M.Tech. (ENVIRONMENTAL ENGINEERING)

CURRICULUM AND SYLLABUS
(Effect from the Academic Year 2011 – 12)

DEPARTMENT OF CIVIL ENGINEERING
PONDICHERRY ENGINEERING COLLEGE
PUDUCHERRY – 605 014.
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/Chemical/Environmental Engineering/Biotechnology 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 / Directed Study / Industrial Training
v) 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>
<thead>
<tr>
<th>Sl. No</th>
<th>Description</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No. of Semesters</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>Min. No. of credits of the programme</td>
<td>72</td>
</tr>
<tr>
<td>3</td>
<td>Max. No. 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>
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<tr>
<td>6</td>
<td>Min. period of completion of programme (continuous semesters)</td>
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</tr>
<tr>
<td>7</td>
<td>Max. period of completion of programme (continuous semesters)</td>
<td>8</td>
</tr>
<tr>
<td>8</td>
<td>No. 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 / Seminar</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 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 this training is to develop the intuitive skills of the candidate and to expose them with real time problems faced in the industry. The candidates may undergo industrial training instead of taking the 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 and the methods to minimise the weakness.

(c) Each student is required to make a seminar presentation on any chosen topic connected with the field of specialization, preparation and presentation of a seminar is intended to investigate an in-depth review of literature, prepare a critical review and develop confidence to present the material by the student. The seminar shall be evaluated by a Department Committee constituted for this purpose, based on a report submitted by the candidate and a viva-voce conducted at the end of the semester.

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.

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>
</tr>
<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:

<table>
<thead>
<tr>
<th>Project work – (Phase – I): 300 Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal valuation</td>
</tr>
<tr>
<td>Guide</td>
</tr>
<tr>
<td>First Evaluation</td>
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<tr>
<td>Second Evaluation</td>
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<tr>
<td>Total</td>
</tr>
<tr>
<td>External valuation</td>
</tr>
<tr>
<td>Evaluation (External Examiner Only)</td>
</tr>
<tr>
<td>Viva voce</td>
</tr>
<tr>
<td>Internal Examiner</td>
</tr>
<tr>
<td>External Examiner</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>
**Project work – (Phase – II):** 400 Marks

<table>
<thead>
<tr>
<th>Guide</th>
<th>Internal valuation</th>
<th>Evaluation (External Examiner Only)</th>
<th>Viva voce</th>
<th>Internal Examiner</th>
<th>External Examiner</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guide</td>
<td>100 marks</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>First Evaluation</td>
<td>50 marks</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Second Evaluation</td>
<td>50 marks</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>200 marks</td>
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<td></td>
<td></td>
<td></td>
<td>200 marks</td>
</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:

<table>
<thead>
<tr>
<th>Test I</th>
<th>15 Marks</th>
</tr>
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<tbody>
<tr>
<td>Test II</td>
<td>15 Marks</td>
</tr>
<tr>
<td>Assignment</td>
<td>10 Marks</td>
</tr>
<tr>
<td>Final test covering the whole syllabus</td>
<td>60 Marks</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100 Marks</strong></td>
</tr>
</tbody>
</table>

(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:

<table>
<thead>
<tr>
<th>Training Report</th>
<th>60 marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viva voce</td>
<td>40 Marks</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100 Marks</strong></td>
</tr>
</tbody>
</table>

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:

\[(9 \times 4 + 8 \times 2 + 10 \times 3 + 0 \times 3)/ (4+2+3+3) = 82/12 = 6.83/10\]

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 in addition secures 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-semes
ter 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. (ENVIRONMENTAL ENGINEERING)
### COURSE CURRICULUM AND SCHEME OF EXAMINATION

(Minimum Credit Requirement for the completion of the Programme: 72)

### SEMESTER – I

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Code</th>
<th>Subject</th>
<th>Hours / Week</th>
<th>Credits</th>
<th>Evaluation (marks)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
<td>L</td>
<td>T</td>
<td>P</td>
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<tr>
<td>1.</td>
<td>CE 911</td>
<td>Mathematics for Environmental Engineers</td>
<td>3</td>
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<td>2.</td>
<td>CE 912</td>
<td>Environmental Chemistry</td>
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<tr>
<td>3.</td>
<td>CE 913</td>
<td>Environmental Microbiology</td>
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<td>4.</td>
<td>CE 914</td>
<td>Principles and Design of Physico-Chemical Treatment Systems</td>
<td>3</td>
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<td>Elective – I</td>
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<td>6.</td>
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<td></td>
<td></td>
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<td></td>
<td></td>
<td>24</td>
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### SEMESTER – II

