HINDUSTAN UNIVERSITY

HINDUSTAN INSTITUTE OF TECHNOLOGY & SCIENCE

(Estd. u/s 3 of the UGC Act, 1956)

Padur, Kancheepuram District - 603 103.

DEPARTMENT OF CIVIL ENGINEERING

Regulations Curriculum and Syllabus 2013

M.Tech. ENVIRONMENTAL ENGINEERING

ACADEMIC REGULATIONS
(M.TECH./ M.B.A. / M.C.A.) (Full - Time / Part - Time)
(Effective 2013-14)

1. Vision, Mission and Objectives

1.1 The Vision of the Institute is "To make every man a success and no man a failure".

In order to progress towards the vision, the Institute has identified itself with a mission to provide every individual with a conducive environment suitable to achieve his / her career goals, with a strong emphasis on personality development, and to offer quality education in all spheres of engineering, technology, applied sciences and management, without compromising on the quality and code of ethics.

1.2 Further, the institute always strives

- To train our students with the latest and the best in the rapidly changing fields of Engineering, Technology, Management, Science & Humanities.
- To develop the students with a global outlook possessing, state of the art skills, capable of taking up challenging responsibilities in the respective fields.
- To mould our students as citizens with moral, ethical and social values so as to fulfill their obligations to the nation and the society.
- To promote research in the field of science, Humanities, Engineering, Technology and allied branches.

1.3 Our aims and objectives are focused on

- Providing world class education in engineering, technology, applied science and management.
- Keeping pace with the ever changing technological scenario to help our students to gain proper direction to emerge as competent professionals fully aware of their commitment to the society and nation.
- To inculcate a flair for research, development and entrepreneurship.

2. Admission

2.1 The admission policy and procedure shall be decided from time to time by the Board of Management (BOM) of the Institute, following guidelines issued by Ministry of Human Resource Development (MHRD), Government of India. The number of seats in each branch of the (M.TECH / M.B.A. / M.C.A.) programme will be decided by BOM as per the directives from Ministry of Human Resource Development (MHRD), Government of India and taking into account the market demands. Some seats for Non Resident Indians and a few seats for foreign nationals shall be made available.

2.2 The selected candidates will be admitted to the (M.TECH / M.B.A. / M.C.A.) programme after he/she fulfills all the admission requirements set by the Institute and after payment of the prescribed fees.

2.3 Candidates for admission to the first semester of the Master's Degree Programme shall be required to have passed an appropriate Degree Examination recognized by Hindustan University.

2.4 In all matters relating to admission to the (M.TECH / M.B.A. / M.C.A.). Programme, the decision of the Institute and its interpretation given by the Chancellor of the Institute shall be final.

2.5 If at any time after admission, it is found that a candidate has not fulfilled any of the requirements stipulated by the Institute, the Institute may revoke the admission of the candidate with information to the Academic Council.

3. Structure of the programme

3.1 The programme of instruction will have the following structure

i) Core courses of Engineering / Technology / Management.

ii) Elective courses for specialization in areas of student's choice

3.2 The minimum durations of the programmes are as given below:

Program	No. of Semesters
M.Tech.(Full-Time)	4
M.Tech.(Part -Time)	6
M.B.A. (Full - Time)	4
M.B.A. (Part - Time)	6
M.C.A.(Full - Time)	6
M.C.A.(Part -Time)	8

Every (M.TECH / M.B.A. / M.C.A.) programme will have a curriculum and syllabi for the courses approved by the Academic Council.

3.3 Each course is normally assigned certain number of credits. The following norms will generally be followed in assigning credits for courses.

- One credit for each lecture hour per week per semester
- One credit for each tutorial hour per week per semester
- One credit for each laboratory practical of three hours per week per semester.
- One credit for 4 weeks of industrial training and
- One credit for 2 hours of project per week per semester.

3.4 For the award of degree, a student has to earn certain minimum total number of credits specified in the curriculum of the relevant branch of study. The curriculum of the different programs shall be so designed that the minimum prescribed credits required for the award of the degree shall be within the limits specified below.

Program	Minimum prescribed credit range
M.Tech. (Full time / Part time)	75 - 85
M.B.A. (Full time / Part time)	85 - 95
M.C.A (Full time / Part time)	115 - 125

3.5 The medium of instruction, examination and the language of the project reports will be English.

4. Faculty Advisor

4.1 To help the students in planning their courses of study and for getting general advice on the academic programme, the concerned Department will assign a certain number of students to a Faculty member who will be called their Faculty Advisor.

5. Class Committee

5.1 A Class Committee consisting of the following will be constituted by the Head of the Department for each class:

(i) A Chairman, who is not teaching the class.

