Torsion of Thin Walled- Open and Closed sections-Design approach to open web section subjected to torsion

UNIT IV BEAMS ON ELASTIC FOUNDATIONS 9

Beams on Elastic foundation – Methods of analysis – Elastic line method – Idealization of soil medium – Winkler model – Infinite beams – Semi infinite and finite beams – Rigid and flexible – Uniform Cross Section – Point load and UDL – Solution by Finite Differences.

UNIT V PLASTICITY 9

Physical Assumptions – Yield Criteria – Failure Theories – Applications of Thick Cylinder – Plastic Stress Strain Relationship. Elasto-Plastic Problems in Bending and Torsion.

TOTAL: 45 PERIODS

OUTCOME:

- On completion of this course the students will be familiar to the concept of elastic analysis of plane stress and plane strain problems, beams on elastic foundation and torsion on non-circular section.
- They will also have sufficient knowledge in various theories of failure and plasticity.

REFERENCES:

1. Ansel.C.Ugural and Saul.K.Fenster, "Advanced Strength and Applied Elasticity," Fourth Edition, Prentice Hall Professional technical Reference, New Jersy, 2003.
2. Chakrabarty.J, "Theory of Plasticity", Third Edition, Elsevier Butterworth - Heinmann – UK, 2007.
3. Jane Helena H, "Theory of Elasticity and Plasticity", PHI Learning Pvt. Ltd., 2016 .
4. Slater R.A.C, "Engineering Plasticity", John Wiley and Son, New York, 1977.
5. Timoshenko, S. and Goodier J.N."Theory of Elasticity", McGraw Hill Book Co., New York, 2010.

ST5201 ADVANCED STEEL STRUCTURES L T P C
3 0 0 3

OBJECTIVE:

- To study the behaviour of members and connections, analysis and design of Industrial buildings and roofs, chimneys. Study the design of with cold formed steel and plastic analysis of structures.

UNIT I GENERAL 9

Design of members subjected to combined forces – Design of Purlins, Louver rails, Gable column and Gable wind girder – Design of simple bases, Gusseted bases and Moment Resisting Base Plates.

UNIT II DESIGN OF CONNECTIONS 9

Types of connections – Welded and Bolted – 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 HSFG bolted connections.

UNIT III ANALYSIS AND DESIGN OF INDUSTRIAL BUILDINGS 9

Analysis and design of different types of trusses – Analysis and design of industrial buildings – Sway and non sway frames – Aseismic design of steel buildings.

UNIT IV PLASTIC ANALYSIS OF STRUCTURES 9

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

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

TOTAL: 45 PERIODS

OUTCOME:

- At the end of this course students will be in a position to design bolted and welded connections in industrial structures.
- They also know the plastic analysis and design of light gauge steel structures.

REFERENCES:

1. Lynn S. Beedle, Plastic Design of Steel Frames, John Wiley and Sons, 1990.
2. Narayanan.R.et.al., Teaching Resource on Structural steel Design, INSDAG, Ministry of Steel Publishing, 2000.
3. Subramanian.N, Design of Steel Structures, Oxford University Press, 2014.
4. Wie Wen Yu, Design of Cold Formed Steel Structures, McGraw Hill Book Company, 1996

ST5202 STABILITY OF STRUCTURES L T P C
3 0 0 3

OBJECTIVE:

- To study the concept of buckling and analysis of structural elements.

UNIT I BUCKLING OF COLUMNS 9

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

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

UNIT III TORSIONAL AND LATERAL BUCKLING 9

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

UNIT IV BUCKLING OF PLATES 9

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

UNIT V INELASTIC BUCKLING 9

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

TOTAL: 45 PERIODS

OUTCOME:

- On completion of this course student will know the phenomenon of buckling and they are in a position to calculate the buckling load on column, beam – column, frames and plates using classical and approximate methods.

REFERENCES:

1. Ashwini Kumar, "Stability Theory of Structures", Allied publishers Ltd., New Delhi, 2003.
2. Chajes, A. "Principles of Structures Stability Theory", Prentice Hall, 1974.
3. Gambhir, "Stability Analysis and Design of Structures", springer, New York, 2004.
4. Simitser.G.J and Hodges D.H, "Fundamentals of Structural Stability", Elsevier Ltd., 2006.
5. Timoshenko.S.P, and Gere.J.M, "Theory of Elastic Stability", McGraw Hill Book Company, 1963.

ST5203 EXPERIMENTAL TECHNIQUES L T P C
3 0 0 3

OBJECTIVE:

- To learn the principles of measurements of static and dynamic response of structures and carryout the analysis of results.

UNIT I FORCES AND STRAIN MEASUREMENT 9

Choice of Experimental stress analysis methods, Errors in measurements - Strain gauge, principle, types, performance and uses. Photo elasticity - principle and applications - 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 MEASUREMENT OF VIBRATION AND WIND FLOW 9

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 – wind tunnels – Flow meters – Venturimeter – Digital data Acquisition systems.

UNIT III DISTRESS MEASUREMENTS AND CONTROL 9

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 – Structural Health Monitoring.

UNIT IV NON DESTRUCTIVE TESTING METHODS 9

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).

UNIT V MODEL ANALYSIS 9

Model Laws – Laws of similitude – Model materials – Necessity for Model analysis – Advantages – Applications – Types of similitude – Scale effect in models – Indirect model study – Direct model study - Limitations of models – investigations – structural problems –Usage of influence lines in model studies.

TOTAL : 45 PERIODS

OUTCOME:

- At the end of this course students will know about measurement of strain, vibrations and wind blow.
- They will be able to analyze the structure by non-destructive testing methods and model analysis.

REFERENCES:

1. Dalley .J. W and Riley. W. F, “Experimental Stress Analysis”, McGraw Hill Book Company, N.Y. 1991
2. Ganesan.T.P, “Model Analysis of Structures”, University Press, India, 2000.
3. Ravisankar.K.and Chellappan.A., “Advanced course on Non-Destructive Testing and Evaluation of Concrete Structures”, SERC, Chennai, 2007.
4. Sadhu Singh, “Experimental Stress Analysis”, Khanna Publishers, New Delhi, 2006.
5. Sirohi.R.S., Radhakrishna.H.C, “Mechanical Measurements”, New Age International (P) Ltd. 1997.

ST5204 FINITE ELEMENT ANALYSIS OF STRUCTURES L T P C
3 0 0 3

OBJECTIVE :

- To study the basics of the Finite Element Technique, a numerical tool for the solution of different classes of problems.