<table>
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<tr>
<th>Sl. No</th>
<th>Code</th>
<th>Subject</th>
<th>Hours / Week</th>
<th>Credits</th>
<th>Evaluation (marks)</th>
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<tr>
<td>1.</td>
<td>CE 915</td>
<td>Principles and Design of Biological Treatment Systems</td>
<td>3  1  0</td>
<td>4</td>
<td>40  60  100</td>
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<td>2.</td>
<td>CE 916</td>
<td>Transport of Water and Wastewater</td>
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### SEMESTER – III

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### SEMESTER – IV

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<td>Cleaner Production and Environmental management</td>
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<td>Environmental Impact Assessment</td>
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<td>CE 951</td>
<td>Principles of Environmental Science</td>
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<td>Remote Sensing and GIS Applications in Environmental Engineering</td>
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<td>CE 956</td>
<td>Environment, Health and Safety in Industries</td>
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</table>
1. **Statistical Methods:**
   Measures of Central tendency, dispersion, skewness and kurtosis- Principles of least squares – Correlation and regression – rank correlation.

2. **Sampling Distributions and Estimation**
   Sampling distribution- point and interval estimates for population proportions, mean and variance- one- way and two – way classification.

3. **Test of hypothesis of Small Samples:**
   Sampling Distributions - t, chi-square and F distribution .

4. **Test of Hypothesis of Large Sample:**
   Test based on Normal distribution, Analysis of variance-one-way and two-way classification.

5. **Linear Programming Methods**
   Basic concepts – Graphical, Simplex, Big M and Two Phase methods – Transportation problem - Assignment problem, regression and correlation analyses

**References:**


CE 912  ENVIRONMENTAL CHEMISTRY

1. **Principles of Physical Chemistry:**
   Reversible reactions, equilibrium constant, Le-Chatelier principle. Reaction rate
   Order and molecularity, kinetic equations of different orders, reversible and
   consecutive reactions. Catalysis-type, characteristics, activation energy,
   mechanism of catalyst action, acid base catalysts. Photo catalysis. Adsorption-
   classification, adsorption of gases on solids, adsorption from solutions, ion
   exchange adsorption, applications, Longmuir theory

2. **Principles of Aquatic Chemistry and BioChemistry**
   Water resources, sea water- composition, Ph of sea water. Humic substances.
   Aquatic chemical reactions- microbial redox reaction, iron and manganese
   bacteria, nitrogen transformation bacteria. Enzymes-mechanism and factors
   influencing enzyme action. Biodegradation- biodegradation of carbohydrates,
   proteins, fats and oils and detergents. Colloidal state- stability, kinetic, optical
   and electrical properties

3. **Environmental Chemicals**
   Chemical speciation – speciation of lead, mercury, arsenic and chromium.
   Structure and property- activity relationship, fate of organics in the environment –
   transformation reactions- hydrolysis, elimination, oxidation, reduction and
   photochemical transformation. Risk evaluation of environmental chemicals,
   Toxic chemicals in the environment, impact on enzymes. Biochemical effects of
   arsenic, lead, mercury and pesticides

4. **Atmospheric Chemistry**
   Structure of atmosphere, chemical and photochemical reactions in the
   atmosphere. Ozone chemistry- formation and depletion of zone layer, oxides
   of nitrogen and sulphur. Acid rain mechanism of formation and effects.
   Photochemical smog, and sulfuric smog. Green house effect/global
   warming, green house gases, effects

5. **Fundamentals of analytical Principles**
   Analysis of water and water quality parameters -concept of pH, measurement
   of acidity, alkalinity, hardness, residual chlorine, chlorides, DO, BOD, COD,
   fluoride and nitrogen. Introduction to spectral analysis, colorimetry, fluorimetry,
   nephelometry, turbidimetry, absorption and emission spectral methods.

