M.Tech. (ENVIRONMENTAL ENGINEERING)

CURRICULUM AND SYLLABUS

(Effect from the Academic Year 2011 – 12)

DEPARTMENT OF CIVIL ENGINEERING

PONDICHERRY ENGINEERING COLLEGE

PUDUCHERRY – 605 014.

PONDICHERRY ENGINEERING COLLEGE
PUDUCHERRY

REGULATIONS FOR POST GRADUATE PROGRAMMES (CBCS)

M.Tech. in Civil Engineering (Environmental Engineering)

(w. e. f. July 2011)

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 programems subject to conforming to the relevant regualations 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
iii) Seminar / Directed Study / Industrial Training
iv) 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 (EE) (Full-Time) Programme

Sl. №	Description	Requirements
1	№ of Semesters	4
2	Min. № of credits of the programme	72
3	Max. №. of credits of the programme	75
4	Min. Cumulative Grade Point Average for pass	5
5	Min. Successful credits needed for registering in the next semester	Sem. I - 10
		Sem. II - 25
		Sem. III - 40
6	Min. period of completion of programme (continuous semesters)	4
7	Max. period of completion of programme (continuous semesters)	8
8	№ of Core and Elective subjects	12
9	Directed Study/Industrial Training	1
10	Laboratories / Seminar	2
11	Project work (in two semesters)	1

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 2: Letter Grade and the Corresponding Grade Point

GRADE	POINTS	DESCRIPTION
S	10	EXCELLENT
A	9	VERY GOOD
B	8	GOOD
C	7	ABOVE AVERAGE
D	6	AVERAGE
E	5	SATISFACTORY
F	0	FAILURE
FA	—	FAILURE DUE TO LACK OF ATTENDANCE/ FAILURE BY ABSENCE

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

Internal valuation

Guide	50 marks
First Evaluation	50 marks
Second Evaluation	50 marks
Total	**150 marks**

External valuation

Evaluation (External Examiner Only)		50 marks
Viva voce	Internal Examiner	50 marks
	External Examiner	50 marks
Total		**150 marks**

Project work – (Phase – II): 400 Marks

Internal valuation		External valuation		
Guide	100 marks	Evaluation (External Examiner Only)		50 marks
First Evaluation	50 marks	Viva voce	Internal Examiner	75 marks
Second Evaluation	50 marks		External Examiner	75 marks
Total	**200 marks**		Total	**200 marks**

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:

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

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 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.

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M.TECH. (ENVIRONMENTAL ENGINEERING)
COURSE CURRICULUM AND SCHEME OF EXAMINATION

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

SEMESTER – I

Sl. No	Code	Subject	Hours / Week			Credits	Evaluation (marks)		
			L	T	P		Internal	External	Total
1.	CE 911	Mathematics for Environmental Engineers	3	1	0	4	40	60	100
2.	CE 912	Environmental Chemistry	3	1	0	4	40	60	100
3.	CE 913	Environmental Microbiology	3	1	0	4	40	60	100
4.	CE 914	Principles and Design of Physico-Chemical Treatment Systems	3	1	0	4	40	60	100
5.		Elective – I	3	0	0	3	40	60	100
6.		Elective – II	3	0	0	3	40	60	100
7.	CE 917	Laboratory and Field Testing	1	0	3	2	50	50	100
						24	290	410	700

SEMESTER – II

Sl. No	Code	Subject	Hours / Week			Credits	Evaluation (marks)		
			L	T	P		Internal	External	Total
1.	CE 915	Principles and Design of Biological Treatment Systems	3	1	0	4	40	60	100
2.	CE 916	Transport of Water and Wastewater	3	1	0	4	40	60	100
3.		Elective – III	3	0	0	3	40	60	100
4.		Elective – IV	3	0	0	3	40	60	100
5.		Elective –V	3	0	0	3	40	60	100
6.		Elective – VI	3	0	0	3	40	60	100
7.	CE 918	Seminar	0	0	3	2	100	-	100
						22	340	360	700

S**EMESTER – III**

Sl. No	Code	Subject	Hours / Week			Credits	Evaluation (marks)		
			L	T	P		Internal	External	Total
1.	CE 971	Directed Study	0	0	6	3	100	---	100
2.	CE 919	Dissertation Project (Phase I)	0	0	24	9	150	150	300
						12	250	150	400

SEMESTER – IV

Sl. No	Code	Subject	Hours / Week			Credits	Evaluation (marks)		
			L	T	P		Internal	External	Total
1.	CE 920	Dissertation Project (Phase II)	0	0	36	14	200	200	400
						14	200	200	400

ELECTIVE SUBJECTS

Sl.No.	Code	Subject	Credits
1.	CE 941	Air and Water Quality Modelling	3
2.	CE 942	Air Pollution Control Engineering	3
3.	CE 943	Cleaner Production and Environmental management	3
4.	CE 944	Ecological Engineering	3
5.	CE 945	Environmental Biotechnology	3
6.	CE 946	Environmental Geotechnology	3
7.	CE 947	Environmental Impact Assessment	3
8.	CE 948	Fundamentals of Sustainable Development	3
9.	CE 949	Industrial Wastewater Management	3
10.	CE 950	Instrumental Monitoring of Environment	3
11.	CE 951	Principles of Environmental Science	3
12.	CE 952	Remote Sensing and GIS Applications in Environmental Engineering	3
13.	CE953	Solid and Hazardous Waste Management	3
14.	CE 954	Environmental Policies and Legislation	3
15.	CE 955	Environmental Risk Assessment and Management	3
16.	CE 956	Environment, Health and Safety in Industries	3

CE 911 MATHEMATICS FOR ENVIRONMENTAL ENGINEERS

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:

1. Freund, J.E. and Miller,I.R., "Probability and Statistics for Engineers", Prentice – Hall of India,5th Edition, New Delhi,1994.