UNIT I INTRODUCTION 9

Approximate solutions of boundary value problems - Methods of weighted residuals, approximate solution using variational method, Modified Galerkin method, Boundary conditions and general comments-continuity,compatibility,convergence aspects.

Basic finite element concepts - Basic ideas in a finite element solution, General finite element solution procedure, Finite element equations using modified Galerkin method.

UNIT II APPLICATION : AXIAL DEFORMATION OF BARS, AXIAL SPRING ELEMENT. 9

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

UNIT III ANALYSIS OF FRAMED STRUCTURES 9

Stiffness of Truss Member - Analysis of Truss -Stiffness of Beam Member-Finite Element Analysis of Continuous Beam -Plane Frame Analysis -Analysis of Grid and Space Frame – Two Dimensional Solids - Constant Strain Triangle -Linear Strain Triangle -Rectangular Elements - Numerical Evaluation of Element Stiffness -Computation of Stresses, Geometric Nonlinearity and Static Condensation - Axisymmetric Element -Finite Element Formulation of Axisymmetric Element -Finite Element Formulation for 3 Dimensional Elements – Solution for simple frames.

UNIT IV PLATES AND SHELLS 9

Introduction to Plate Bending Problems - Finite Element Analysis of Thin Plate -Finite Element Analysis of Thick Plate -Finite Element Analysis of Skew Plate - Introduction to Finite Strip Method -Finite Element Analysis of Shell.

UNIT V APPLICATIONS 9

Finite Elements for Elastic Stability - Dynamic Analysis - Nonlinear, Vibration and Thermal Problems - Meshing and Solution Problems - Modelling and analysis using recent softwares.

TOTAL : 45 PERIODS

OUTCOME:

- On completion of this course, the students will know the concept of finite element analysis and enable to analyze framed structure, Plate and Shells and modify using recent softwares.

REFERENCES:

1. Bhavikatti.S.S, “Finite Element Analysis”, New Age International Publishers, 2007.
2. Chandrupatla, R.T. and Belegundu, A.D., “Introduction to Finite Elements in Engineering”, Prentice Hall of India, 2007.
3. Rao.S.S, “Finite Element Method in Engineering”, Butterworth – Heinmann, UK, 2008
4. Logan D. L., A First Course in the Finite Element Method, Thomson Learning, 2007.
5. R.D.Cook, Concepts and Applications of Finite Element Analysis, John Wiley &Sons.
6. David Hutton, “Fundamentals of Finite Element Analysis”, Tata McGraw Hill Publishing Company Limited, New Delhi, 2005.

ST5211 ADVANCED STRUCTURAL ENGINEERING LABORATORY L T P C
0 0 4 2

LIST OF EXPERIMENTS

1. Fabrication, casting and testing of simply supported reinforced concrete beam for strength and deflection behaviour.
2. Testing of simply supported steel beam for strength and deflection behaviour.
3. Fabrication, casting and testing of reinforced concrete column subjected to concentric and eccentric loading.
4. Dynamic Response of cantilever steel beam
   a. To determine the damping coefficients from free vibrations.
   b. To evaluate the mode shapes.

5. 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.
6. Non-Destructive Test on concrete
    i) Rebound hammer and ii) Ultrasonic Pulse Velocity Tester.

LIST OF EQUIPMENTS

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
14. FFT Analyser

TOTAL: 60 PERIODS

OUTCOME:

- On completion of this laboratory course students will be able to cast and test RC beams for strength and deformation behaviour.
- They will be able to test dynamic testing on steel beams, static cyclic load testing of RC frames and non-destruction testing on concrete.

REFERENCES:

1. Dally J W, and Riley W F, “Experimental Stress Analysis”, McGraw-Hill Inc. New York, 1991.

ST5212	**PRACTICAL TRAINING I (2 Weeks)**	**L T P C**
		0 0 0 1

OBJECTIVE:

- To train the students in the field work so as to have a firsthand knowledge of practical problems related to Structural Engineering in carrying out engineering tasks.
- To develop skills in facing and solving the field problems.

SYLLABUS:

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

OUTCOME:

- They are trained in tackling a practical field/industry orientated problem related to Structural Engineering.

ST5301 EARTHQUAKE ANALYSIS AND DESIGN OF STRUCTURES L T P C
3 0 0 3

OBJECTIVE:

- To study the effect of earthquakes, analysis and design of earthquake resistant Structures.

UNIT I EARTHQUAKE GROUND MOTION 9

Engineering Seismology (Definitions, Introduction to Seismic hazard, Earthquake Phenomenon), Seismotectonics and Seismic Zoning of India, Earthquake Monitoring and Seismic Instrumentation, Characteristics of Strong Earthquake Motion, Estimation of Earthquake Parameters, Microzonation.

UNIT II EFFECTS OF EARTHQUAKE ON STRUCTURES 9

Dynamics of Structures SDOFS MDOFS - Response Spectra - Evaluation of Earthquake Forces as per codal provisions - Effect of Earthquake on Different Types of Structures - Lessons Learnt From Past Earthquakes

UNIT III EARTHQUAKE RESISTANT DESIGN OF MASONRY STRUCTURES 9

Structural Systems - Types of Buildings - Causes of damage - Planning Considerations - Philosophy and Principle of Earthquake Resistant Design - Guidelines for Earthquake Resistant Design - Earthquake Resistant Masonry Buildings - Design consideration – Guidelines.

UNIT IV EARTHQUAKE RESISTANT DESIGN OF RC STRUCTURES 9

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

UNIT V VIBRATION CONTROL TECHNIQUES 9

Vibration Control - Tuned Mass Dampers – Principles and application, Basic Concept of Seismic Base Isolation – various Systems- Case Studies, Important structures.

TOTAL: 45 PERIODS

OUTCOME:

- At the end of this course the students will be able to understand the causes and effect of earthquake.
- They will be able to design masonry and RC structures to the earthquake forces as per the recommendations of IS codes of practice.

REFERENCES:

1. Brebbia C. A.,"Earthquake Resistant Engineering Structures VIII",WIT Press, 2011
2. Bruce A Bolt, "Earthquakes" W H Freeman and Company, New York, 2004.
3. Duggal S K , "Earthquake Resistant Design of Structures", Oxford University Press, 2007.
4. Mohiuddin Ali Khan "Earthquake-Resistant Structures: Design, Build and Retrofit", Elsevier Science & Technology, 2012
5. Pankaj Agarwal and Manish Shrikhande, "Earthquake Resistant Design of Structures", Prentice Hall of India, 2009.
6. Paulay,T and Priestley, M.J.N., "Seismic Design of Reinforced Concrete and Masonry buildings", John Wiley and Sons, 1992.