**References**
1. C.N Sawyer, P.L McCarty and G.F Parkin, Chemistry for Environmental
2. B.S Bhal, GD Tuli and Arun Bhal, Essentials of Physical Chemistry, S.
   Chand & Co Ltd.
   New Delhi, 2003
3. Arun Kumar De, Environmental Chemistry, 5th ed, New Age
   International (P) Ltd.
   New Delhi
CE 913 ENVIRONMENTAL MICROBIOLOGY

1. Introduction:

Microorganisms – classification, prokaryotic and eukaryotic cells, structure, characteristics, nucleic acids, DNA and RNA, replication, Recombinant DNA – Genetic Engineering.

2. Microbial growth and Metabolism

Environmental factors, nutrition and metabolism, growth phases, enzymes, carbohydrate, protein, lipids metabolism, respiration, fermentation, Glycolysis, Kreb’s cycle, Hexose monophosphate pathway, significance of energetics.

3. Microbiology of Drinking water:


4. Microbiology of Toxic Wastewater Treatment

Biodegradation of toxic pollutants – alpha oxidation, beta-oxidation, electrons transport system and oxidative phosphorylation mechanism, Microbiology of biological treatment process.

5. Aquatic Microbiology


References:


1. Classification of Pollutants

Pollutants in water and wastewater – characteristics, Standards for performance Significance of physico-chemical treatment – Selection criteria-types of reactor- reactor selection-batch-continuous type-kinetics

2. Physical Treatment Principles


3. Chemical Treatment Principles


4. Design of Water Treatment Plants


5. Design of Wastewater Treatment Plants


References:
CE 915  PRINCIPLES AND DESIGN OF BIOLOGICAL TREATMENT SYSTEM

1. PRINCIPLES


2. DESIGN OF AEROBIC TREATMENT SYSTEMS


3. ANAEROBIC TREATMENT OF WASTEWATER


4. SLUDGE TREATMENT AND DISPOSAL

Design of sludge management facilities, sludge thickening, sludge digestion, biogas generation, sludge dewatering (mechanical and gravity) Layout PID hydraulics profile – upgrading existing plants – ultimate residue disposal – recent advances.

5. CONSTRUCTION OPERATIONS AND MAINTENANCE ASPECTS


REFERENCES:


CE 916 TRANSPORT OF WATER AND WASTEWATER

1. **General hydraulics and flow measurement:** Fluid properties; fluid flow – continuity principle, energy principle and momentum principle; frictional head loss in free and pressure flow, minor heads losses, Carrying Capacity–Flow measurement.

2. **Water transmission and distribution:** Need for Transport of water and wastewater- Planning of Water System –Selection of pipe materials, pipe thickness calculations. Water transmission main design- gravity and pumping main; Selection of Pumps- characteristics-economics; Specials, Jointing, laying and maintenance, water hammer analysis.


4. **Wastewater collection and conveyance:** Planning factors – Design of sanitary sewer; partial flow in sewers, economics of sewer design. Handling and transport of slurry. Wastewater pumps and pumping stations- sewer appurtenances; material, construction, inspection and maintenance of sewers; Design of sewer outfalls-mixing conditions; conveyance of corrosive wastewaters. Use of computer software in sewer design, handling and transport of slurries.

5. **Storm water drainage:** Necessity- - combined and separate system; Estimation of storm water run off Formulation of rainfall intensity duration and frequency relationships- Rational methods. Use of computer software in storm water design.

REFERENCES:

1. **Chemistry Laboratory practice:**

Sampling and characterization of water and wastewater by gravimetric, volumetric and colorimetric methods – Sampling and analysis of ambient air for SPM, SO$_2$, Oxides of nitrogen – Good laboratory practice – Analytical quality control

2. **Microbiology Laboratory Practicals**


3. **Air pollutants and leachate analyses**

Instrumental methods of analyses for particulates, HC, CO, NOx, SO$_2$, bioaerosols. TCLP and leachate tests for solidwastes

**References:**


CE 918 SEMINAR

Each candidate is required to give one seminar on any chosen topic connected with the field of specialisation. The topic shall be chosen in consultation with the concerned Faculty and Head of the Department. Preparation and presentation of a seminar is intended to investigate an indepth review of literature; to prepare a critical review and to develop confidence for making a good presentation. A report has to be submitted in the prescribed format and the seminar shall be evaluated by the respective department committee.

