1.0 ELIGIBILITY
Candidates seeking admission to the first semester of the four-semester M.Tech Course in Civil Engineering with specialization in Advanced Construction Technology should have passed B.E/B.Tech in Civil/Structural Engineering or B. Arch/B. Arch Engineering through regular course of study from an AICTE approved institution or an examination of any University or Authority accepted by the Pondicherry University as equivalent thereto, with at least 55% marks in the degree examination or equivalent CGPA.

Note: (1) Candidates belonging to Scheduled Caste / Scheduled Tribe who have a mere pass in qualifying examination are eligible.
(2) There is no age limit for this programme.

2.0 ADMISSION
The admission policy for various M.Tech programmes shall be decided by the respective institutes offering M.Tech programmes subject to conforming to the relevant regulations of the Pondicherry University.

3.0 STRUCTURE OF PG PROGRAMME
3.1 GENERAL
3.1.1 The M.Tech Programmes are of semester pattern with 16 weeks of instruction in a semester.
3.1.2 The programme of instruction for each stream of specialisation will consist of:
   i) Core courses (Compulsory)
   ii) Electives
   iii) Laboratory
   iv) Seminar
   v) Directed Study/Industrial Training
   vi) Project work
3.1.3 The M.Tech Programmes are of 4 semester duration.
3.1.4 Credits will be assigned to the courses based on the following general pattern:
   i) One credit for each lecture period
   ii) One credit for each tutorial period
   iii) Two credits for practical course
   iv) Three credits for Directed study/Industrial training
   v) Nine credit for Project Phase-I and Fourteen credits for Project Phase – II

One teaching period shall be of 60 minutes duration including 10 for discussion and movement.

3.1.5 Regulations, curriculum and syllabus of the M.Tech programme shall have the approval of the Board of Studies and other Boards/Committees/Councils, prescribed by the Pondicherry University. The curriculum should be so drawn up that the minimum number of credits and other requirements for the successful completion of the programme will be as given in Table – 1.

Table 1: Minimum Credits and other Requirements of M.Tech (ACT) (Full-Time) Programme

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Description</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Nr of Semesters</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>Min. Nr of credits of the programme</td>
<td>72</td>
</tr>
<tr>
<td>3</td>
<td>Max. Nr. of credits of the programme</td>
<td>75</td>
</tr>
<tr>
<td>4</td>
<td>Min. Cumulative Grade Point Average for pass</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>Min. Successful credits needed for registering in the next semester</td>
<td>Sem. I - 10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sem. II - 25</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sem. III - 40</td>
</tr>
<tr>
<td>6</td>
<td>Min. period of completion of programme</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>(continuous semesters)</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Max. period of completion of programme</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>(continuous semesters)</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Nr of Core and Elective subjects</td>
<td>12</td>
</tr>
<tr>
<td>9</td>
<td>Directed Study/Industrial Training</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>Laboratories</td>
<td>2</td>
</tr>
<tr>
<td>11</td>
<td>Project work (in two semesters)</td>
<td>1</td>
</tr>
</tbody>
</table>
3.1.6 The core course is a course that a student admitted to the M.Tech programme must successfully complete to receive the degree. A student shall register for all the core courses listed in the curriculum. Core courses in a particular specialisation are offered by the Department concerned.

3.1.7 Elective courses are required to be chosen from the courses offered by the department in that particular semester from among the approved courses. A core course of one M.Tech programme/department may be chosen as an elective by a student from other M.Tech programme/department.

3.1.8 (a) Directed study is a theory course required to be credited by each student under the close supervision of a faculty member of the department. The title of the course and syllabus are to be formulated by the designated faculty member and approved by the vice-chairperson, taking into account the broad area in which the student proposes to pursue his/her project work.
(b) The intention of training is to develop the intuitive skills of the candidate and to expose them with real time problems faced in the industry. Candidates may opt to undergo industrial training instead of directed study. The candidate(s) who is/are desirous to undergo industrial training may identify a suitable industry in consultation with the Staff Advisor and Vice Chairperson. The training shall be at least for 6 weeks duration. The candidate is required to identify a real time problem in the industry and come up with the possible solution or the strength and weakness of an industry.

3.1.9 Project work is envisaged to train a student to analyze independently any problem posed to him/her. The work may be analytical, experimental, design or combination of both. The student can undertake the project work in the department concerned or in an industry/research laboratory approved by the Chairperson/Vice-Chairperson. The project report is expected to exhibit clarity of thought and expression. The evaluation of project work will be a continuous internal assessment based on two reviews, an internal viva-voce and an external viva-voce examination. (The permission from industry may be obtained during the second semester and can undergo training immediately after the end semester examinations).

3.1.10 A student who has acquired the minimum number of total credits for the award of Degree will not be permitted to register for more courses only to improve his/her cumulative grade point average (see Table 1).

3.1.11 The medium of instruction, examination, directed study, project work will be in English.

3.2 GRADING

3.2.1 Based on the performance of each student in a semester, letter grades will be awarded in each course at the end of the semester. The letter grades, the corresponding grade point and the description will be as shown in Table – 2.