ST5311 **PRACTICAL TRAINING II (2 Weeks)** **L T P C**
0 0 0 1

OBJECTIVE:

- To train the students in the field work so as to have a firsthand knowledge of practical problems related to Structural Engineering in carrying out engineering tasks.
- To develop skills in facing and solving the field problems.

SYLLABUS:

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

OUTCOME:

- They are trained in tackling a practical field/industry orientated problem related to Structural Engineering.

ST5312 **SEMINAR** **L T P C**
0 0 2 1

OBJECTIVE:

- To work on a specific technical topic in Structural Engineering and acquire the skills of written and oral presentation.
- To acquire writing abilities for seminars and conferences.

SYLLABUS:

The students will work for two hours per week guided by a group of staff members. They will be asked to give a presentation on any topic of their choice related to Structural Engineering and to engage in discussion with the audience. A brief copy of their presentation also should be submitted. Similarly, the students will have to present a seminar of not less than fifteen minutes and not more than thirty minutes on the technical topic. They will defend their presentation. Evaluation will be based on the technical presentation and the report and also on the interaction shown during the seminar.

TOTAL: 30 PERIODS

OUTCOME:

- The students will be trained to face an audience and to tackle any problem during group discussion in the Interviews.

ST5313 **PROJECT WORK (PHASE I)** **L T P C**
0 0 12 6

OBJECTIVE:

- To identify a specific problem for the current need of the society and collecting information related to the same through detailed review of literature.
- To develop the methodology to solve the identified problem.
- To train the students in preparing project reports and to face reviews and viva-voce examination.

SYLLABUS:

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

TOTAL: 180 PERIODS

OUTCOME:

- At the end of the course the students will have a clear idea of his/her area of work and they are in a position to carry out the remaining phase II work in a systematic way.

ST5411	PRACTICAL TRAINING III (2 Weeks)	L	T	P	C
		0	0	0	1

OBJECTIVE:

- To train the students in the field work so as to have a firsthand knowledge of practical problems related to Structural Engineering in carrying out engineering tasks.
- To develop skills in facing and solving the field problems.

SYLLABUS:

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

OUTCOME:

- They are trained in tackling a practical field/industry orientated problem related to Structural Engineering.

ST5412	PROJECT WORK (PHASE II)	L	T	P	C
		0	0	24	12

OBJECTIVE:

- To solve the identified problem based on the formulated methodology.
- To develop skills to analyze and discuss the test results, and make conclusions.

SYLLABUS:

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

TOTAL: 360 PERIODS

OUTCOME:

- On completion of the project work students will be in a position to take up any challenging practical problem and find better solutions.

ST5001 MAINTENANCE AND REHABILITATION OF STRUCTURES L T P C
3 0 0 3

OBJECTIVE:

- To study the damages, repair and rehabilitation of structures.

UNIT I INTRODUCTION 9

General Consideration – Distresses monitoring – Causes of distresses – Quality assurance – Defects due to climate, chemicals, wear and erosion – Inspection – Structural appraisal – Economic appraisal.

UNIT II BUILDING CRACKS 9

Causes – diagnosis – Thermal and Shrinkage cracks – unequal loading – Vegetation and trees – Chemical action – Foundation movements – Remedial measures - Techniques for repair – Epoxy injection.

UNIT III MOISTURE PENETRATION 9

Sources of dampness – Moisture movement from ground – Reasons for ineffective DPC – Roof leakage – Pitched roofs – Madras Terrace roofs – Membrane treated roofs - Leakage of Concrete slabs – Dampness in solid walls – condensation – hygroscopic salts – remedial treatments – Ferro cement overlay – Chemical coatings – Flexible and rigid coatings.

UNIT IV DISTRESSES AND REMEDIES 9

Concrete Structures: Introduction – Causes of deterioration – Diagnosis of causes – Flow charts for diagnosis – Materials and methods of repair – repairing, spalling and disintegration – Repairing of concrete floors and pavements.

Steel Structures : Types and causes for deterioration – preventive measures – Repair procedure – Brittle fracture – Lamellar tearing – Defects in welded joints – Mechanism of corrosion – Design of protect against corrosion – Design and fabrication errors – Distress during erection.

Masonry Structures: Discoloration and weakening of stones – Biotical treatments – Preservation – Chemical preservatives – Brick masonry structures – Distresses and remedial measures.

UNIT V STRENGTHENING OF EXISTING STRUCTURES 9

General principle – relieving loads – Strengthening super structures – plating – Conversation to composite construction – post stressing – Jacketing – bonded overlays – Reinforcement addition – strengthening substructures – under pinning – Enhancing the load capacity of footing – Design for rehabilitation.

TOTAL: 45 PERIODS

OUTCOME:

- At the end of this course students will be in a position to point out the causes of distress in concrete, masonry and steel structures and also they will be able to suggest the remedial measures.

REFERENCES:

1. Allen R.T and Edwards S.C, “Repair of Concrete Structures”, Blakie and Sons, UK, 1987
2. Dayaratnam.P and Rao.R, “Maintenance and Durability of Concrete Structures”, University Press, India, 1997.
3. Denison Campbell, Allen and Harold Roper, “Concrete Structures, Materials, Maintenance and Repair”, Longman Scientific and Technical, UK, 1991.
4. Dodge Woodson.R,”Concrete Structures – protection, repair and rehabilitation”, Elsevier Butterworth – Heinmann, UK, 2009.
5. Hand book on seismic retrofit of Building by CPWD and IIT Madras,2003.
6. Peter H.Emmons, “Concrete Repair and Maintenance Illustrated”, Galgotia Publications Pvt. Ltd., 2001.
7. Raikar, R.N., “Learning from failures - Deficiencies in Design, Construction and Service” – Rand D Centre (SDCPL), Raikar Bhavan, Bombay, 1987.

ST5002 **PREFABRICATED STRUCTURES** **L T P C**
3 0 0 3

OBJECTIVE:

- To Study the design principles, analysis and design of elements**.**

UNIT I DESIGN PRINCIPLES 9

General Civil Engineering requirements, specific requirements for planning and layout of prefabrication plant. IS Code specifications. Modular co-ordination, standardization, Disuniting of Prefabricates, production, transportation, erection, stages of loading and code provisions, safety factors, material properties, Deflection control, Lateral load resistance, Location and types of shear walls.