CE 919 DISSERTATION PROJECT - PHASE I

It will be taken up by the student at the end of the second semester and the duration would be six months. This is aimed at training the students to analyse independently any problem posed to them. The work may be analytical, experimental, design or combination of these. The dissertation report is expected to exhibit clarity of thought and expression, critical appreciation of the existing literature and analytical and/or experimental or design skill. The evaluation of dissertation will be based on continuous internal assessment comprising three seminars, one internal Viva-voce and an external Viva-voce examination.

CE 920 DISSERTATION PROJECT - PHASE II

It is the continuation of the Dissertation Project - Phase I. The Dissertation report is to be submitted at the end of the fourth semester. The evaluation of dissertation will be based on continuous internal assessment comprising three seminars, one internal Viva-voce and an external Viva-voce examination.
1. **Modelling/Concept**

Water and air quality management – Role of mathematical models; systems approach – systems and models – kinds of mathematical models – model development and validation effluent and stream standards; ambient air quality standards.

2. **Surface Water Quality Modelling:**


3. **Air Quality Modelling:**

Transport and dispersion of air pollutants – wind velocity, wind speed and turbulence; estimating concentrations from point sources – the Gaussian Equation – determination of dispersion parameters, atmospheric stability; dispersion instrumentation – Atmospheric traces; concentration variation with averaging time; Air pollution modeling and prediction – Plume rise modeling techniques, modeling for non-reactive pollutants, single source – short term impact, multiple sources and area sources, model performance and utilisation, computer models.

4. **Groundwater Quality Modelling:**

Mass transport of solutes, degradation of organic compounds, application of concepts to predict groundwater contaminant movement, seawater intrusion – basic concepts and modelling

5. **Computer Models:**

Exposure to computer models for surface water quality, groundwater quality and air quality.

**References:**

1. **Introduction:**


2. **Control of Particulates:**

Objectives – Filters, gravitational, centrifugal – multiple type cyclones, prediction of collection efficiency, pressure drop, wet collectors, Electrostatic Precipitation theory-particle charging-particle collection – ESP design procedure.

3. **Gaseous Pollutant Control:**


4. **Control Measures for Industrial Applications:**

Control methods – Processes based control mechanisms – mineral products – asphaltic concrete, cement plants and glass manufacturing plants; Thermal power plants, Petroleum refining and storage plants, Fertilizers, Pharmaceuticals and wood processing industry. Field Study.

5. **Indoor air quality management**

Noise Standards; measurement, control and preventive measures, indoor air quality measures and management

**References:**

1. **Introduction:**

2. **Principles Cleaner Production:**

3. **Cleaner Production Project Development and Implementation:**

4. **Life Cycle Assessment and Environmental Management Systems:**

5. **Case Studies:**
Industrial applications of CP, LCA, EMS and Environmental Audits, green energy and green process management.

**References:**

CE 944 ECOLOGICAL ENGINEERING

1. Introduction to Ecology and Ecological Engineering


2. Systems Approach in Ecological Engineering:

Classification of ecotechnology – Principles and components of Systems and Modeling – Structural and functional interactions in environmental systems – Human modifications of environmental systems.

3. Ecological Engineering Processes:


4. Ecotechnology for Waste Treatment:


5. Case Studies:

Case studies of integrated ecological engineering systems.

References:

CE 945  ENVIRONMENTAL BIOTECHNOLOGY

1. Principles and concepts:
   Principles and concepts of environmental biotechnology – usefulness to mankind.

2. Microbial Systems for Detoxification of Environmental Pollutants.

3. Microbial Technology for Waste Management:

4. Recombinant DNA Technology:
   Concept of rDNA technology – plasmid – cloning of DNA – mutation – construction of microbial strains.

5. Regulatory and Ethical issues:
   Environmental effects and ethics of microbial technology – safety of genetically engineered organisms.