<table>
<thead>
<tr>
<th>GRADE</th>
<th>POINTS</th>
<th>DESCRIPTION</th>
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<tbody>
<tr>
<td>S</td>
<td>10</td>
<td>EXCELLENT</td>
</tr>
<tr>
<td>A</td>
<td>9</td>
<td>VERY GOOD</td>
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<tr>
<td>B</td>
<td>8</td>
<td>GOOD</td>
</tr>
<tr>
<td>C</td>
<td>7</td>
<td>ABOVE AVERAGE</td>
</tr>
<tr>
<td>D</td>
<td>6</td>
<td>AVERAGE</td>
</tr>
<tr>
<td>E</td>
<td>5</td>
<td>SATISFACTORY</td>
</tr>
<tr>
<td>F</td>
<td>0</td>
<td>FAILURE</td>
</tr>
<tr>
<td>FA</td>
<td></td>
<td>FAILURE DUE TO LACK OF ATTENDANCE/ FAILURE BY ABSENCE</td>
</tr>
</tbody>
</table>

3.2.2 A student is deemed to have completed a course successfully and earned the appropriate credit if and only if, he/she receives a grade of E and above. The student should obtain 40% of marks in end semester examination in a subject to earn a successful grade. A subject successfully completed cannot be repeated at any time.

3.2.3 The letter grades do not correspond to any fixed absolute mark. Each student is awarded a grade depending on his/her performance in relation to the performance of other students taking or have taken the course. For example, S does not mean he/ she has secured 100% or 95%, but, rather that he /she is in the top 5% of all the students who have taken / are taking the course, in the judgment of the teachers. Grades shall be awarded based on the absolute marks in a meeting of the P.G. Programme Committee to be held not later than 10 days after the last day of semester examination. Normally not more than 5% of the students in any written/ laboratory course shall be awarded the grade S and not more than one – third awarded A grade. Average marks in the class shall normally be C grade excepting in the case of practical /project where it may be B grade.

4.0 REGISTRATION

4.1 Each student, on admission, shall be assigned to a Faculty Advisor, who shall advise the student about the academic programme and counsel him/her on the choice of courses depending on his/her academic background and objective.
4.2 With the advice and consent of the Faculty Advisor, the student shall register for courses he/she plans to take for the semester before the commencement of classes. No student shall be permitted to register for courses exceeding 30 contact hours per week nor shall any student be permitted to register for any course without satisfactorily completing the prerequisites for the course, except with the permission of the teacher concerned in the prescribed format.

4.3 If the student feels that he/she has registered for more courses than he/she can handle, he/she shall have the option of dropping one or more of the courses he/she has registered for, with the consent of his/her Faculty Advisor, before the end of 3rd week of the semester. However, a student to retain his/her status, should register for at least 10 credits/semester.

4.4 Students, other than newly admitted, shall register for the courses of their choice in the preceding semester by filling in the prescribed forms.

4.5 The College shall prescribe the maximum number of students in each course taking into account the physical facilities available.

4.6 The college shall make available to all students a bulletin, listing all the courses offered in every semester specifying the credits, the prerequisites, a brief description or list of topics the course intends to cover, the faculty offering the course, the time and place of the classes for the course.

4.7 In any Department, preference shall be given to those students for whom the course is a core-course, if, the demand for registration is beyond the maximum permitted member of students.

4.8 Normally no course shall be offered unless a minimum of 3 students are registered.

5.0 EVALUATION

5.1 Evaluation of theory courses shall be based on 40% continuous internal assessment and 60% end-semester examination. Evaluation of laboratory course shall be based on 50% internal assessment and 50% end-semester examination. In each course, there shall be a 3 hour end-semester examination.

5.2 The total marks for the project work will be 400 marks and 100 marks for Directed study/Industrial training. The allotment of marks for external valuation and internal valuation shall be as detailed below:

Project work – (Phase – I): 300 Marks

<table>
<thead>
<tr>
<th>Internal valuation</th>
<th></th>
<th></th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Guide</td>
<td>50 marks</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>First Evaluation</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Second Evaluation</td>
<td>50 marks</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>150 marks</strong></td>
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</table>

<table>
<thead>
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<th>External valuation</th>
<th></th>
<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Evaluation (External Examiner Only)</td>
<td>50 marks</td>
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<td></td>
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</tr>
<tr>
<td>Viva voce</td>
<td>Internal Examiner</td>
<td>50 marks</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>External Examiner</td>
<td>50 marks</td>
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<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>150 marks</strong></td>
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Project work – (Phase – II): 400 Marks

<table>
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<tr>
<td>Guide</td>
<td>100 marks</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<td></td>
<td></td>
</tr>
<tr>
<td>Second Evaluation</td>
<td>50 marks</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>200 marks</strong></td>
<td></td>
<td></td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>External valuation</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Evaluation (External Examiner Only)</td>
<td>50 marks</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Viva voce</td>
<td>Internal Examiner</td>
<td>75 marks</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>External Examiner</td>
<td>75 marks</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>200 marks</strong></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Internal valuation should be done by a committee comprising of not less than 3 faculty members appointed by the Vice-Chairperson.

5.3 (a) The directed study shall be evaluated internally and continuously as detailed below:

- Test I : 15 Marks
- Test II : 15 Marks
- Assignment : 10 Marks
- Final test covering the whole syllabus : 60 Marks
- **Total** : 100 Marks

(b) The candidates who undergo industrial training shall submit a report along with a certificate of completion of training obtained from the industry. The duration of the training shall be at least 6 weeks. Internal valuation should be done by a committee comprising of not less than 3 faculty members appointed by the Vice-Chairperson. The marks will be awarded as below:

- Training Report : 60 marks
- Viva voce : 40 Marks
- **Total** : 100 Marks
5.4 The end-semester examination shall be conducted for all the courses offered by the Department. Each teacher shall, in the 4th week of the semester submit to the Vice Chairman, a model question paper for the end-semester examination. The end-semester question paper shall cover the entire course.