UNIT II REINFORCED CONCRETE 9

Prefabricated structures - Long wall and cross-wall large panel buildings, one way and two way prefabricated slabs, Framed buildings with partial and curtain walls, -Connections – Beam to column and column to column.

UNIT III FLOORS, STAIRS AND ROOFS 9

Types of floor slabs, analysis and design example of cored and panel types and two-way systems, staircase slab design, types of roof slabs and insulation requirements, Description of joints, their behaviour and reinforcement requirements, Deflection control for short term and long term loads, Ultimate strength calculations in shear and flexure.

UNIT IV WALLS 9

Types of wall panels, Blocks and large panels, Curtain, Partition and load bearing walls, load transfer from floor to wall panels, vertical loads, Eccentricity and stability of wall panels, Design Curves, types of wall joints, their behaviour and design, Leak prevention, joint sealants, sandwich wall panels, approximate design of shear walls.

UNIT V INDUSTRIAL BUILDINGS AND SHELL ROOFS 9

Components of single-storey industrial sheds with crane gantry systems, R.C. Roof Trusses, Roof Panels, corbels and columns, wind bracing design. Cylindrical, Folded plate and hyper-prefabricated shells, Erection and jointing, joint design, hand book based design.

TOTAL: 45 PERIODS

OUTCOME:

- At the end of this course student will have good knowledge about the prefabricated elements and the technologies used in fabrication and erection.
- They will be in a position to design floors, stairs, roofs, walls and industrial buildings, and various joints for the connections.

REFERENCES:

1. Koncz.T., Manual of Precast Concrete Construction, Vol.I II and III & IV Bauverlag, GMBH, 1971.
2. Laszlo Mokk, Prefabricated Concrete for Industrial and Public Structures, Akademiai Kiado, Budapest, 2007.
3. Lewicki.B, Building with Large Prefabricates, Elsevier Publishing Company, Amsterdam/ London/New York, 1998.
4. Structural Design Manual, Precast Concrete Connection Details, Society for the Studies in the use of Precase Concrete, Netherland Betor Verlag, 2009.
5. Warszawski, A., Industrialization and Robotics in Building - A managerial approach, Harper and Row, 1990.

ST5003 **OFFSHORE STRUCTURES** **L T P C**
3 0 0 3

OBJECTIVE:

- To study the concept of wave theories, forces and design of jacket towers, pipes and cables**.**

UNIT I WAVE THEORIES 9

Wave generation process, small, finite amplitude and nonlinear wave theories.

UNIT II FORCES OF OFFSHORE STRUCTURES 9

Wind forces, wave forces on small bodies and large bodies - current forces - Morison equation.

UNIT III OFFSHORE SOIL AND STRUCTURE MODELLING 9

Different types of offshore structures, foundation modeling, fixed jacket platform structural modeling.

UNIT IV ANALYSIS OF OFFSHORE STRUCTURES 9

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

UNIT V DESIGN OF OFFSHORE STRUCTURES 9

Design of platforms, helipads, Jacket tower, analysis and design of mooring cables and pipelines.

TOTAL: 45 PERIODS

OUTCOME:

- On completion of this course students will be able to determine the forces due to ocean waves and analyze and design offshore structures like platform, helipads, jackets, towers etc.,

REFERENCES:

1. API RP 2A-WSD, Planning, Designing and Constructing Fixed Offshore Platforms - Working Stress Design - API Publishing Services, 2005
2. Chakrabarti, S.K., Handbook of Offshore Engineering by, Elsevier, 2005.
3. Chakrabarti, S.K., Hydrodynamics of Offshore Structures, WIT press, 2001.
4. Dawson.T.H., Offshore Structural Engineering, Prentice Hall Inc Englewood Cliffs, N.J. 1983.
5. James F. Wilson, Dynamics of Offshore Structures, John Wiley & Sons, Inc, 2003.
6. Reddy, D.V. and Arockiasamy, M., Offshore Structures, Vol.1 and Vol.2, Krieger Publishing Company, 1991.
7. Reddy.D.V and Swamidas A.S.J.,Essential of offshore structures.CRC Press.2013
8. Turgut Sarpkaya, Wave Forces on Offshore Structures, Cambridge University Press, 2010.

ST5004 **MATRIX METHODS FOR STRUCTURAL ANALYSIS** **L T P C**
3 0 0 3

OBJECTIVES:

- To study the concepts, characteristics and transformation of structures using matrix approach

UNIT I ENERGY CONCEPTS IN STRUCTURES 9

Introduction – Strain Energy – Symmetry of The Stiffness And Flexibility Matrices – Strain Energy in Terms of Stiffness And Flexibility Matrices – Stiffness And Flexibility Coefficients in Terms of Strain Energy – Additional properties of [a] and [k] – another Interpretation of coefficients a_{ij} and k_{ij} – Betti's law – Applications of Betti's law: Forces not at the coordinates – Strain energy in systems and in Elements.

UNIT II CHARACTERSTICS OF STRUCTURES – STIFFNESS AND FLEXIBILITY 9

Introduction – Structure with Single Coordinate- Two Coordinates-Flexibility and Stiffness Matrices in Coordinates- Examples-Symmetric Nature of Matrices- Stiffness and Flexibility Matrices in Constrained Measurements- Stiffness and Flexibility of Systems and Elements-Computing Displacements and Forces form Virtual Work-Computing Stiffness and Flexibility Coefficients.

UNIT III TRANSFORMATION OF INFORMATION IN STRUTURES 9

Determinate- Indeterminate Structures-Transformation of System Forces to Element Forces-Element Flexibility to System Flexibility - System Displacement to Element Displacement-Element Stiffness to System Stiffness-Transformation of Forces and Displacements in General –Stiffness and Flexibility in General –Normal Coordinates and Orthogonal Transformation-Principle of Contregradience

UNIT IV THE FLEXIBILITY METHOD 9

Statically Determinate Structures –Indeterminate Structures-Choice of Redundant Leading to Ill and Well Conditioned Matrices-Transformation to One Set of Redundant to Another-Internal Forces due to Thermal Expansion and Lack of Fit-Reducing the Size of Flexibility Matrix-Application to Pin-Jointed Plane Truss-Continuous Beams-Frames-Grids.