2. Gupta, S.C. and Kapur, V.K., Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi, 1999.

3. Taha, H.A., "Operations Research: An Introduction", Prentice – Hall of India, 6th Edition, New Delhi, 1997.

4. Kapoor.V.K., "Problems and Solutions in Operations Research", Sultan Chand & Sons, New Delhi,1997.

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 BioChemsitry**
   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

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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 sulfurous 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, fluorimety, nephlometry, turbidimetry, absorption and emission spectral methods.

References

1. C.N Sawyer, P.L McCarty and G.F Parkin, Chemistry for Environmental Engineering and Science, 5th ed. Tata McGraw-Hill, 2003
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:

Distribution of microorganisms, indicator organisms, coliforms – fecal coliforms – E.coli, Streptococcus fecalis and Clostridium welchii, differentiation of coliforms – significance – MPN index, M.F. technique, standards. Virus-concentration techniques. Algae in water supplies – problems and control.

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

Ecotoxicology – toxicants and toxicity – factors influencing toxicity, effects, acute, chronic, concentration response relationships, test organisms, toxicity testing bioconcentration – bioaccumulation – bio-magnification – bioassay – biomonitoring.

References:

1. Pelczar, Jr, M.J., Chan E.C.S., Krieg, R.Noel., and Pelczar Merna Foss, Microbiology, 5thEdition, Tata McGraw Hill Publishing Company Limited, New Delhi, 1996.

2. Stainer, R.Y., Ingrahum, J.L., Wheelis, M.C. and Painter, P.R. General Microbiology, Mac Millan Edition Limited, London, 1989.

3. Pichai, R. and Govindan, V.S., Edition, Biological processes in pollution control Anna University, Madras, 1988.

CE 914 PRINCIPLES AND DESIGN OF PHYSICO-CHEMICAL TREATMENT SYSTEMS

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

Principles of Screening – Mixing, Equalization – Sedimentation – Filtration – Modeling back washing – Evaporation – Incineration – gas transfer – mass transfer coefficient Adsorption – Isotherms – Principles, kinetics, regeneration membrane separation, Reverse Osmosis, nano filtration, ultra filtration and hyper filtration electrodialysis, distillation – stripping and crystallization – Recent Advances.

3. Chemical Treatment Principles

Principles of Chemical treatment – Coagulation flocculation – Precipitation – flotation solidification and stabilization – Disinfection, Ion exchange, Electrolytic methods, Solvent extraction – advanced oxidation /reduction – Recent Trends

4. Design of Water Treatment Plants

Selection of Treatment – Design of municipal water treatment plant units – Aerators – chemical feeding – Flocculation – clarifies – tube settling – filters – Rapid sand filters slow sand filter, pressure filter, Dual media inlets Displacement and gaseous type. Design of Industrial Water Treatment Units- Selection of process – Design of softeners – Demineralisers –Reverse osmosis plants –flow charts – Layouts –Hydraulic Profile PID construction and O&M aspects – case studies, Residue and rejects management – Upgradation of existing plants – Recent Trends – Software application.

5. Design of Wastewater Treatment Plants

Design of municipal wastewater treatment units-screens-detritors-grit chamber-settling tanks-sludge thickening-sludge dewatering systems-sludge drying beds - Design of Industrial Wastewater Treatment Units-Equalization- Neutralization-Chemical Feeding Devices-mixers-floatation units-oil skimmer- flow charts – Layouts –Hydraulic Profile PID construction and O&M aspects – case studies, Residue management – Upgradation of existing plants – Recent Trends – Software application.

References:

1. Metcalf and Eddy, Wastewater Engineering, Treatment and Reuse, Tata McGraw Hill, New Delhi, 2003.

2. Qasim, S.R., Motley, E.M. and Zhu.G. Water works Engineering – Planning, Design and Operation, Prentice Hall, New Delhi, 2002.
3. Lee, C.C. and Shun dar Lin, Handbook of Environmental Engineering Calculations, Mc Graw Hill, New York, 1999.
4. Hendricks, D. 'Water Treatment Unit Processes – Physical and Chemical' CRC Press, New York 2006

CE 915 PRINCIPLES AND DESIGN OF BIOLOGICAL TREATMENT SYSTEM

1 PRINCIPLES

Objectives of biological treatment – significance – aerobic and anaerobic treatment kinetics of biological growth – Factors affecting growth – attached and suspended growth Determination of Kinetic coefficients for organics removal – Biodegradability assessment -selection of process- reactors-batch-continuous type-kinetics

2. DESIGN OF AEROBIC TREATMENT SYSTEMS

Design of sewage treatment plant units –Activated Sludge process and variations, Sequencing Batch reactors, Membrane Biological Reactors-Trickling Filters-Bio Tower-RBC-Moving Bed Reactors-fluidized bed reactors, aerated lagoons, waste stabilization ponds – nutrient removal systems – natural treatment systems, constructed wet land – Disinfectant – disposal options – reclamation and reuse – Flow charts, layout, hydraulic profile, recent trends.