5.5 The department shall invite 2 or 3 external experts for evaluating the end-semester examinations and grading. Each expert will be asked to set the question paper(s) for the course(s) he/she is competent to examine for the end-semester examination based on the model question paper submitted by the teacher concerned. The teacher and the expert concerned shall evaluate the answer scripts together and award the marks to the student. If, for any reason, no external expert is available for any paper, then, the teacher concerned shall set the question paper(s) for the end-semester examination, and the teacher himself/herself shall evaluate the papers and award the marks.

5.6 In the department, after the evaluation of the end-semester examination papers, all the teachers who handled the courses and the external experts together shall meet with the M.Tech Programme Committee (see 7.0) and decide the cut-offs for grades in each of the courses and award the final grades to the students.

5.7 Continuous internal assessment mark of 40 for a theory course shall be based on two tests (15 marks each) and one assignment (10 marks). A laboratory course carries an internal assessment mark of 50 distributed as follows: (i) Regular laboratory exercises and records – 20 marks (ii) Internal laboratory test – 20 marks and (iii) Internal viva-voce – 10 marks.

5.8 Every student shall have the right to scrutinize his/her answer scripts, assignments etc. and seek clarifications from the teacher regarding his/her evaluation of the scripts immediately after or within 3 days of receiving the evaluated scripts.

5.9 The department shall send all records of evaluation, including internal assessment for safe-keeping, to the college administration, as soon as all the formalities are completed.

5.10 At the end of the semester, each student shall be assigned a grade based on his/her performance in each subject, in relation to the performance of other students.

5.11 A student securing F grade in a core course must repeat that course in order to obtain the Degree. A student securing F grade in an elective course may be permitted to choose another elective against the failed elective course, as the case may be, in consultation with the Faculty Adviser.

5.12 A student shall not be permitted to repeat any course(s) only for the purpose of improving the grade in a particular course or the cumulative grade point average (CGPA).

5.13 In exceptional cases, with the approval of the Chairperson, PG Programme committee, make-up examination(s) can be conducted to a student who misses end-semester examination(s) due to extreme medical emergency, certified by the college Medical Officer, or due to time-table clash in the end-semester examination between two courses he/she has registered for, in that semester.

5.14 All eligible students shall appear for end-semester examinations.

5.15 No student who has less than 75% attendance in any course will be permitted to attend the end-semester examinations. However, a student who has put in 60-75% attendance in any course and has absented on medical grounds will have to pay a condonation fee of Rs.200/- for each course and produce a medical certificate from a Government Medical Officer not below the rank of R.M.O. or officer of equal grade to become eligible to appear for the examinations. A student with less than 60% attendance shall be given the grade of FA. He/She shall have to repeat that course if it is a core course, when it is offered the next time.

6.0 SUMMER TERM COURSE

6.1 A summer term course (STC) may be offered by the department concerned on the recommendations of M.Tech. Programme Committee. A summer term course is open only to those students who had registered for the course earlier and failed. No student should register for more than two courses during a summer term. Those students who could not appear for examination due to lack of attendance will not be allowed to register for the same course offered in summer, unless, certified by the Vice-Chairperson concerned and the Principal.

6.2 Summer term course will be announced at the end of even semester. A student has to register within the stipulated time by paying the prescribed fees.

6.3 The number of contact hours per week for any summer term course will be twice that of a regular semester course. The assessment procedure in a summer term course will be similar to the procedure for a regular semester course.

6.4 Withdrawal from a summer term course is not permitted.
7.0 PG PROGRAMME COMMITTEE

7.1 Every M.Tech. Programme shall be monitored by a committee constituted for this purpose by the college. Each committee shall consist of all teachers offering the courses for the programme and two student members or 10% of students enrolled whichever is less. The HOD or a senior faculty in the rank of a Professor shall be the Vice-Chairperson, nominated by the Head of the Institution. There shall be a common Chairperson in the Rank of Professor nominated by the Head of the Institution for all the P.G. programmes offered by the institute. There can be a common co-ordinator in the rank of Professor nominated by the Head of the Institution.

7.2 It shall be the duty and responsibility of the committee to review periodically the progress of the courses in the programme, discuss the problems concerning the curriculum and syllabi and conduct of classes. The committee may frame relevant rules for the conduct of evaluation.

7.3 The committee shall have the right to make suggestions to individual teachers on the assessment procedure to be followed for his/her course. It shall be open to the committee to bring to the notice of the Head of the Institution any difficulty encountered in the conduct of the classes or any other pertinent matter.

7.4 The committee shall meet at least twice a semester – first at the beginning of the semester, and second at the end of the semester. In the second meeting, the committee excluding student members but with the external experts invited by the Chairperson PG Programme Committee, shall finalize the grades of the students.

8.0 MINIMUM REQUIREMENTS

8.1 To be eligible towards continuing the Programme, a student must have earned a certain number of successful credits at the end of each semester as given in Table – 1. If he/she fails to satisfy this criterion in any semester, he/she shall be placed on scholastic probation in the succeeding semester. If he/she fails to earn the number of credits by the end of that year (including courses taken in summer), then, he/she shall be asked to discontinue the Programme.

8.2 Students are expected to abide by all the rules of the college and maintain a decorous conduct. Any deviation will be referred to the Head of the Institution for suitable action.

8.3 No student who has any outstanding dues to the college, hostel, library or laboratory or against whom any disciplinary action is contemplated/pending, will be eligible to receive his/her degree.

9.0 DECLARATION OF RESULTS AND ISSUE OF GRADE CARD

9.1 The PG Programme (CBCS) office shall display the grades as soon as possible after the finalization of the grades. The student shall have the right, for a look at the evaluated examination scripts and represent to the M.Tech. Programme Committee for review if he/she feels aggrieved by the evaluation within a week from the commencement of succeeding semester classes.