UNIT V THE STIFFNESS METHOD 9

Introduction-Development of Stiffness Method- Stiffness Matrix for Structures with zero Force at some Coordinates-Analogy between Flexibility and Stiffness-Lack of Fit-Stiffness Matrix with Rigid Motions-Application of Stiffness Approach to Pin Jointed Plane Trusses-Continuous Beams-Frames-Grids-Space Trusses and Frames-Introduction Only-Static Condensation Technique-Choice of Method-Stiffness or Flexibility.

TOTAL : 45 PERIODS

OUTCOMES:

- On completion of this course students will be able to use matrix approach for solving structural engineering problems
- Students will have a thorough understanding of both flexibility and stiffness approach of analysis.

REFERENCE S:

1. Natarajan C and Revathi P., “Matrix Methods of Structural Analysis”, PHI Learning Private Limited, New Delhi, 2014
2. Devdas Menon., “Advanced Structural Analysis”, Narosa Publishing House, New Delhi, 2009
3. Pandit G.S. and Gupta S.P., “Structural Analysis-A Matrix Approach”, Tata McGraw-Hill PublishingCompany Limited, New Delhi, 1997.
4. Moshe F. Rubinstein – Matrix Computer Analysis of Structures- Prentice Hall,1969
5. Reddy C.S., “Basic Structural Analysis”, Tata McGraw-Hill Publishing Company Limited, New Delhi, 1997

ST5005 THEORY OF PLATES L T P C
3 0 0 3

OBJECTIVE:

- To study the behaviour and analysis of thin plates and the behaviour of anisotropic and thick plates.

UNIT I INTRODUCTION TO PLATES THEORY 9

Thin Plates with small deflection. Laterally loaded thin plates, governing differential equation, various boundary conditions.

UNIT II RECTANGULAR PLATES 9

Rectangular plates. Simply supported rectangular plates, Navier solution and Levy's method, Rectangular plates with various edge conditions, plates on elastic foundation. Moody's chart (for analysis of plates with various boundary conditions/loading)

UNIT III CIRCULAR PLATES 9

Symmetrical bending of circular plates.

UNIT IV SPECIAL AND APPROXIMATE METHODS. 9

Energy methods, Finite difference and Finite element methods.

UNIT V ANISOTROPIC PLATES AND THICK PLATES 9

Orthotropic plates and grids, moderately thick plates.

TOTAL: 45 PERIODS

OUTCOME:

- At the end of this course students will be able to analyze different types of plates (rectangular and circular) under different boundary connections by various classical methods and approximate methods.
- They will also know behavior of orthotropic and thick plates and grids.

REFERENCES:

1. Ansel C.Ugural, "Stresses in plate and shells", McGraw Hill International Edition, 1999.
2. Bairagi, "Plate Analysis", Khanna Publishers, 1996.
3. Bulson.P.S.,"Stability Of Flat Plates.,American Elsevier Publisher. Co.,1969.
4. Chandrashekahara, K. Theory of Plates, University Press (India) Ltd., Hyderabad, 2001.
5. Reddy J N, "Theory and Analysis of Elastic Plates and Shells", McGraw Hill Book Company, 2006.
6. Szilard, R., "Theory and Analysis of Plates – classical and numerical methods, Prentice Hall Inc., 2004.
7. Timoshenko.S.P, and Krieger S.W. "Theory of Plates and Shells", McGraw Hill Book Company, New York, 2003.

ST5006 MECHANICS OF COMPOSITE MATERIALS L T P C
3 0 0 3

OBJECTIVE:

- To study the behaviour of composite materials and to investigate the failure and fracture characteristics.

UNIT I INTRODUCTION 9

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

UNIT II STRESS STRAIN RELATIONS 9

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

Governing equations for anisotropic and orthotropic plates. Angle-ply and cross ply laminates – Static, Dynamic and Stability analysis for Simpler cases of composite plates, Interlaminar stresses.

UNIT IV FAILURE AND FRACTURE OF COMPOSITES 9

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

UNIT V APPLICATIONS AND DESIGN 9

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

TOTAL: 45 PERIODS

OUTCOME:

- On completion of this course students will have sufficient knowledge on behavior of various composite materials and will have an idea of failure and fracture mechanisms.

REFERENCES:

1. Agarwal.B.D., Broutman.L.J., and Chandrashekara.K. “Analysis and Performance of Fiber Composites”, John-Wiley and Sons, 2006.
2. Daniel.I.M., and Ishai.O, “Engineering Mechanics of Composite Materials”, Oxford University Press, 2005.
3. Hyer M.W., and White S.R., “Stress Analysis of Fiber-Reinforced Composite Materials”, D.Estech Publications Inc., 2009
4. Jones R.M., “Mechanics of Composite Materials”, Taylor and Francis Group 1999.
5. Mukhopadhyay.M, “Mechanics of Composite Materials and Structures”, Universities Press, India, 2005.

ST5007 ANALYSIS AND DESIGN OF TALL BUILDINGS L T P C
3 0 0 3

OBJECTIVE:

- To study the behaviour, analysis and design of tall structures.

UNIT I LOADING AND DESIGN PRINCIPLES 9

Loading- sequential loading, Gravity loading, Wind loading, Earthquake loading, - Equivalent lateral force, modal analysis - combination of loading, – Static and Dynamic approach - Analytical and wind tunnel experimental methods - Design philosophy - working stress method, limit state method and plastic design.

UNIT II BEHAVIOUR OF VARIOUS STRUCTURAL SYSTEMS 9

Factors affecting growth, height and structural form. High rise behaviour, Rigid frames, braced frames, In filled frames, shear walls, coupled shear walls, wall-frames, tubulars, cores, outrigger - braced and hybrid mega systems.

UNIT III ANALYSIS AND DESIGN 9

Modeling for approximate analysis, Accurate analysis and reduction techniques, Analysis of buildings as total structural system considering overall integrity and major subsystem interaction, Analysis for member forces, drift and twist - Computerized three dimensional analysis – Assumptions in 3D analysis – Simplified 2D analysis.

UNIT IV STRUCTURAL ELEMENTS 9

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 ISSUES 9

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 PERIODS

OUTCOME:

- On completion of this course students will be able to know the behavior of tall buildings due to various types of loads.
- They will be able to analyze and design such buildings by approximate, accurate and simplified methods.