3. ANAEROBIC TREATMENT OF WASTEWATER

Attached and suspended growth, Design of units – UASB, up flow filters, Fluidized beds, septic tank and disposal – Nutrient removal systems – Flow chart Layout and Hydraulic profile – Recent trends.

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

Construction and Operational Maintenance problems – Trouble shooting – Planning, Organising and Controlling of plant operations – capacity building, Case studies – sewage treatment plants – sludge management facilities.

REFERENCES:

1. Arceivala, S.J., Wastewater Treatment for Pollution Control, TMH, New Delhi, Second Edition, 2000.
2. Manual on "Sewerage and Sewage Treatment" CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 1999.

3. Metcalf & Eddy, INC, 'Wastewater Engineering – Treatment and Reuse, Fourth Edition, Tata Mc Graw-Hill Publishing Company Limited, New Delhi, 2003.
4. Qasim, S.R. Wastewater Treatment Plant, Planning, Design & Operation, Technomic Publications, New York, 1994.

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.

3. **Water distribution systems:** Water distribution pipe networks, Methods, Design, analysis and optimization – appurtenances – corrosion prevention – minimization of water losses – leak detection Storage reservoirs. Use of computer software in water transmission and water distribution.

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. Bajwa, G.S. Practical Handbook on Public Health Engineering, Deep Publishers, Simla, 2003
2. "Manual on water supply and Treatment", CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 1999.
3. "Manual on Sewerage and Sewage Treatment", CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 1993.

CE 917 LABORATORY AND FIELD TESTING

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

Media preparation and inoculation – staining – environmental factors – bacteriological analysis of water, sewage, test for plate count – coliforms – fecal coliforms – E.coli – S.fecalis – M.P.N. and M.F. techniques. Techniques for studying aquatic organisms – identification of phytoplankton and zooplankton – bioassay study and biodegradation.

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:

1. Sawyer, C.N. and McCarty, P.L. and Parkin, G.F. "Chemistry for Environmental Engineers", 4th Edition, McGraw Hill, New Delhi, 1994.

2. De.A.K. "Environmental Chemistry ", New Age International Ltd., New Delhi, 1995.

3. "Standard Methods for the Examination of Water and Wastewater", 21th Edition, American Public Health Association, Washington. D.C. 2005.

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.

CE 941 AIR AND WATER QUALITY MODELLING

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:

Historical development of water quality models; rivers and streams water quality modeling – river hydrology and flow – low flow analysis – dispersion and mixing – flow, depth and velocity – estuaries – estuarine transport, net estuarian flow, estuary dispersion coefficient; Lakes and impoundments – Water quality response to inputs; water quality modeling process – model sensitivity – assessing model performance; Models for dissolved oxygen, pathogens; Streeter – Phelps models.

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:

2. Steven C.Chapra, Surface Water Quality Modeling, The McGraw-Hill Companies, Inc., New York, 1997.
3. R.W.Boubel, D.L. Fox, D.B. Turner & A.C. Stern, Fundamentals of Air Pollution Academic Press, New York, 1994.
4. Ralph A. Wurbs, Water Management Models – A Guide to Software, Prentice Hall. PTR, New Jersey, 1995.

CE 942 AIR POLLUTION CONTROL ENGINEERING

1. Introduction:

Sources and classification of Air Pollutants: Natural contaminants-aerosol – gases and vapour. Air quality standards – Meteorology and Air Pollution: Atmospheric stability and inversions-mixing height-plume rise estimation – effluent dispersion theories - Isokinetic sampling – Modelling.

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:

Absorption: principles, description of equipment-packed and plate columns, design and performance equations. Adsorption: principal adsorbents, equipment descriptions – PSA – adsorption cycle-solvent recovery system-continuous rotary bed-fluidized bed, Design and performance equations. Condensation: contact condensers-shell and tube condensers, design and performance equation. Incineration: hydrocarbon incineration kinetics, equipment description, design and performance equations.

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 airquality management

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

References:

1. Richard W. Boubel et al "Fundamentals of Air pollution", Academic Press, New York, 1994.
2. Noel de Nevers, Air Pollution control Engineering, McGraw Hill, New York, 1995.
3. M.N. Rao et al, "Air Pollution" Tata McGraw Hill, 1989.

CE 943 CLEANER PRODUCTION and ENVIRONMENTAL MANAGEMENT

1. **Introduction:**
   Sustainable Development – Indicators of Sustainability – Sustainability Strategies Barriers to Sustainability – Industrial activity and Environment – Industrialization and sustainable development – Industrial Ecology – clean development mechanism, Cleaner Production (CP) in Achieving Sustainability – Prevention versus Control of Industrial Pollution – Environmental Polices and Legislations – Regulations to Encourage Pollution Prevention and Cleaner Production – Regulatory versus Market-Based Approaches.