References:

CE 946 ENVIRONMENTAL GEOTECHNOLOGY

1. Soil- Pollutant Interaction:
   Introduction to geo environmental engineering – environmental cycle – sources, production and classification of waste – causes of soil pollution – factors governing soil-pollutant interaction- Physico-chemical behavior and modelling - failures of foundations due to pollutants

2. Characterization, Stabilization and Disposal

3. Transport of Contaminants:

4. Detection and Testing Methods
   Methodology- review of current soil testing concepts – Proposed approach for characterization and identification of contaminated ground soil for engineering purposes

5. Remediation of Contaminated Soils:

References:
CE 947 ENVIRONMENTAL IMPACT ASSESSMENT

1. Introduction

2. Components And Methods For Eia

3. Socio-Economic Impact Assessment

4. Environmental Management Plan

5. Sectoral EIA

References:
2. World Bank –Source book on EIA
1. **Principles of Sustainable Development:**


2. **Indians Judiciary System & Sustainable Development:**


3. **Sustainable Development and International Contribution:**


4. **Socio-economic Sustainable Development Systems:**


5. **Agenda for Future Global Sustainable Development:**

Role of developed countries in the sustainable development of developing countries – Demographic dynamics and sustainability – Integrated approach for resource protection and management.

**References:**

1. **Introduction**


2. **Industrial Pollution Prevention**


3. **Industrial Wastewater Treatment**


4. **Wastewater Reuse And Residual Management**


5. **Case Studies**


**References:**


1. **Basics of Measurement**

2. **Spectroanalytical Methods**

3. **Chromatographic Methods**

4. **Electro analytical Methods**

5. **Radio analytical and Other methods**
   Particles emitted in radioactive decay. Measurement of radioactivity- Ionization chamber , proportional counter, scintillation counter and Geiger counter. Isotopic dilution analysis and activation analysis. NDIR for CO analysis, chemiluminescent analyzer for NOx, fluorescent analyzer for. SO₂ , flow injection analysis and CHN analyzer.

References:

CE 951 PRINCIPLES OF ENVIRONMENTAL SCIENCE

1. **Introduction:**


2. **Biological Systems:**


3. **Microbiology of Environment:**


4. **Chemistry of Aquatics:**


5. **Chemistry of Atmosphere:**


**References:**

1. **Remote sensing**


2. **Emr Interaction With Atmosphere And Earth Materials**


3. **Optical And Microwave Remote Sensing**


4. **Geographic Information System**


5. **Miscellaneous Topics**


**References:**

1. **Municipal Solid Waste Management:**

2. **Collection and Transport of Solid Waste:**
   **Collection of Solid Waste:** Type of waste collection systems, analysis of collection system – alternative techniques for collection system. **Separation and Processing and Transformation of Solid Waste:** unit operations user for separation and processing, Materials Recovery facilities, Waste transformation through combustion and aerobic composting, anaerobic methods for materials recovery and treatment – Energy recovery – Incinerators
   **Transfer and Transport:** Need for transfer operation, transport means and methods, transfer station types and design requirements. **Landfills:** Site selection, design and operation, drainage and leachate collection systems – requirements and technical solution, designated waste landfill remediation – Integrated waste management facilities.

3. **Hazardous Waste Management:**

4. **Hazardous waste treatment and Design:**
   Hazardous waste treatment technologies - Design and operation of facilities for physical, chemical and thermal treatment of hazardous waste – Solidification, chemical fixation and encapsulation, incineration. **Hazardous waste landfills:** Site selection, design and operation – remediation of hazardous waste disposal sites.

5. **Laboratory Practice:**
   Sampling and characterization of Solid Wastes; TCLP tests and leachate studies.

**References:**
1. **Introduction**


2. **Water (P&CP) Act, 1974**

Power & functions of regulatory agencies - responsibilities of Occupier Provision relating to prevention and control Scheme of Consent to establish, Consent to operate – Conditions of the consents – Outlet – Legal sampling procedures, State Water Laboratory – Appellate Authority – Penalties for violation of consent conditions etc. Provisions for closure/directions in apprehended pollution situation.

3. **Air (P&CP) Act, 1981**

Power & functions of regulatory agencies - responsibilities of Occupier Provision relating to prevention and control Scheme of Consent to establish, Consent to operate – Conditions of the consents – Outlet – Legal sampling procedures, State Air Laboratory – Appellate Authority – Penalties for violation of consent conditions etc. Provisions for closure/directions in apprehended pollution situation.