9.2 The College shall issue at the beginning of each semester a grade card to the student, containing the grades obtained by the student in the previous semester(s) and his/her Grade Point Average (GPA) and his/her Cumulative Grade Point Average (CGPA).

9.3 The grade card shall list:
   a) title of the course(s) taken by the student.
   b) credits associated with each course.
   c) grade secured by the student.
   d) total credits earned by the student in that semester.
   e) GPA of the student.
   f) total credits earned by the student till that semester and
   g) CGPA of the student.

9.4 The GPA shall be calculated as the weighted average of the Grade Points weighted by the credit of the course as follows:

   The product of the credit assigned to each course and the grade point associated with the grade obtained in the course is totalled over all the courses and the total is divided by the sum of credits of all the courses and rounded off to two decimal places.

   For example, a student securing grade A in a 4 credit course, grade B in a 2 credit course, grade S in a 3 credit course and grade F in a 3 credit course, will have a GPA as:

   \[
   \frac{(9 \times 4 + 8 \times 2 + 10 \times 3 + 0 \times 3)}{(4+2+3+3)} = \frac{92}{12} = 6.83/10
   \]

   The sum will cover all the courses the student has taken in that semester, including those in which he/she has secured grade F. Grades FA are to be excluded for calculating GPA and CGPA.
9.5 For computing CGPA, the procedure described in 9.4 is followed, except, that the sum is taken over all the courses the student has studied in all the semesters till then. If a student has repeated any course, the grade secured by him/her in the successful attempt only will be taken into account for calculating CGPA.

9.6 To convert CGPA into percentage marks, the following formula shall be used:

\[
\text{Percentage Mark} = (\text{CGPA} - 0.5) \times 10
\]

9.7 A candidate who satisfies the course requirements for all semesters and passes all the examinations prescribed for all the four semesters within a maximum period of 10 semesters reckoned from the commencement of the first semester to which the candidate was admitted shall be declared to have qualified for the award of degree.

9.8 A candidate who qualifies for the award of the degree shall be declared to have passed the examination in **FIRST CLASS** with **DISTINCTION** upon fulfilling the following requirements:

(i) Should have passed all the subjects pertaining to semesters 1 to 4 in his/her first appearance in four consecutive semesters starting from first semester to which the candidate was admitted.

(ii) Should not have been prevented from writing examinations due to lack of attendance.

(iii) Should have secured a CGPA of 8.50 and above for the semesters 1 to 4.

9.9 A candidate who qualifies for the award of the degree by passing all the subjects relating to semesters 1 to 4 within a maximum period of 6 consecutive semesters after his/her commencement of study in the first semester and securing a CGPA not less than 6.5 shall be declared to have passed the examination in **FIRST CLASS**.

9.10 All other candidates who qualify for the award of degree shall be declared to have passed the examination in **SECOND CLASS**.

9.11 A student with CGPA less than 5.0 is not eligible for the award of degree.

9.12 For the award of University rank and gold medal, the CGPA secured from 1st to 4th semester should be considered and it is mandatory that the candidate should have passed all the subjects from 1st to 4th semester in the first appearance and he/she should not have been prevented from writing the examination due to lack of attendance and should not have withdrawn from writing the end-semester examinations.

10.0 **PROVISION FOR WITHDRAWAL**

A candidate may, for valid reasons, and on the recommendation of the vice-chairperson and chairperson be granted permission by the Head of the Institution to withdraw from writing the entire semester examination as one unit. The withdrawal application shall be valid only if it is made earlier than the commencement of the last theory examination pertaining to that semester. Withdrawal shall be permitted only once during the entire programme. Other conditions being satisfactory, candidates who withdraw are also eligible to be awarded **DISTINCTION** whereas they are not eligible to be awarded a rank/ gold medal.

11.0 **TEMPORARY DISCONTINUATION FROM THE PROGRAMME**

If a candidate wishes to temporarily discontinue the programme for valid reasons, he/she shall apply to the Chairperson, PG Programme committee, through the Head of the department in advance and secure a written permission to that effect. A candidate after temporary discontinuance may rejoin the programme only at the commencement of the semester at which he/she discontinued, provided he/she pays the prescribed fees. The total period of completion of the programme reckoned from the commencement of the first semester to which the candidate was admitted shall not in any case exceed 10 consecutive semesters including the period of discontinuance.

12.0 **POWER TO MODIFY**

12.1 Notwithstanding anything contained in the foregoing, the Pondicherry University shall have the power to issue directions/orders to remove any difficulty.

12.2 Nothing in the foregoing may be construed as limiting the power of the Pondicherry University to amend, modify or repeal any or all of the above.
# M. Tech. (ADVANCED CONSTRUCTION TECHNOLOGY)
## Curriculum and Scheme of Examination
(Total No. of credits required for the completion of the programme: 72)

### Semester I

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Code</th>
<th>Subject</th>
<th>Hours per Week</th>
<th>Credits</th>
<th>Evaluation (Marks)</th>
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<td></td>
<td>L  T  P</td>
<td></td>
<td>Internal  External Total</td>
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<td>1</td>
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<td>Advanced Materials of Construction</td>
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<td><strong>290</strong> <strong>410</strong> <strong>700</strong></td>
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### Semester II

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<tr>
<th>Sl. No</th>
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<th>Subject</th>
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### Semester III

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*The training period shall at least be 6 weeks duration.