2. **Principles Cleaner Production:**

   Definition – Importance – Historical evolution – Benefits – Promotion – Barriers – Role of Industry, Government and Institutions – Environmental Management Hierarchy – Source Reduction Techniques – Process and equipment optimization, reuse, recovery, recycle, raw material substitution – Internet Information & Other CP Resources.

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

   Overview of CP Assessment Steps and Skills, Preparing for the Site, Visit, Site, Visit, Information Gathering, and Process Flow Diagram, Material Balance, CP Option Generation – Technical and Environmental Feasibility analysis – Economic valuation of alternatives - Total Cost Analysis – CP Financing – Establishing a Program – Organizing a Program – Preparing a Program Plan – Measuring Progress – Pollution Prevention and Cleaner Production Awareness Plan – Waste audit – Environmental Statement, carbon credit, carbon sequestration, carbon trading,

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

   Elements of LCA – Life Cycle Costing – Eco Labelling – Design for the Environment – International Environmental Standards – ISO 14001 – Environmental audit, Green building & green energy concepts and management

5. **Case Studies:**

   Industrial applications of CP, LCA, EMS and Environmental Audits, green energy and green process management.

References:

1. Paul L Bishop (2000) 'Pollution Prevention : Fundamentals and Practice', McGraw Hill International.
2. World Bank Group (1998) 'Pollution Prevention and Abatement Handbook – Towards Cleaner Production', World Bank and UNEP, Washington D.C.
3. Prasad Modak, C.Visvanathan and Mandar Parasnis (1995) 'Cleaner Production Audit', Environmental System Reviews, No.38, Asian Institute of Technology, Bangkok.

CE 944 ECOLOGICAL ENGINEERING

1. Introduction to Ecology and Ecological Engineering

Aim – scope and applications of Ecology, Ecological Engineering and Ecotechnology and their relevance to human civilization – Development and evolution of ecosystems – Principles and concepts pertaining to communities in ecosystem – Energy flow and material cycling in ecosystems – Productivity in ecosystems.

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:

Self-organizing processes – Multiple seeded microcosms – Interface coupling in ecological systems. Concepts of energy – Adapting ecological engineering systems to potentially catastrophic events – Agro ecosystems – Determination of sustainable loading of ecosystems.

4. Ecotechnology for Waste Treatment:

Principles and operation of soil infiltration systems – wetlands and ponds – source separation systems – aquacultural systems – detritus based treatment for solid wastes – Applications of ecological engineering marine systems.

5. Case Studies:

Case studies of integrated ecological engineering systems.

References:

1. Mitsch, J.W & Jorgensen, S.E., Ecological Engineering – An Introduction to Ecotechnology, John Wiley & Sons, New York, 1989.
2. White, I.D, Mottershed, D.N and Harrison, S.L., Environmental Systems – An Introductory Text, Chapman Hall, London, 1994.

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.

Degradation of high concentrated toxic pollutants – non-halogenated – halogenated-petroleum hydrocarbons – metals. Mechanisms of detoxification – oxidation reactions, dehalogenation – biotransformation of metals. Microbial cell/ enzyme technology – adapted microorganisms – biological removal of nutrients – microalgal biotechnology and applications in agriculture – role of extracellular polymers.

3. Microbial Technology for Waste Management:

Biotechnological remedies for environmental damages – decontamination of ground water systems – subsurface environment – reclamation concepts – bioremediation. Production of proteins – biofertilizers. Biodegradation of solid wastes – physical, chemical and microbiological factors of composting – health risk – pathogens – odour management – technologies of commercial importance advances in biogas technology – case study.

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:

1. Wainwright, M, An Introduction to Environmental Biotechnology, 1999.
2. Martin, A.M., Biological Degradation of Wastes, Elsevier Appl. Science, New York, 1991.
3. Sayler, Gray S. Robert Fox and James W. Blackburn Environmental Biotechnology for Waste Treatment, Plenum Press, New York, 1991.
4. Bruce E. Rittmann, Eric Seagren, Brian A.Wrenn and Albert J. Valocchi, Chittaranjan Ray, Lutgarde Raskin, Insitu Bioremediation (2nd Edition) Nayes Publication, U.S.A, 1991.
5. Old R.W., and Primrose, S.B., Principles of Gene Manipulation (3rd Edition) Blackwell Science Publication, Cambridge, 1985.

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**
   Safe disposal of waste – site selection for land fills – characterization of land fill sites – waste characterization –stability of land fills – current practice of waste disposal- passive contaminant system - Hazardous waste control and storage system – mechanism of stabilization -solidification of wastes – micro and macro encapsulation – absorption, adsorption, precipitation- detoxification — organic and inorganic stabilization

3. **Transport of Contaminants:**
   Contaminant transport in sub surface – advection – diffusion – dispersion – governing equations – contaminant transformation – sorption – biodegradation – ion exchange – precipitation – hydrological consideration in land fill design – ground water pollution – bearing capacity of compacted fills – pollution of aquifers by mixing of liquid waste – protecting aquifers.

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:**
   Rational approach to evaluate and remediate contaminated sites – monitored natural attenuation – exsitu and insitu remediation – solidification, bio – remediation, incineration, soil washing, electro kinetics, soil heating, verification, bio venting – Ground water remediation – pump and treat, air sparging, reactive well- application of geo synthetics in solid waste management – rigid or flexible liners.