REFERENCES:

1. Beedle.L.S., “Advances in Tall Buildings”, CBS Publishers and Distributors, Delhi, 1986.
2. Bryan Stafford Smith and Alexcoull, “Tall Building Structures - Analysis and Design”, John Wiley and Sons, Inc., 2005.
3. 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.
4. Lin T.Y and Stotes Burry D, “Structural Concepts and systems for Architects and Engineers”, John Wiley, 1988.
5. Taranath B.S., “Structural Analysis and Design of Tall Buildings”, McGraw Hill, 1988.

ST5008 INDUSTRIAL STRUCTURES L T P C
3 0 0 3

OBJECTIVE:

- To study the requirements, planning and design of Industrial structures**.**

UNIT I PLANNING AND FUNCTIONAL REQUIREMENTS 9

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

Steel and RCC - Gantry Girder, Crane Girders - Design of Corbels and Nibs – Design of Staircase.

UNIT III POWER PLANT STRUCTURES 9

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

UNIT IV TRANSMISSION LINE STRUCTURES AND CHIMNEYS 9

Analysis and design of steel monopoles, transmission line towers – Sag and Tension calculations, Methods of tower testing – Design of s elf supporting and guyed chimney, Design of Chimney bases.

UNIT V FOUNDATION 9

Design of foundation for Towers, Chimneys and Cooling Towers - Machine Foundation - Design of Turbo Generator Foundation.

TOTAL: 45 PERIODS

OUTCOME:

- On completion of this course student will be able to plan industrial structures for functional requirements.
- They will be able to design various structures such as Bunkers, Silos, Cooling Towers, Chimneys, and Transmission Towers with required foundations.

REFERENCES:

1. Jurgen Axel Adam, Katharria Hausmann, Frank Juttner, Klauss Daniel, Industrial Buildings: A Design Manual, Birkhauser Publishers, 2004.
2. Manohar S.N, Tall Chimneys - Design and Construction, Tata McGraw Hill, 1985
3. Santhakumar A.R. and Murthy S.S., Transmission Line Structures, Tata McGraw Hill,1992.
4. Srinivasulu P and Vaidyanathan.C, Handbook of Machine Foundations, Tata McGraw Hill, 1976.

ST5009 PRESTRESSED CONCRETE L T P C
3 0 0 3

OBJECTIVE:

- Principle of prestressing, analysis and design of prestressed concrete structures**.**

UNIT I PRINCIPLES OF PRESTRESSING 9

Basic concepts of Prestressing - Types and systems of prestressing - Need for High Strength materials, Analysis methods, losses of prestress – Short and Long term deflections – Cable layouts.

UNIT II DESIGN OF FLEXURAL MEMBERS 9

Behaviour of flexural members, determination of ultimate flexural strength – Various Codal provisions - Design of flexural members, Design for shear, bond and torsion. Transfer of prestress – Box girders.

UNIT III DESIGN OF CONTINUOUS AND CANTILEVER BEAMS 9

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

UNIT IV DESIGN OF TENSION AND COMPRESSION MEMBERS 9

Design of tension members - application in the design of prestressed pipes and prestressed concrete cylindrical water tanks - Design of compression members with and without flexure - its application in the design piles, flag masts and similar structures.

UNIT V DESIGN OF COMPOSITE MEMBERS 9

Composite beams - analysis and design, ultimate strength - their applications. Partial prestressing - its advantages and applications.

TOTAL: 45 PERIODS

OUTCOME:

- On completion of this course students will have sufficient knowledge on various methods of prestressing and the concepts of partial pre-stressing.
- They will be in a position to design beams, pipes, water tanks, posts and similar structures.

REFERENCES:

1. Arthur H. Nilson, “Design of Prestressed Concrete”, John Wiley and Sons Inc, New York, 2004.

2. Krishna Raju, “Prestressed Concrete”, Tata McGraw Hill Publishing Co., New Delhi, 2008.
3. Lin.T.Y.,and Burns.H “Design of Prestressed Concrete Structures”, John Wiley and Sons Inc, New York, 2009.
4. Rajagopalan.N, “Prestressed Concrete”, Narosa Publications, New Delhi, 2008.
5. Sinha.N.C.and.Roy.S.K, “Fundamentals of Prestressed Concrete”, S.Chand and Co., 1998.

ST5010 WIND AND CYCLONE EFFECTS ON STRUCTURES L T P C
3 0 0 3

OBJECTIVE:

- To study the concept of wind and cyclone effects for the analysis and design of structures.

UNIT I INTRODUCTION 9

Introduction, Types of wind – Characteristics of wind – Wind velocity, Method of measurement, variation of speed with height, shape factor, aspect ratio, drag effects - Dynamic nature of wind – Pressure and suctions - Spectral studies, Gust factor.

UNIT II WIND TUNNEL STUDIES 9

Wind Tunnel Studies, Types of tunnels, - Prediction of acceleration – Load combination factors – Wind tunnel data analysis – Calculation of Period and damping value for wind design - Modeling requirements, Aero dynamic and Aero-elastic models.

UNIT III EFFECT OF WIND ON STRUCTURES 9

Classification of structures – Rigid and Flexible – Effect of wind on structures - Static and dynamic effects on Tall buildings – Chimneys.

UNIT IV DESIGN OF SPECIAL STRUCTURES 9

Design of Structures for wind loading – as per IS, ASCE and NBC code provisions – design of Tall Buildings – Chimneys – Transmission towers and steel monopoles– Industrial sheds.

UNIT V CYCLONE EFFECTS 9

Cyclone effect on – low rise structures – sloped roof structures - Tall buildings. Effect of cyclone on claddings – design of cladding – use of code provisions in cladding design – Analytical procedure and modeling of cladding.

TOTAL: 45 PERIODS

OUTCOME:

- On completion of this course, students will be able to design high rise structures subjected wind load, even structures exposed to cyclone.
- Students will be conversant with various code provisions for the design of structures for wind load.

REFERENCES:

1. Cook.N.J., “The Designer’s Guide to Wind Loading of Building Structures”, Butterworths, 1989.
2. Kolousek.V, Pirner.M, Fischer.O and Naprstek.J, “Wind Effects on Civil Engineering Structures”, Elsevier Publications, 1984
3. Lawson T.V., “Wind Effects on Building Vol. I and II”, Applied Science Publishers, London, 1980.
4. Peter Sachs, “Wind Forces in Engineering”, Pergamon Press, New York, 1978.

ST5011 **NONLINEAR ANALYSIS OF STRUCTURES** **L T P C**
3 0 0 3

OBJECTIVE:

- To study the concept of nonlinear behaviour and analysis of elements and simple structures.