(ii) All subject teachers of the class.

(iii) Two students nominated by the department in consultation with the class.

The Class Committee will meet as often as necessary, but not less than three times during a semester.

The functions of the Class Committee will include:

(i) Addressing problems experienced by students in the classroom and the laboratories.

(ii) Analyzing the performance of the students of the class after each test and finding ways and means of addressing problems, if any.

(iii) During the meetings, the student members shall express the opinions and suggestions of the class students to improve the teaching / learning process.

6. Grading

6.1 A grading system as below will be adhered to.

Range of Marks	Letter Grade	Grade points
95-100	S	10
85 - 94	A	09
75- 84	B	08
65-74	C	07
55-64	D	06
50-54	E	05
< 50	U	00
	I (Incomplete)	–

6.2 GPA & CGPA

GPA is the ratio of the sum of the product of the number of credits C_i of course "i " and the grade points P_i earned for that course taken over all courses "i" registered by the student to the sum of Ci for all "i ". That is,

$$GPA = \frac{\sum_i C_i P_i}{\sum_i C_i}$$

CGPA will be calculated in a similar manner, at any semester, considering all the courses enrolled from first semester onwards.

6.3 For the students with letter grade I in certain subjects, the same will not be included in the computation of GPA and CGPA until after those grades are converted to the regular grades.

6.4 Raw marks will be moderated by a moderation board appointed by the Vice-Chancellor of the University. The final marks will be graded using an absolute grading system. The Constitution and composition of the moderation board will be dealt with separately.

7. Registration and Enrollment

7.1 Except for the first semester, registration and enrollment will be done in the beginning of the semester as per the schedule announced by the University.

7.2 A student will be eligible for enrollment only if he/she satisfies regulation 10 (maximum duration of the programme) and will be permitted to enroll if (i) he/she has cleared all dues in the Institute, Hostel & Library up to the end of the previous semester and (ii) he/she is not

debarred from enrollment by a disciplinary action of the University.

7.3 Students are required to submit registration form duly filled in.

8. Registration requirement

8.1 **(i)** A Full time student shall not register for less than 16 credits or more than 26 credits in any given semester.

8.1 **(ii)** A part time student shall not register for less than 10 credits or more than 20 credits in any given semester.

8.2 If a student finds his/her load heavy in any semester, or for any other valid reason, he/she may withdraw from the courses within three weeks of the commencement of the semester with the written approval of his/her Faculty Advisor and HOD. However the student should ensure that the total number of credits registered for in any semester should enable him/her to earn the minimum number of credits per semester for the completed semesters.

9. Minimum requirement to continue the programme

9.1 For those students who have not earned the minimum required credit prescribed for that particular semester examination, a warning letter to the concerned student and also to his parents regarding the shortage of his credit will be sent by the HOD after the announcement of the results of the university examinations.

10. Maximum duration of the programme

The minimum and maximum period for the completion of various programs are given below.

Program	Min. No. of Semesters	Max. No. of Semesters
M.Tech (Full - time)	4	8
M.Tech (Part - time)	6	10
M.B.A. (Full Time)	4	8
M.B.A. (Part Time)	6	10
M.C.A. (Full - Time)	6	12
M.C.A (Part -Time)	8	14

11. Temporary discontinuation

11.1 A student may be permitted by the Director(academic) to discontinue temporarily from the programme for a semester or a longer period for reasons of ill health or other valid reasons. Normally a student will be permitted to discontinue from the programme only for a maximum duration of two semesters.

12. Discipline

12.1 Every student is required to observe discipline and decorum both inside and outside the campus and not to indulge in any activity which will tend to bring down the prestige of the University.

12.2 Any act of indiscipline of a student reported to the Director (Academic) will be referred to a Discipline Committee so constituted. The Committee will enquire into the charges and decide on suitable punishment if the charges are substantiated. The committee will also authorize the Director(Academic) to recommend to the Vice-Chancellor the implementation of the decision. The student concerned may appeal to the Vice-Chancellor whose decision will be final. The Director (Academic) will report the action taken at the next meeting of the Council.

12.3 Ragging and harassment of women are strictly prohibited in the University campus and hostels.

13. Attendance

13.1 A student whose attendance is less than 75% is not eligible to appear for the end semester examination for that semester. The details of all students who have attendance less than 75% will be announced by the teacher in the class. These details will be sent to the concerned HODs and Director (Academic).

13.2 Those who have less than 75% attendance will be considered for condonation of shortage of attendance. However a condonation of 10% in attendance will be given on medical reasons. Application for condonation recommended by the Faculty Advisor, concerned faculty member and the HOD is to be submitted to the Director (Academic) who, depending on the merits of the case, may permit the student to appear for the end semester examination. A student will be eligible for this concession at most in two semesters during the entire degree programme. Application for medical leave, supported by medical certificate with endorsement by a Registered Medical Officer, should reach the HOD within seven days after returning from leave or, on or before the last instructional day of the semester, whichever is earlier.