R**eferences**:

1. Wentz, C.A., Hazardous Waste Management, McGraw Hill, Singapore, 1989.
2. Daniel, B.E., Geotechnical practice for waste disposal, Chapman and Hall, London, 1993.
3. Fang, H.Y. Introduction to environmental Geotechnology, CRC press New York, 1997.
4. Lagrega, M.d., Bukingham, P.L., and Evans, J.C., Hazardous Waste Management, McGraw Hill, Inc. Singapore, 1994.

CE 947 ENVIRONMENTAL IMPACT ASSESSMENT

1. Introduction

Historical development of Environmental Impact Assessment (EIA). EIA in Project Cycle. Legal and Regulatory aspects in India. – Types and limitations of EIA – Cross sectoral issues and terms of reference in EIA – Public Participation in EIA. EIA process- screening – scoping - setting – analysis – mitigation

2. Components And Methods For Eia

Matrices – Networks – Checklists – Connections and combinations of processes - Cost benefit analysis – Analysis of alternatives – Software packages for EIA – Expert systems in EIA. Prediction tools for EIA – Mathematical modeling for impact prediction – Assessment of impacts – air – water – soil – noise – biological — Cumulative Impact Assessment – Documentation of EIA findings – planning – organization of information and visual display materials – Report preparation. EIA methods in other countries.

3. Socio-Economic Impact Assessment

Definition of social impact assessment. Social impact assessment model and the planning process. Rationale and measurement for SIA variables. Relationship between social impacts and change in community and institutional arrangements. Individual and family level impacts. Communities in transition - neighborhood and community impacts. Selecting, testing and understanding significant social impacts. Mitigation and enhancement in social assessment. Environmental costing of projects.

4. Environmental Management Plan

Environmental Management Plan - preparation, implementation and review – Mitigation and Rehabilitation Plans – Policy and guidelines for planning and monitoring programmes – Post project audit – Ethical and Quality aspects of Environmental Impact Assessment.

5. Sectoral EIA

EIA related to the following sectors - Infrastructure –construction and housing Mining – Industrial - Thermal Power - River valley and Hydroelectric – coastal projects-Nuclear Power. EIA for coastal projects.

References:

1. Lawrence, D.P., Environmental Impact Assessment – Practical solutions to recurrent problems, Wiley-Interscience, New Jersey, 2003.
2. World Bank –Source book on EIA
3. Petts, J., Handbook of Environmental Impact Assessment, Vol., I and II, Blackwell Science, London, 1999.
4. Canter, L.W., Environmental Impact Assessment, McGraw Hill, New York. 1996

CE 948 FUNDAMENTALS OF SUSTAINABLE DEVELOPMENT

1. Principles of Sustainable Development:

History and emergence of the concept of Sustainable Development – Definitions – Environmental issues and crisis – Resource degradation – green house gases – desertification – social insecurity – Industrialization – Globalization and Environment.

2. Indians Judiciary System & Sustainable Development:

Judicial System in India – Induction of sustainability concepts through legal systems – concepts – principles – doctrines – case laws.

3. Sustainable Development and International Contribution:

Components of sustainability – Complexity of growth and equity – International Summits – Conventions – Agreements – Transboundary issues – Action plan for implementing sustainable development – Moral obligations and Operational guidelines.

4. Socio-economic Sustainable Development Systems:

Socio-economic policies for sustainable development – Strategies for implementing ecodevelopment programmes – Sustainable development through trade – Economic growth – Carrying Capacity – Public participation.

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. Kirkby, J., O' Keefe, P. and Timberlake, Sustainable Development, Earthscan Publication, London,1996.
2. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998.
3. Bowers, J., Sustainability and Environmental Economics – an alternative text, Longman, London, 1997.

CE 949 INDUSTRIAL WASTEWATER MANAGEMENT

1. Introduction

Industrial scenario in India– Industrial activity and Environment - Uses of Water by industry – Sources and types of industrial wastewater – Nature and Origin of Pollutants - Industrial wastewater and environmental impacts – Regulatory requirements for treatment of industrial wastewater – Industrial waste survey – Industrial wastewater monitoring and sampling - generation rates, characterization and variables –Toxicity of industrial effluents and Bioassay tests – Major issues on water quality management

2. Industrial Pollution Prevention

Prevention and Control of Industrial Pollution – Benefits and Barriers – Waste management Hierarchy - Source reduction techniques – Pollution Prevention of Assessment - Material balance - Evaluation of Pollution prevention options –Cost benefit analysis – pay back period - Waste minimization Circles

3. Industrial Wastewater Treatment

Equalisation - Neutralisation – Oil separation – Flotation – Precipitation – Heavy metal Removal– Aerobic and anaerobic biological treatment – Sequencing batch reactors – High Rate reactors - Chemical oxidation – Ozonation – carbon adsorption - Photocatalysis – Wet Air Oxidation – Evaporation – Ion Exchange – Membrane Technologies – Nutrient removal.- Treatability studies.