UNIT I INTRODUCTION TO NONLINEAR ANALYSIS 9

Material nonlinearity, geometric nonlinearity; statically determinate and statically indeterminate bar systems of uniform and variable thickness.

UNIT II INELASTIC ANALYSIS OF FLEXURAL MEMBERS 9

Inelastic analysis of uniform and variable thickness members subjected to small deformations; inelastic analysis of bars of uniform and variable stiffness members with and without axial restraints

UNIT III VIBRATION THEORY AND ANALYSIS OF FLEXURAL MEMBERS 9

Vibration theory and analysis of flexural members; hysteretic models and analysis of uniform and variable stiffness members under cyclic loading

UNIT IV ELASTIC AND INELASTIC ANALYSIS OF PLATES 9

Elastic and inelastic analysis of uniform and variable thickness plates

UNIT V NONLINEAR VIBRATION AND INSTABILITY 9

Nonlinear vibration and Instabilities of elastically supported beams.

TOTAL: 45 PERIODS

OUTCOME:

- At the end of this course student will have enough knowledge on inelastic and vibration analysis of Flexural members.
- Also they will know the difference between elastic and inelastic analysis of plates and Instabilities of elastically supported beams.

REFERENCES:

1. Fertis, D.G, Non-linear Mechanics, CRC Press, 1999.
2. Reddy.J.N, Non-linear Finite Element Analysis, Oxford University Press, 2008.
3. Sathyamoorthy.M, Nonlinear Analysis of Structures, CRC Press, 2010.

ST5012 **DESIGN OF SUB STRUCTURES** **L T P C**
3 0 0 3

OBJECTIVES:

- To gain familiarity with different types of foundation.
- To expose the students to the design of shallow foundations and deep foundations.
- To understand the concepts of designing well, machine and special foundations.

UNIT I SHALLOW FOUNDATIONS 9

Soil investigation – Basic requirements of foundation – Types and selection of foundations. Bearing capacity of soil - plate load test – Design of reinforced concrete isolated, strip, combined and strap footings – mat foundation.

UNIT II PILE FOUNDATIONS 9

Introduction – Types of pile foundations – load carrying capacity - pile load test – structural design of straight piles –configuration of piles- different shapes of piles cap – structural design of pile cap.

UNIT III WELL FOUNDATIONS 9

Types of well foundation – Grip length – load carrying capacity – construction of wells – Failures and Remedies – Design of well foundation – Lateral stability.

UNIT IV MACHINE FOUNDATIONS 9

Introduction – Types of machine foundation – Basic principles of design of machine foundation – Dynamic properties of soil – vibration analysis of machine foundation – Design of foundation for Reciprocating machines and Impact machines – Reinforcement and construction details – vibration isolation.

UNIT V SPECIAL FOUNDATIONS 9

Foundation on expansive soils – choice of foundation – under-reamed pile foundation. Foundation for concrete Towers, chimneys – Design of anchors- Reinforced earth retailing walls.

TOTAL: 45 PERIODS

OUTCOMES:

- On completion of this course students will be able to select appropriate foundation type based on available soil conditions.
- They will be in a position to determine the load carrying capacity of each type of foundation.
- They will gain thorough knowledge about the design of reinforced concrete shallow foundations, pile foundations, well foundations, and machine foundations.

REFERENCES:

1. Bowles .J.E., “Foundation Analysis and Design”, McGraw Hill Publishing co., New York, 1997.
2. Swamy Saran, Analysis and Design of substructures, Oxford and IBH Publishing Co. Pvt. Ltd., 2006.
3. Tomlinson.M.J, “Foundation Design and Construction”, Longman, Sixth Edition, New Delhi, 1995.
4. Varghese.P.C, “Design of Reinforced Concrete Foundations” – PHI learning private limited, New Delhi – 2009.

ST5013 OPTIMIZATION OF STRUCTURES L T P C

3 0 0 3

OBJECTIVE:

- To study the optimization methodologies applied to structural engineering

UNIT I BASIC PRINCIPLES AND CLASSICAL OPTIMIZATION TECHNIQUES 9

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

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: Unidimensional - Unimodal function - Exhaustive and unrestricted search - Dichotomous search - Fibonacci Method - Golden section method - Interpolation methods. Unconstrained optimization Techniques.

UNIT III GEOMETRIC PROGRAMMING 9

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

UNIT IV DYNAMIC PROGRAMMING 9

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

UNIT V STRUCTURAL APPLICATIONS 9

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

TOTAL: 45 PERIODS

OUTCOME:

- On completion of this course students will have sufficient knowledge on various optimization techniques like linear programming, non-linear programming, geometric and dynamic programming and they will also in a position to design various structural elements for minimum weight.

REFERENCES:

1. Iyengar.N.G.R and Gupta.S.K, "Structural Design Optimization", Affiliated East West Press Ltd, New Delhi, 1997
2. Rao,S.S. "Optimization theory and applications", Wiley Eastern (P) Ltd., 1984
3. Spunt, "Optimization in Structural Design", Civil Engineering and Engineering Mechanics Services, Prentice-Hall, New Jersey 1971.
4. Uri Krish, "Optimum Structural Design", McGraw Hill Book Co. 1981

ST5014 DESIGN OF STEEL CONCRETE COMPOSITE STRUCTURES L T P C
3 0 0 3

OBJECTIVE:

- To develop an understanding of the behaviour and design concrete composite elements and structures.

UNIT I INTRODUCTION 9

Introduction to steel - concrete composite construction – Codes – Composite action – Serviceability and Construction issues in design.

UNIT II DESIGN OF COMPOSITE MEMBERS 9

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

UNIT III DESIGN OF CONNECTIONS 9

Shear connectors – Types – Design of connections in composite structures – Design of shear connectors – Partial shear interaction.

UNIT IV COMPOSITE BOX GIRDER BRIDGES 9

Introduction - behaviour of box girder bridges - design concepts.

UNIT V CASE STUDIES 9

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

TOTAL: 45 PERIODS

OUTCOME:

- At the end of this course students will be in a position to design composite beams, columns, trusses and box-girder bridges including the related connections.
- They will get exposure on case studies related to steel-concrete constructions of buildings.

REFERENCES:

1. Johnson R.P., “Composite Structures of Steel and Concrete Beams, Slabs, Columns and Frames for Buildings”, Vol.I, Blackwell Scientific Publications, 2004.
2. Oehlers D.J. and Bradford M.A., “Composite Steel and Concrete Structural Members, Fundamental behaviour”, Pergamon press, Oxford, 1995.
3. Owens.G.W and Knowles.P, ”Steel Designers Manual”, Steel Concrete Institute(UK), Oxford Blackwell Scientific Publications, 1992.