4. **Environment (Protection) Act 1986**

Genesis of the Act – delegation of powers – Role of Central Government - EIA Notification – Sitting of Industries – Coastal Zone Regulation - Responsibilities of local bodies mitigation scheme etc., for Municipal Solid Waste Management - Responsibilities of Pollution Control Boards under Hazardous Waste rules and that of occupier, authorisation – Biomedical waste rules – responsibilities of generators and role of Pollution Control Boards

5. **Other Topics**

Relevant Provisions of Indian Forest Act, Public Liability Insurance Act, CrPC, IPC - Public Interest Litigation - Writ petitions - Supreme Court Judgments in Landmark cases.

**References:**

1. CPCB, “Pollution Control acts, Rules and Notifications issued there under “Pollution Control Series – PCL/2/1992, Central Pollution Control Board, Delhi, 1997.
CE 955  ENVIRONMENTAL RISK ASSESSMENT AND MANAGEMENT

1. **Introduction**
   Sources of Environmental hazards – Environmental and ecological risks – Environmental risk assessment framework – Regulatory perspectives and requirements – Risk Analysis and Management and historical perspective; Social benefit Vs technological risks; Path to risk analysis; Perception of risk, risk assessment in different disciplines.

2. **Elements of Environmental Risk Assessment**

3. **Tools and Methods for Risk Assessment**

4. **Risk Management**

5. **Applications**

References:
1. **Introduction**


2. **Occupational Health and Hygiene**


3. **Workplace Safety and Safety Systems**

   Features of the satisfactory design of work premises HVAC, ventilation. Safe installation and use of electrical supplies. Fire safety and first aid provision. Significance of human factors in the establishment and effectiveness of safe systems. Safe systems of work for manual handling operations. Control methods to eliminate or reduce the risks arising from the use of work equipment. Requirements for the safe use of display screen equipment. Procedures and precautionary measures necessary when handling hazardous substances. Contingency arrangements for events of serious and imminent danger.

4. **Techniques of Environmental Safety**


5. **Education and Training**

   Requirements for and benefits of the provision of information, instruction, training and supervision. Factors to be considered in the development of effective training programmes. Principles and methods of effective training. Feedback and evaluation mechanism.

**References:**

1. Environmental and Health and Safety Management by Nicholas P. Cheremisinoff and Madelyn L. Graffia, William Andrew Inc. NY, 1995
INFRASTRUCTURE AND FACULTY REQUIREMENT FOR M.TECH (ENVIRONMENTAL ENGINEERING)

1. INFRASTRUCTURE

(i) Building Infrastructure

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<tr>
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<td>Project lab</td>
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(ii) Equipment Infrastructure

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<th>Facilities / Equipment/Accessories</th>
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<td>Rectangular water bath (thermostatically controlled) with six holes at the top</td>
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<tr>
<td>2</td>
<td>Distilled water plant complete unit made of capacity: 4.5 lit/hr, 3.0kw</td>
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<tr>
<td>3</td>
<td>Laboratory centrifuge 200ml capacity with step less control</td>
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<td>4</td>
<td>Gambacks hot air oven thermostatically controlled oven</td>
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<td>Refrigerator Godrej 165 lit capacity</td>
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<td>Jar testing apparatus for uniform stirring of up to six samples with 1 lit capacity</td>
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<td>Electronic micro analytical balance dual range</td>
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<td>Modiflame Flame photometer with filters and compressors</td>
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<td>Gas flow meter of capacity 0.50 liters</td>
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<td>Peristaltic pump of flow rate pp-20-2ml/hr</td>
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<tr>
<td>16</td>
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2. **LIBRARY**

   - Number of Books: 120
   - Titles: As required by the curriculum
   - Journals: 10 related National & International

3. **FACULTY REQUIREMENT**

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<tr>
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<tr>
<td>2</td>
<td>Associate Professor</td>
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<td>3</td>
<td>Assistant Professor</td>
<td>1</td>
<td>As per AICTE Norms</td>
<td>Environmental Engineering / Solid Waste Management / Industrial Waste Management</td>
</tr>
</tbody>
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4. **TEACHER TO STUDENT RATIO**: 1 : 12