4. Wastewater Reuse And Residual Management

Individual and Common Effluent Treatment Plants – Joint treatment of industrial and domestic wastewater - Zero effluent discharge systems - Quality requirements for Wastewater reuse – Industrial reuse , Present status and issues - Disposal on water and land – Residuals of industrial wastewater treatment – Quantification and characteristics of Sludge – Thickening, digestion, conditioning, dewatering and disposal of sludge – Management of RO rejects.

5. Case Studies

Industrial manufacturing process description, wastewater characteristics, source reduction options and waste treatment flow sheet for Textiles – Tanneries – Pulp and paper – metal finishing – Oil Refining – Pharmaceuticals – Sugar and Distilleries.

References:

1. Eckenfelder, W.W., 'Industrial Water Pollution Control', Mc-Graw Hill, 2000.
2. Nelson Leonard Nemerow, "Industrial waste treatment – contemporary practice and vision for the future", Elsevier, Singapore, 2007
3. Frank Woodard, 'Industrial waste treatment Handbook', Butterworth Heinemann, New Delhi, 2001.

4. World Bank Group, 'Pollution Prevention and Abatement Handbook – Towards Cleaner Production', World Bank and UNEP, Washington D.C., 1998
5. Paul L. Bishop, 'Pollution Prevention: - Fundamentals and Practice', Mc-Graw Hill International, Boston, 2000.

CE 950 INSTRUMENTAL MONITORING OF ENVIRONMENT

1. Basics of Measurement

Classification of instrumental methods, signals and noise- sources of noise, noise reduction. Sensitivity and detection limit. Errors-types, expression of errors. Precision and accuracy-methods of expressing an accuracy- methods of expressing precision and accuracy. Calibration of instrumental methods-calibration curves, standard addition and internal standard methods – theory

2. Spectroanalytical Methods

Electromagnetic radiation- properties, emission and absorption of radiation. Fluorescence and Phosphorescence. Atomic absorption and emission spectrometry- principle and instrumentation. ICP source. Fluorimetry, nephelometry and turbidimety- principle and instrumentation. Ultraviolet-visible spectrophotometry principle and instrumentation. Beer's law.

3. **Chromatographic Methods**

Classification, general theory- column efficiency and resolution, band broadening. Evaluation methods, quantitative determination . Principle and instrumentation of gas chromatography and HPLC. Ion exchange chromatography and size exclusion chromatography. Mass spectrometry.

4. Electro analytical Methods

Potentiomety- electrochemical cell, reference electrodes, Glass electrode. Measurement of pH . Potentiometric titrations. Ion – selective electrodes. Conductomety- electrolytic conductivity- specific, equivalent and molar conductance. Conductance cells, conductivity meters. Conductometric titrations. Coulometry and polarography

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.

SO_2 , flow injection analysis and CHN analyzer.

References:

1. H.H, Willard, L.L Merit, J.A. Dean and F.A. Settle, Instrumental Methods of Analysis, 7th Ed. CBP Publishers and Distributors, New Delhi 1986
2. D.A.Skoog, D,M, West and T.A Nieman, Principles of Instrumental Analysis, 5th Ed. Thomson Asion (P) Ltd. Singapore, 2004
3. J. Mendham, R.C Denney, J.D Barnes and M.Thomas, Vogel's Textbook of Quantitative Chemical analysis, 6th Ed. Pearson Education Ltd New Delhi 2002.

CE 951 PRINCIPLES OF ENVIRONMENTAL SCIENCE

1. Introduction:

Structure of Environment – interaction between biological and chemical components – Law of Mass Action – Chemical equilibria – Chemical kinetics – Colloidal Chemistry – catalysis and Photocatalysis – Corrosion and its control.

2. Biological Systems:

Plants – Animals – distribution – interaction – biomass – classification – salient features – nutrients and microorganisms – environmental factors.

3. Microbiology of Environment:

Microbiology of water – soil – air. Indicator organisms, - coliforms – MPN index – M.F. technique – Biological indices. Biomonitoring methods – Eutrophication. Biological treatment of wastewater – bacterial reductions. Algae in water supply systems – problems and control. Macrophytes in water bodies –role – control.

4. Chemistry of Aquatics:

Common organic reactions – Enzymes and factors influencing enzymic reactions – Pesticides and syndets – Transformation and degradation of pollutants.

5. Chemistry of Atmosphere:

Structure of the atmosphere – Photochemistry of the atmosphere – ozone layer depletion – Acid rain – Greenhouse gases and global warming.

References:

1. Biswarup Mukherjee, Environmental Biology, Tata McGraw Hill Publishing Company Limited, New Delhi, 1997.
2. Manohaan, S.E., Environmental Science and Technology, Lewis Publication, New York, 1997.
3. Sawyer, C.N., McCarty, P.L. and Parkin, G.F. Chemistry for Environmental Engineers, 4th Edition, McGraw Hill, New Delhi, 1994.
4. De, A.K. Environmental Chemistry, New Age International Limited, New Delhi, 1995.

CE 952 REMOTE SENSING AND GIS APPLICATIONS IN ENVIRONMENTAL ENGINEERING

1. Remote sensing

Definition – Components of Remote Sensing - Energy, Sensor, Interacting Body - Active and Passive Remote Sensing – Platforms – Aerial and Space Platforms - Balloons, Helicopters, Aircraft and Satellites- Synoptivity and Repetivity - Electro Magnetic Radiation (EMR) – EMR Spectrum – Visible, Infra Red (IR), Near IR, Middle IR, Thermal IR and Microwave – Black Body Radiation – Planck's Law - Stefan- Boltzman law.