13.3 As an incentive to those students who are involved in extra curricular activities such as representing the University in Sports and Games, Cultural Festivals, and Technical Festivals, NCC/ NSS events, a relaxation of up to 10% attendance will be given subject to the condition that these students take prior approval from the officer-in-charge. All such applications should be recommended by the concerned HOD and forwarded to Director (Academic) within seven instructional days after the programme/activity.

14. Assessment Procedure

14.1 The Academic Council will decide from time to time the system of tests and examinations in each subject in each semester.

14.2 For each theory course, the assessment will be done on a continuous basis as follows:

Test / Exam	Weightage	Duration of Test Exam
First Periodical Test*	10%	2 Periods
Second Periodical Test*	10%	2 Periods
Model exam	20%	3 hours
Seminar/ Assignments/Quiz	20%	
End - semester examination	50%	3 Hours

*** Best out of the two tests will be considered.**

14.3 For practical courses, the assessment will be done by the subject teachers as below:

(i) Weekly assignment/Observation note book / lab records - weightage 60%.

(ii) End semester examination of 3 hours duration including viva - weightage 40%

15. Make up Examination/model examination

15.1 Students who miss the end-semester examinations / model examination for valid reasons are eligible for make-up examination /model examination. Those

who miss the end-semester examination / model examination should apply to the Head of the Department concerned within five days after he / she missed examination, giving reasons for absence.

15.2 Permission to appear for make-up examination / model exam will be given under exceptional circumstances such as admission to a hospital due to illness. Students should produce a medical certificate issued by a Registered Medical Practitioner certifying that he/she was admitted to hospital during the period of examination / model exam and the same should be duly endorsed by parent / guardian and also by a medical officer of the University within 5 days.

16. Project evaluation

16.1 For Project work, the assessment will be done on a continuous basis as follows:

Review / Examination	Weightage
First Review	10%
Second Review	20%
Third Review	20%
End semester Examination	50%

For end semester exam, the student will submit a Project Report in a format specified by the Director (Academic). The first three reviews will be conducted by a Committee constituted by the Head of the Department. The end - semester examination will be conducted by a Committee constituted by the Controller of Examinations. This will include an external expert.

17. Declaration of results

17.1 A candidate who secures not less than 50% of total marks prescribed for a course with a minimum of 50% of the marks prescribed for the end semester examination shall be declared to have passed the course and earned the specified credits for the course.

17.2 After the valuation of the answer scripts, the tabulated results are to be scrutinized by the Result Passing Boards of PG programmes constituted by the Vice-Chancellor. The recommendations of the Result Passing Boards will be placed before the Standing Sub Committee of the Academic Council constituted by the Chancellor for scrutiny. The minutes of the Standing Sub Committee along with the results are to be placed before the Vice-Chancellor for approval. After getting the approval of the Vice-Chancellor, the results will be published by the Controller of Examination/ Registrar.

17.3 If a candidate fails to secure a pass in a course due to not satisfying the minimum requirement in the end semester examination, he/she shall register and re-appear for the end semester examination during the following semester. However, the sessional marks secured by the candidate will be retained for all such attempts.

17.4 If a candidate fails to secure a pass in a course due to insufficient sessional marks though meeting the minimum requirements of the end semester examination, wishes to improve on his/ her sessional marks, he/she will have to register for the particular course and

attend the course with permission of the HOD concerned and the Registrar. The sessional and external marks obtained by the candidate in this case will replace the earlier result.

17.5 A candidate can apply for the revaluation of his/her end semester examination answer paper in a theory course within 2 weeks from the declaration of the results, on payment of a prescribed fee through proper application to the Registrar/Controller of Examinations through the Head of the Department. The Registrar/ Controller of Examination will arrange for the revaluation and the results will be intimated to the candidate concerned through the Head of the Department. Revaluation is not permitted for practical courses and for project work.

17.6 The weightage for internal marks in finalizing results and grades shall be waived off after completion of 5 semesters.

18. Grade Card

18.1 After results are declared, grade sheet will be issued to each student, which will contain the following details:

(i) Program and branch for which the student has enrolled.

(ii) Semester of registration.

(iii) List of courses registered during the semester and the grade scored.

(iv) Semester Grade Point Average (GPA)

(v) Cumulative Grade Point Average (CGPA).