### Semester IV

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UNIT – I

UNIT-II

UNIT-III

UNIT-IV

UNIT-V
Concrete mix design- basic consideration-influencing factors. Mix design of concrete by IS, BS and ACI methods, mixes for high performance and high strength concretes.

REFERENCES:
CONDITION ASSESSMENT AND REHABILITATION OF STRUCTURES

UNIT – I
Maintenance, repair and rehabilitation, Facets of maintenance- various aspects of inspection. Assessment procedure for evaluating a damaged structure - causes and agencies causing deterioration- durability of materials - types of problems in components such as foundations, roofs, floors, walls, etc - safety evaluation of existing structures -failure patterns and controls.

UNIT – II

UNIT – III

UNIT – IV

UNIT – V

REFERENCES:
2. S. Champion, Failure and Repair of Concrete Structures, John Wiley & Sons.
5. Sidney M. Johnson, Deterioration, Maintenance and Repair of Concrete Structures, McGraw-Hill Book
UNIT I

UNIT II
Behaviour of concrete in flexure-stages leading to limit state of collapse-analysis at service loads-analysis at ultimate state- moment curvature relationships.
Behaviour of concrete in shear-shear resistance with and without web reinforcement-interactions of flexure and shear-interaction of flexure, shear and axial forces-effects of repeated and cyclic loading of shear strength.

UNIT III
Behavior of concrete in torsion-equilibrium and compatibility torsion-combined flexure and torsion – torsional stiffness. Bond and anchorage-mechanisms of bond resistance-type of bond-bond failure mechanisms-anchorage requirements-splicing of reinforcement

UNIT IV
Deflection and cracking-factors influencing deflection-short term deflection-control of deflection-deflection calculation. Long term deflection-deflections due to temperature, creep and shrinkage-limits on deflection-causes of cracking-factors influencing crack width in flexure- mechanisms of flexural cracking-control of flexural cracking in design.

UNIT V
Detailing of reinforcement-beams-compression members-brackets and corbels-deep beams-beam-column joints.

REFERENCES:
CE 904 CONSTRUCTION METHODS AND EQUIPMENTS

UNIT-I
Equipments: Compacting equipments, Scrapers, Dozers, Hydraulic Excavators, Trenching Machines, Graders, Gradalls, Trimmers, Trucks and hauling equipments - Draglines and Cam Shells.

UNIT-II
High Rise Structures: Methods and Equipments for foundations (Raft and pile foundations), well foundations, Shoring, Scaffolding, Formwork, Cranes and hoisting equipment. Slip form technique for tall chimneys and shafts.

UNIT-III
Concreting methods: Methods and Equipments for Concrete: Aggregate preparation, Batching, Mixing, Placing Concrete: Pumps, Ready Mix Plants, Consolidating Concrete, Finishing and Curing methods, Shotcreting and guniting.

UNIT-IV
Construction and Erection Techniques: Concrete Bridges - In-situ and precast construction methods, Balanced cantilever Methods, Span by Span Method, Incremental launching, Steel Bridges, Cable Stayed Bridges and Suspension Bridge.

UNIT-V
Ports: Types, Breakwaters – berthing structures, mooring accessories – dredgers and dredging methods.

References:

CE 907 EXPERIMENTAL TECHNIQUES LABORATORY

Use of various types of strain gauges - Mechanical and Electrical strain gauges - Casting and testing of R.C. beams and study of their behavior in flexure and shear - Studies on strain and displacement measurements. LVDT’s, Load cells and data acquisition systems – software and analysis.

Simple dynamics experiments- determination of natural frequency and damping ratio
UNIT I
Design principles of members subjected to lateral loads and axial loads - Principles of analysis and design of Industrial buildings and bents - Crane and gantry girders.

UNIT II
Analysis and design of steel towers, Trestles and Masts- Design of industrial stacks - Self supporting and guyed stacks lined and unlined.

UNIT III
Cold formed sections-types of cross sections- design of cold formed thin walled members- local buckling and post buckling strength-beams-columns and beam columns-connections.

UNIT IV
Introduction to Plastic Analysis of Structures-shape factors, moment redistribution- Static-kinematic and uniqueness theorems-combined mechanisms- analysis of single bay and two bay portal frames- Effect of axial force and shear force on plastic moment.

UNIT V
Pre Engineered buildings- rigid frame end-post and beam end- design of purlin and girders subject to different load conditions-limitations of pre-engineered buildings- advantages and comparison with conventional steel buildings.

References:
CE 906    SAFETY PRACTICES IN CONSTRUCTION

UNIT – I

UNIT – II

UNIT – III

UNIT – IV

UNIT – V

REFERENCES

CE 908    COMPUTING TECHNIQUES LABORATORY


2. Solution of linear simultaneous equations using Gauss elimination.
3. Matrix inversion using GJ method
4. Linear regression analysis.
6. Eigen value extraction power method
7. Spreadsheets for design of various structural elements- footings, beams, slabs and columns

Computer methods of structural analysis - Finite Element programming – Hands on experience for structural analysis through application packages Staad Pro, SAP, ETABS and Ansys.
CE 921  ADVANCED BRIDGE CONSTRUCTION ENGINEERING

UNIT – I


UNIT – II

Caissons or well foundations: Caisson construction and sinking methods - construction of well curb (shoe) - towing a floating caisson to sinking site - bed preparation - supporting structures - lowering caissons - sinking open Well caissons - excavation method - de-watering for freeing a 'hanging' caisson. Sand Blow -jetting and lubrication - rectifying tilt in wells - skin friction in caissons - construction details of pneumatic sinking of caissons - construction methods of steining and bottom plugging

UNIT – III


UNIT – IV

Slab, T-beam and Box girder deck slab construction: Slab type, T-beam and box-girder bridges Decks Construction methods. Span lengths -deck and stiffening system.