2. Emr Interaction With Atmosphere And Earth Materials

Atmosphere characteristics - Scattering of EMR - Raleigh, Mie, Non –Selective and Raman Scattering – EMR Interaction with water vapour and ozone – Atmosphere Windows – Significance of Atmospheric Windows - EMR interaction with earth surface Materials – Radiance , Irradiance , Incident , Reflected , Absorbed and Transmitted Energy – Reflectance – Specular and Diffuse Reflection Surfaces – Spectral Signature – Spectral Signature curves – EMR interaction with water, soil, and Earth surface

3. Optical And Microwave Remote Sensing

Satellites – Classification – Based on Orbits – Sun Synchronous and Geo Synchronous – Based on Purpose – Earth Resources Satellites, Communication Satellites, Weather Satellites, Spy Satellites, Satellite Sensors, Resolution – Spectral , Spatial Radiometric and Temporal Resolution – Description of Multi Spectral Scanning – Along and Across Track scanners – Description of Sensors in Landsat, SPOT, IRS series – Current Satellites – Radar – Speckle – Back Scattering – Side Looking Airborne Radar - Synthetic Aperture Radar – Radiometer – Geometrical characteristics

4. Geographic Information System

GIS - Components of GIS – Hardware, Software and Organization Context – Data – Spatial and Non Spatial – Maps – Types of Maps – Projection – Types of Projection – Data Input – Digitizer, Scanner - Editing - Raster and Vector data structures - Comparison of Raster and Vector Date structure – Analysis using raster and Vector Data - Retrieval , Reclassification , Overlaying, Buffering – Data Output – Printers and Plotters.

5. Miscellaneous Topics

Visual Interpretation of Satellite Images - Elements of Interpretation - Interpretation Keys Characteristics of Digital Satellite Image - Image enhancement - Filtering - Classification – Integration of GIS and Remote Sensing – Application Remote Sensing and GIS in Environmental Engineering – management and monitoring of land , air , water pollution, conservation of resources and coastal zone management.

References:

1. Lilliesand, T.M and Kiefer, R.W., Remote Sensing and Image Interpretation , John Wiley and Sons, 1994.

2. Burrough, P.A and McDonnel, R.A., Principles of Geographic Information Systems, Oxford university press,1998
3. Lintz,J. and Simonet , Remote sensing of Environment, Addison Wesley Pub. Com., 1994
4. Chang , K.T., Introduction to Geographic Information Systems, Tata McGraw – Hill ,2006

CE 953 SOLID AND HAZARDOUS WASTE MANAGEMENT

1. **Municipal Solid Waste Management:**
   Legal and Organizational foundation: Definition of solid waste – waste generation technological society – major legislation, monitoring responsibilities, sources and types of solid waste – sampling and characterization – Determination of composition of MSW – storage and handling of solid waste – Future changes in waste composition.

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 fir 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:**
   Definition and identification of hazardous wastes-sources and characteristics – hazardous wastes in Municipal Waste – Hazardous waster regulations – minimization of Hazardous Waste-compatibility, handling and storage of hazardous waste-collection and transport, e-waste - sources, collection, treatment and reuse 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. George Techobanoglous et al, "Integrated Solid Waste Management", McGraw-Hill Publication, 1993.
2. Charles A. Wentz; ""Hazardous Waste Management", McGraw Hill Publication, 1995.

CE 954 ENVIRONMENTAL POLICIES AND LEGISLATION

1. Introduction

Indian Constitution and Environmental Protection – National Environmental policies – Precautionary Principle and Polluter Pays Principle – Concept of absolute liability – multilateral environmental agreements and Protocols – Montreal Protocol, Kyoto agreement, Rio declaration – Environmental Protection Act, Water (P&CP) Act, Air (P&CP) Act – Institutional framework (SPCB/CPCB/MoEF)

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.
2. Shyam Divan and Armin Roseneranz "Environmental law and policy in India "Oxford University Press, New Delhi, 2001.
3. Greger I.Megregor, "Environmental law and enforcement", Lewis Publishers, London. 1994.

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

Hazard identification and accounting – Fate and behaviour of toxics and persistent substances in the environment – Properties, processes and parameters that control fate and transport of contaminants – Receptor exposure to Environmental Contaminants – Dose Response Evaluation – Exposure Assessment – Exposure Factors, Slope Factors, Dose Response calculations and Dose Conversion Factors – Risk Characterization and consequence determination – Vulnerability assessment – Uncertainty analysis.

3. Tools and Methods for Risk Assessment

HAZOP and FEMA methods – Cause failure analysis – Event tree and fault tree modeling and analysis – Multimedia and multipath way exposure modeling of contaminant migration for estimation of contaminant concentrations in air, water, soils, vegetation and animal products – Estimation of carcinogenic and non carcinogenic risks to human health – Methods in Ecological risk assessment – Probabilistic risk assessments – radiation risk assessment – Data sources and evaluation.