ST5015 DESIGN OF BRIDGES L T P C

3 0 0 3

OBJECTIVE:

- To study the loads, forces on bridges and design of several types of bridges.

UNIT I GENERAL INTRODUCTION AND SHORT SPAN RC BRIDGES 9

Types of bridges and loading standards - Choice of type - I.R.C. specifications for road bridges – Design of RCC solid slab bridges - analysis and design of slab culverts , Tee beam and slab bridges.

UNIT II LONG SPAN RC BRIDGES 9

Design principles of continuous girder bridges, box girder bridges, balanced cantilever bridges – Arch bridges – Box culverts – Segmental bridges.

UNIT III PRESTRESSED CONCRETE BRIDGES 9

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 IV STEEL BRIDGES 9

General – Railway loadings – dynamic effect – Railway culvert with steel beams – Plate girder bridges – Box girder bridges – Truss bridges – Vertical and Horizontal stiffeners.

UNIT V BEARINGS AND SUBSTRUCTURES 9

Different types of bearings – Design of bearings – Design of piers and abutments of different types – Types of bridge foundations – Design of foundations.

TOTAL: 45 PERIODS

OUTCOME:

- At the end of this course students will be able to design different types of RCC bridges, Steel bridges and pre-stressed concrete bridges with the bearings and substructures.

REFERENCES:

1. Jagadeesh.T.R. and Jayaram.M.A., "Design of Bridge Structures", Prentice Hall of India Pvt. Ltd. 2004.
2. Johnson Victor, D. "Essentials of Bridge Engineering", Oxford and IBH Publishing Co. New Delhi, 2001.
3. Ponnuswamy, S., "Bridge Engineering", Tata McGraw Hill, 2008.
4. Raina V.K." Concrete Bridge Practice" Tata McGraw Hill Publishing Company, New Delhi, 1991.

ST5016 DESIGN OF SHELL AND SPATIAL STRUCTURES L T P C
3 0 0 3

OBJECTIVE:

- Study the behaviour and design of shells, folded plates, space frames and application of FORMIAN software.

UNIT I CLASSIFICATION OF SHELLS 9

Classification of shells, types of shells, structural action, - Design of circular domes, conical roofs, circular cylindrical shells by ASCE Manual No.31. application to design of shell roofs of water tanks(membrane analyses)

UNIT II FOLDED PLATES 9

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

UNIT III INTRODUCTION TO SPACE FRAME 9

Space frames - configuration - types of nodes - Design Philosophy - Behaviour.

UNIT IV ANALYSIS AND DESIGN 9

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

UNIT V SPECIAL METHODS 9

Application of Formex Algebra, FORMIAN for generation of configuration.

TOTAL: 45 PERIODS

OUTCOME:

- On completion of this course students will be able to analyze and design various types of shells, folded plates and space frames manually and also using computer Aided design and software packages.

REFERENCES:

1. ASCE Manual No.31, Design of Cylindrical Shells.
2. Billington.D.P, “Thin Shell Concrete Structures”, McGraw Hill Book Co., New York, 1982.
3. Ramasamy, G.S., “Design and Construction of Concrete Shells Roofs”, CBS Publishers, 1986.
4. Subramanian.N ,”Principles of Space Structures”, Wheeler Publishing Co. 1999.
5. Varghese.P.C., Design of Reinforced Concrete Shells and Folded Plates, PHI Learning Pvt. Ltd., 2010.

ST5017 COMPUTER AIDED ANALYSIS AND DESIGN L T P C
2 0 2 3

OBJECTIVES:

- To learn the principles of computer graphics, structural analysis, structural design, Finite Element Analysis, Optimization and Artificial Intelligence supported by software tools

THEORY

UNIT I COMPUTER GRAPHICS 6+6

Graphic primitives – Transformations – Basics of 2D drafting – Modelling of curves and surfaces – Wire frame modelling – Solid Modelling - Graphic standards - Drafting Software packages .

UNIT II STRUCTURAL ANALYSIS 6+6

Computer method of structural analysis – Simulation and Analysis of steel sections I, channel and Angle –PEB Elements – RCC and Composite members - Nonlinear Analysis through software packages

UNIT III STRUCTURAL DESIGN 6+6

Computer Aided Design of Steel and RC structural elements – Detailing of reinforcement – Detailed Drawing .

UNIT IV OPTIMIZATION 6+6

Introduction to Optimization – Applications of Linear programming – Simplex Algorithm – Post Optimality Analysis – Project scheduling – CPM and PERT Applications.

UNIT V ARTIFICIAL INTELLIGENCE 6+6

Introduction – Heuristic Research – Knowledge based Expert Systems – Architecture and Applications – Rules and Decision tables – Inference Mechanisms – Simple Applications – Genetic Algorithm and Applications – Principles of Neural Network – Expert system shells.

PRACTICAL

LIST OF EXERCISES

1. 2-D Frame Modelling and Analysis.
2. 3 – D Frame Modelling and Analysis.
3. Non Linear Analysis using Design software.
4. Design and Detailing of Structural Elements.
5. Simulation and Analysis of steel beam using FEA software.
6. Simulation and Analysis of R.C.Beam using FEA software.
7. Simulation and Analysis of Composite element s using FEA software.
8. Eigen Value Buckling analysis using FEA software.

TOTAL (L : 30 P :30) : 60 PERIODS

OUTCOMES:

- On completion of this course students will be familiar and will have sufficient knowledge on the concepts and working principle of various structural engineering softwares

REFERENCES:

1. Krishnamoorthy C.S and Rajeev S., “Computer Aided Design”, Narosa Publishing House, New Delhi, 1991.
2 GrooverM.P.and Zimmers E.W. Jr.," CAD/CAM, Computer Aided Design and Manufacturing", Prentice Hall of India Ltd, New Delhi, 1993.
3. Harrison H.B., “Structural Analysis and Design Vol.I and II”, Pergamon Press, 1991
4. Rao. S.S., "Optimisation Theory and Applications ", Wiley Eastern Limited, New Delhi, 2009.
5. Richard Forsyth (Ed.), “Expert System Principles and Case Studies”, Chapman and Hall, 1996.
6. Shah V.L. “Computer Aided Design in Reinforced Concrete” Structural Publishers, 2014.