UNIT – V


REFERENCES:

CE 922 CONDITION ASSESSMENT AND EVALUATION ENGINEERING

UNIT – I


UNIT – II


UNIT – III


UNIT – IV

**Chemical Analysis**: Chemical analysis for cement content and type – Depth of carbonation – original water content – Chloride content – Sulphate content.

UNIT – V


References:

2. R. Holland., Appraisal & Repair of Reinforced Concrete, Thomas Telford
CE 923    ENERGY CONSERVATION TECHNIQUES IN BUILDING CONSTRUCTION

UNIT – I

UNIT - II

UNIT – III
Design: Natural building design consideration - Energy efficient design strategies - Contextual factors - Longevity and process Assessment -Renewable energy sources and design- Advanced building Technologies - Smart buildings - Economies and cost analysis.

UNIT – IV

UNIT – V

REFERENCES
CE 924  DETERIORATION PROCESS IN REINFORCED CONCRETE

UNIT-I


UNIT – II


UNIT – III

**Chemical Attack on Concrete:** Sulphate attack – Seawater damage – Salt weathering – Carbonation – Acid attack – Attack of soft water – Alkali – Silica reaction – Alkali – Carbonate reaction – Unsound Cement – Biological attack.

UNIT – IV


UNIT – V

**Blemishes and Defects in Concrete:** Honey Combing – Pop outs – Crazing – Efflorescence – Scaling and Spalling – Cold Joints – Discoloration – Bleeding – Curling.

REFERENCES:

1. Mark Richardson – Technology, Fundamentals of Durable Reinforced Concrete-Spon press (UK)
2. Pietro Pedeferri, Rob. B. Polder, Corrosion of Steel in Concrete Prevention, Diagnosis, Repair, Wiley – VCH
3. G. Jorv, Concrete under severe conditions, Spon Press (UK)
CE 925  ADVANCED STRUCTURAL ANALYSIS

Unit – I

Unit – II
Matrix flexibility method Analysis of pin-jointed frames –effects due to lack of fit and temperature changes. Application to space frames – Direct flexibility approach.

Unit – III
Matrix stiffness method – Transformation of displacements – Elements stiffness to system stiffness – Application to continuous beams – effects of support settlements and elastic supports.

Unit – IV
Matrix stiffness method — Application to pin-jointed plane frames - support settlements – lack of fit and temperature effect. Analysis of three dimensional pinned frames.

Unit – V
Special analysis techniques – Condensation, Substructuring – reanalysis techniques – transfer matrix method. Analysis of frames with semi rigid connections.

REFERENCES:
CONTRACT LAWS AND REGULATIONS

UNIT - I

UNIT – II

UNIT - III

UNIT – IV

UNIT – V

REFERENCES:
UNIT I: Shallow Foundation
- Functions and requisites of a foundation
- Different types
- Bearing capacity determination
- Field Tests
- Settlement determination
- Proportioning of shallow foundation
- Design guidelines
- Coidal recommendations
- Construction aspects.

UNIT II: Raft Foundation
- Coidal Recommendations
- Construction aspects
- Ground modification for shallow foundations.

UNIT III: Pile Foundation
- Function
- Classification of piles
- Factors governing choice of pile foundation
- Load transfer principles
- Load evaluation of piles and pile groups
- Static method
- Dynamic method
- Pile load test
- Under reamed piles
- Pile raft system
- Laterally loaded piles
- Coidal Recommendations
- Construction aspects.

UNIT IV: Caisson Foundation
- Caissons types
- Stability of caissons
- Loads
- Principles of analysis and design
- IRC Guidelines
- Construction aspects.

UNIT V: Machine Foundation
- Types of Machines and Foundations
- General requirements
- Principles of measuring dynamic properties
- Field tests
- Factors affecting dynamic properties
- Mechanism of Liquefaction
- Influencing factors
- Evaluation of Liquefaction potential
- Design of Block Foundation
- Coidal Recommendations
- Construction aspects
- Vibration Isolation.

REFERENCE BOOKS
CE 928 RESOURCE MANAGEMENT AND CONTROL IN CONSTRUCTION

UNIT – I

UNIT – II

UNIT - III
Materials: Time of purchase, Quantity of material, sources, Transportation, Delivery and Distribution.
Equipment: Planning and selecting by optimistic choice with respect to cost, Time, Source and handling.

UNIT – IV
Time: Personnel time, Management and planning, Managing time on the project, forecasting the future, Critical path measuring the changes and their effects. Cost control: Cash flow and cost control, objectives of cost, Time and Quality.

UNIT V
Resource allocation and leveling: Time-cost trade off, Computer application in resource leveling examples, resource list, resource allocation graph, Resource loading, Cumulative cost ETC - Value Management.
Introduction to project management software: MS project and Primaveera.

REFERENCES:
UNIT – I

UNIT – II

UNIT – III

UNIT – IV
Connections in Composite construction- flexible and rigid connections- moment resisting connections. Seismic behaviour of composite structures.

UNIT – V

REFERENCES:
UNIT-I

UNIT-II
Pre-casting techniques - Planning, analysis and design considerations - Handling techniques -Transportation Storage and erection of structures.

UNIT-III
Joints -Curing techniques including accelerated curing such as steam curing, hot air blowing etc., -Test on precast elements -skeletal and large panel constructions - Industrial structures.

UNIT-IV
Pre-cast and pre-fabricating technology for low cost and mass housing schemes. Small pre-cast products like door frames, shutters, Ferro-cement in housing - Water tank service core unit.