4. Risk Management

Risk communication and Risk Perception – comparative risks – Risk based decision making – Risk based environmental standard setting – Risk Cost Benefit optimization and tradeoffs – Emergency Preparedness Plans – Emergency planning for chemical agent release – Design of risk management programs – risk based remediation; Risk communication, adaptive management, precaution and stake holder involvement.

5. Applications

Case studies on risk assessment and management for hazardous chemical storage – Chemical industries – Tanneries – Textile industries – Mineral processing and Petrochemical plants – Hazardous waste disposal facilities – nuclear power plants – contaminated site remediation – Case histories on Bhopal, Chernobyl, Seveso, Three Mile Island.

References:

1. Cutter, S.L., Environmental Risk and Hazards, Prentice-Hall of India Pvt. Ltd., New Delhi, 1999.
2. Kolluru Rao, Bartell Steven, Pitblado R and Stricoff, "Risk Assessment and Management Handbook", McGraw Hill Inc., New York, 1996.
3. Kofi Asante Duah, "Risk Assessment in Environmental management", John Wiley and sons, Singapore, 1998.
4. Kasperson, J.X. and Kasperson, R.E. and Kasperson,R.E., Global Environmental Risks, V.N.University Press, New York, 2003.
5. Risks and Decisions for Conservation and environmental management, Mark Burman, Cambridge University Press.

6. Susan L |Cutter, "Environmental Risks and Hazards" Prentice Hall of India, New Delhi, 1999.
7. Joseph F Louvar and B Diane Louver, Health and Environmental Risk Analysis fundamentals with applications, Prentice Hall, New Jersey, 1997.

CE 956 ENVIRONMENT, HEALTH and SAFETY IN INDUSTRIES

1. Introduction

Need for developing Environment, Health and Safety systems in work places. Status and relationship of Acts, Regulations and Codes of Practice. Role of trade union safety representatives. International initiatives. Ergonomics and work place.

2. Occupational Health and Hygiene

Definition of the term occupational health and hygiene. Categories of health hazards. Exposure pathways and human responses to hazardous and toxic substances. Advantages and limitations of environmental monitoring and occupational exposure limits. Hierarchy of control measures for occupational health risks. Role of personal protective equipment and the selection criteria. Effects on humans, control methods and reduction strategies for noise, radiation and excessive stress.

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

Elements of a health and safety policy and methods of its effective implementation and review. Functions and techniques of risk assessment, inspections and audits. Investigation of accidents- Principles of quality management systems in health and safety management. Relationship between quality manuals, safety policies and written risk assessments. Records and other documentation required by an organisation for health and safety. Industry specific EHS issues.

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

2. The Facility Manager's Guide to Environmental Health and Safety by Brian Gallant, Government Inst Publ., 2007.
3. Effective Environmental, Health, and Safety Management Using the Team Approach by Bill Taylor, Culinary and Hospitality Industry Publications Services 2005

INFRASTRUCTURE AND FACULTY REQUIREMENT FOR M.TECH (ENVIRONMENTAL ENGINEERING)

1. INFRASTRUCTURE

(i) Building Infrastructure

Sl.No.	Building Details	Area (sq.m)
1	Class/Tutorial room	35
2	Laboratory	100
3	Project lab	50

(ii) Equipment Infrastructure

Sl No	Facilities / Equipment/Accessories	Qty.
1	Rectangular water bath (thermostatically controlled) wiyh six	10
2	holes at the top	2
3	Distilled water plant complete unit made of capacity:4.5 lit/ hr	2
4	3.0kw	2
5	Laboratory centrifuge 200ml capacity with step less control	2
6	Gambacks hot air oven thermostatically controlled oven	2
7	Refrigerator Godrej 165 lit capacity	1
8	Jar testing apparatus for uniform stirring of upto six samples	1
9	with 1 lit capacity	1
10	Lab Autoclave- Vertical Cat no : tsi 402 chamber size : 300 mm x 500mm depth	2
11	Muffle furnace : max working temperature 930oc rating 2kw	1
12	SHIMADZU UV visible recording double beam spectro	1
13	photometer with 2nm spectro band width wavelength 200 -	2
14	1100 220v , 50hz	4
15	Electronic micro analytical balance dual range	6
16	Digital nephelo turbidity meter with instruction manual	2
17	Modi flame" Flame photometer with filters and compressors	4
	Hybrid uasb reactor lab scale standard type, Vertical coloumn reactor	
	Gas flow meter of capacity 0.50 litres	
	Peristaltic pump of flow rate pp- 20-2ml / hr	
	Hybrid uasb reactor lab scale standard type, Vertical coloumn reactor	

	Gas flow meter of capacity 0.50 liters	

2. LIBRARY

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

3. FACULTY REQUIREMENT

Sl.No.	Cadre	No.	Qualification	Specialization
1	Professor	1	As per AICTE Norms	Environmental Engineering / Ground Water Modeling / Water and Waste Water Engineering
2	Associate Professor	1	As per AICTE Norms	Environmental Engineering /Air and Water Quality Modeling / Environmental Management
3	Assistant Professor	1	As per AICTE Norms	Environmental Engineering / Solid Waste Management / Industrial Waste Management

4. **TEACHER TO STUDENT RATIO : 1 : 12**