UNIT-V
Quality control - Repairs and economical aspects on prefabrication.

REFERENCES:
CE 931  EARTHQUAKE RESISTANT DESIGN OF STRUCTURES

UNIT I


UNIT II


UNIT III

System Provision of seismic code (IS1893 & IS 13920) – Building systems – frames – shear wall – braced frames – layout design of Moment Resisting Frames (MRF) – ductility of MRF – Infill walls – Non-structural elements

UNIT IV

Calculation of EQ load – 3D modeling of building systems and analysis (theory only) Design and detailing of frames, shear wall, and frame walls – earthquake resistant design of masonry structures.

UNIT V

Cyclic loading behavior of RC steel and masonry structures - modern concepts –base isolation – Adoptive systems – case studies

REFERENCES:

1. Pankaj Agarwal and Manish ShriKhande, Earthquake Resistant Design of Structures, Prentice Hall of India, 2007, New Delhi
UNIT-I

UNIT-II
Design of shear wall: Introduction, Types of shear walls, behaviour of cantilever walls with rectangular cross section, Flange cantilever shear walls, Moment – Axial load interaction for shear wall section, Interaction of shear walls and Rigid jointed frames, Shear walls with openings, Coupled shear walls.

UNIT-III
Analysis of Steel Towers, Trestles and Masts: Introduction, wind Loads on towers, stresses due to vertical loads and horizontal loads.

UNIT-IV
Analysis of forces in Chimneys Introduction, Wind pressure, Stresses in chimney shaft due to self weight and wind, Stresses due to temperature effect.

UNIT-V
Design of Glass and Glazing – Control of wind induced vibration on structures – cyclone resistant design of structures – wind tunnel experiments.

REFERENCES:
UNIT I

Specific requirements for industries, like textile, sugar, cement, chemical etc., site layout and external facilities.

UNIT II

Planning of building work-standards-structural materials including plastics, polymers, fibre glass, pressed cardboards, etc., multi-storey buildings; steel skeletal structures, reinforced concrete frames; workshops; ware houses; single storey buildings; sheds in steel and reinforced concrete; north lights; single span spherical and other special constructions; cooling towers and chimneys; bunkers and silos; prefabrication; construction.

UNIT III

Construction Techniques-Expansion joints-machine foundations; water proofing; roofs and roofing; roof drainage; floors and flooring joists; curtain walling; outer wall facing; sound and shock proof mountings; use of modern hoisting and other construction equipments.

UNIT IV

Circulation, communication and transport; fixed points (central cores); stair cases; grid floor sections; lifts; cranes; continuous conveyors; mobile cranes; transporters; doors; sliding gates

UNIT V

Functional requirements- Lighting: natural lighting; protection from the sun-sky lights; window cleaning installations. Services: layout; wiring; fixtures, cable and pipe bridges; electrical installations; lighting substation; effluent. Ventilation and fire protection: ventilation; air conditioning; fire escapes and chutes; fire alarms; extinguishers and hydrants.

REFERENCES

CE 934  BASICS OF FINITE ELEMENT ANALYSIS

UNIT – I
Differential equilibrium equations - strain displacement relation - linear constitutive relation - special cases- Principle of stationary potential energy - application to finite element methods.

UNIT – II
Some numerical techniques in finite element Analysis Displacement models - convergence requirements. Natural coordinate systems – Shape function. Interpolation function- Linear and quadratic elements - Lagrange & Serendipity elements- Strain displacement matrix - element stiffness matrix and nodal load vector

UNIT – III
Two dimensional isoparametric elements - Four noded quadrilateral elements – triangular elements- Computation of stiffness matrix for isoparametric elements - numerical integration (Gauss quadrature) -Convergence criteria for isoparametric elements. Assemblage of elements – Direct stiffness method- Special characteristics of stiffness matrix - Boundary condition & reaction - Gauss elimination and LDT decomposition- Basic steps in finite element analysis.

UNIT – IV

UNIT – V
Introduction to 3 Dimensional elements – Shape functions - Introduction to finite element softwares – Pre and Post processors.

REFERENCES:
UNIT – I
Acoustics: Sound - Velocity of sound - frequency and intensity of sound - reflection of sound - reverberation - absorption of sound - Sabin's equation - absorption materials - conditions for good acoustics.

UNIT – II
Acoustical design of an auditorium - defects in an auditorium and their remedies - acoustics of studies - noise and its effects - type of noises - transmission of noise - sound insulation - transmission loss - acceptable noise levels

UNIT – III
Methods of sound insulation - materials used for sound insulation - measurement of acoustical level - methods of acoustical improvement for existing structures.

UNIT – IV
Lighting: Day lighting (or) Natural lighting - design of windows - orientation of buildings - lighting for industrial structures - supplementary illumination - artificial illumination - summary.

UNIT – V
Ventilation: Ventilation due to wind - ventilation due to stack effect - ventilation due to combined effect - infiltration - ventilation of industrial building - calculation of natural ventilation - mechanical ventilation - examples - building regulation - air conditioning - summary

REFERENCES:
CE 936     STABILITY ANALYSIS OF STRUCTURES

UNIT – I

UNIT – II

UNIT – III
Beams and Beam columns – introduction – lateral buckling of beams – beam column with concentrated and distributed loads – effect of axial load on bending stiffness

UNIT – IV

UNIT – V

References
UNIT I
Simple bending of Plates-Assumptions in thin plate theory-Different relationships- Different Boundary Conditions for plates- Plates subjected to lateral loads – Navier’s method for simply supported plates – Levy’s method for general plates – Example problems with different types of loading.

UNIT II
Circular plates subjected to Axi-symmetrical loads–concentrated load, uniformly distributed load and varying load – Annular circular plate with end moments.

UNIT III
Rayleigh-Ritz method – Application to different problems – Finite difference method – Finite element methodology for plates- Orthotropic Plates.

UNIT IV
Bending of anisotropic plates with emphasis on orthotropic plates – Material Orthotropy – Structural Orthotropy - Plates on elastic foundation.

UNIT V
Shells- Classification of shells - Membrane and bending theory for singly curved and doubly curved shells - Various approximations - Analysis of folded plates.

References
UNIT I

The concept of plastic design, ductility of steel, ultimate load as the design criterion- margin of safety-bending of symmetrical sections-plastic hinge-redistribution of moment-mechanisms...

UNIT II

Fundamental principles; statistical method of analysis- mechanism method of analysis-Further methods of analysis-distributed load-members of non-uniform cross sections-calculation of failure loads by computer.

UNIT III

Influence of axial force on the plastic moment-influence of shear force- local buckling of flanges and webs-lateral buckling-column stability-brittle fracture-repeated loading-computer solution for Shakedown analysis.

UNIT IV

Connections-requirements for connections-straight corner connections-Haunched connections-interior beam-column connections-deflection at ultimate load-deflection at working load-rotation capacity.

UNIT V

Design of beams and frames-Design guides- continuous beams-uniform and non-uniform cross sections-single-span frames-procedures for multi storeyed frames-computer solution for elastic-plastic failure loads-simple examples of minimum weight design-minimum weight design by computer.

References:

CE 939 STRUCTURAL DYNAMICS

UNIT I
Introduction to Dynamic analysis - Elements of vibratory systems and simple Harmonic Motion- Mathematical models of SDOF systems - Principle of Virtual displacements - Evaluation of damping resonance.

UNIT II
Fourier series expression for loading - (blast or earthquake) - Duhamel’s integral – Numerical methods - Expression for generalised system properties - vibration analysis Rayleigh’s method - Rayleigh - Ritz method.

UNIT III
Evaluation of structural property matrices - Natural vibration - Solution of the Eigen value problem - Iteration due to Holzer and Stodola

UNIT IV
Idealisation of multi-storeyed frames - analysis to blast loading - Deterministic analysis of earthquake response - lumped SDOF system

UNIT V
Differential equation of motion - Beam flexure including shear deformation and rotator inertia - Vibration analysis using finite element method for beams and frames

REFERENCES:
UNIT-I
Pavement types, components, highway and airport pavements, complexities in pavement design, subgrade - significance, soil classification, assessment of strength characteristics, Traffic Loads, Climatic factors - variation in moisture content and temperature, frost action, pavement component materials - Environmental factors.

UNIT-II
Stresses and deflections through homogeneous mass, Two-layer and three layer theories and applications, wheel load stresses, wheel load configurations in highway and airport pavements, ESWL, repetition of loads and EWL factors. Stresses due to wheel load and temperature, Westergaard's analysis, IRC design method for highway pavements, design of expansion and longitudinal joint details.

UNIT-III
General design approaches, IRC37, IRC 58 ACI-LCN design methods for pavements. stabilometer, Triaxil test, Mcleod and Burmister's two layer theory Problems on above.

UNIT-IV
Highway construction, non bituminous – WBM& WMM-mix design, Bituminous mix design -Bituminous pavements-Cement concrete pavements-RCC pavements-CRC pavements- PSC pavements-construction of joints in CC pavements-Joint filler and sealer compounds and application methods.

UNIT-V
Pavement maintenance methods- Pavements failures, Pavement evaluation methods (flexible & rigid)- Benkelman beam rebound deflection method, strengthening of rigid pavements, pavement surface condition evaluation, highway drainage.

References:
5. Yoder and Witzach, 'Principles of pavement Design', John Wiley and Sons, (2nd Edn.)
7. IRC 37 and IRC 58.
INFRASTRUCTURE AND FACULTY REQUIREMENT FOR M.Tech (ACT)

1. Infrastructure
   a. Building

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Building Details</th>
<th>Area (m²)</th>
<th>Nos Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Class/Tutorial Rooms</td>
<td>33</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Laboratory</td>
<td>75</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Project Lab</td>
<td>50</td>
<td>1</td>
</tr>
</tbody>
</table>

   b. Equipment

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Facilities</th>
<th>Qty.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Universal Testing Machine (1000 kN)</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Universal Testing Machine (60 kN)</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Universal Testing Machine (50 kN)</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>UPV Tester</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>Rebound Hammer</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>Compression Testing Machine (3000 kN)</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>Loading Frame (300 kN)</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>Load and Displacement Measurement Devices</td>
<td>1 Set</td>
</tr>
<tr>
<td>9</td>
<td>Accelerated Curing Tank</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>Box Furnace</td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>Ball Mill</td>
<td>1</td>
</tr>
<tr>
<td>12</td>
<td>Autoclave</td>
<td>1</td>
</tr>
</tbody>
</table>

2. Library
   - Books: 100 Nos
   - Titles: As required by the curriculum
   - Journals: 5 related International Journals

3. Faculty Requirements

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Cadre</th>
<th>Nos</th>
<th>Qualification</th>
<th>Specialisation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Professor</td>
<td>1</td>
<td>As per AICTE norms</td>
<td>Civil Engg/ Structural Engg, Geotechnical Engg/Construction Management</td>
</tr>
<tr>
<td>2</td>
<td>Associate Professor</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Assistant Professor</td>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. Teacher Student Ratio: 1 : 12