19. Class / Division

19.1 Classification is based on CGPA and is as follows:

CGPA $\geq$ 8.0 : **First Class with distinction**

6.5 $\leq$ CGPA < 8.0 : **First Class**

5.0 $\leq$ CGPA < 6.5 : **Second Class.**

19.2 (i) Further, the award of 'First class with distinction' is subject to the candidate becoming eligible for the award of the degree having passed the examination in all the courses in his/her first appearance within the minimum duration of the programme.

(ii) The award of 'First Class' is further subject to the candidate becoming eligible to the award of the degree having passed the examination in all the courses within the below mentioned duration of the programme.

Program	No. of Semesters
M.Tech.(Full-Time)	5
M.Tech.(Part -Time)	7
M.B.A. (Full - Time)	5
M.B.A. (Part - Time)	7
M.C.A.(Full - Time)	7
M.C.A.(Part -Time)	9

(iii) The period of authorized discontinuation of the programme (vide clause 11.1) will not be counted for the purpose of the above classification.

20. Transfer of credits

20.1 Within the broad framework of these regulations, the Academic Council, based on the recommendation of the transfer of credits committee so constituted by the Chancellor may permit students to earn part of the credit requirement in other approved institutions of repute and status in the country or abroad.

21. Eligibility for the award of (M.TECH / M.B.A. / M.C.A.) Degree

21.1 A student will be declared to be eligible for the award of the (M.TECH / M.B.A. / M.C.A.). Degree if he/she has

i) registered and successfully credited all the core courses,

ii) successfully acquired the credits in the different categories as specified in the curriculum corresponding to the discipline (branch) of his/her study within the stipulated time,

iii) has no dues to all sections of the Institute including Hostels, and

iv) has no disciplinary action pending against him/her.

The award of the degree must be recommended by the Academic Council and approved by the Board of Management of the University.

22. Power to modify

22.1 Notwithstanding all that has been stated above, the Academic Council has the right to modify any of the above regulations from time to time subject to approval by the Board of Management.

HINDUSTAN UNIVERSITY

M.Tech. ENVIRONMENTAL ENGINEERING

CURRICULUM - 2013-14

SEMESTER I

S.No	Course Code	Course Title	L	T	P	C	TCH
Theory							
1	PMA103	Probability And Statistics	3	1	0	4	4
2	PEV101	Chemistry for Environmental Engineering	4	0	0	4	4
3	PEV102	Microbiology for Environmental Engineering	4	0	0	4	4
4	PEV103	Air Pollution and Control	4	0	0	4	4
5	PEV104	Water and Sewage Conveyance	4	0	0	4	4
6	PEV 105	Solid and Hazardous Waste Management	4	0	0	4	4
Practical							
7	PEV106	Environmental Engineering Laboratory	0	0	4	2	4
		Total				**26**	**28**

SEMESTER II

S.No	Course Code	Course Title	L	T	P	C	TCH
Theory							
1	PEV201	Physical and Chemical Treatment of Water and Wastewater	4	0	0	4	4
2	PEV202	Biological Treatment of Wastewater	4	0	0	4	4
3	PEV203	Industrial Waste Water Management	4	0	0	4	4
4	PEV204	Environmental Impact Assessment	4	0	0	4	4
5	-	Elective - I	3	0	0	3	3
6	-	Elective - II	3	0	0	3	3
		Total				**22**	**22**

SEMESTER III

S.No	Course Code	Course Title	L	T	P	C	TCH
Theory							
1	-	Elective - III	3	0	0	3	3
2	-	Elective - IV	3	0	0	3	3
3	-	Elective - V	3	0	0	3	3
Practical							
4	PEV301	Practical Training	-	-	-	2	-
5	PEV302	Seminar	0	0	2	1	2
6	PEV303	Project Work - Phase - I	0	0	12	6	12
		Total				**18**	**23**

SEMESTER IV

S.No	Course Code	Course Title	L	T	P	C	TCH
Practical							
1	PEV401	Project Work - Phase - II	0	0	24	12	24
		Total				**12**	**24**

ELECTIVE SUBJECTS

S.No	Course Code	Course Title	L	T	P	C	TCH
1	PEV701	Environmental Quality Modelling	3	0	0	3	3
2	PEV702	Instrumental Monitoring of Environment	3	0	0	3	3
3	PEV703	Remote Sensing and GIS for Environmental Applications	3	0	0	3	3
4	PEV704	Ecological Engineering	3	0	0	3	3
5	PEV705	Ground Water Contamination and Transport Modeling	3	0	0	3	3
6	PEV706	Environmental Biotechnology	3	0	0	3	3
7	PEV707	Indoor Air Quality	3	0	0	3	3
8	PEV708	Environmental Policies and Legislation	3	0	0	3	3
9	PEV709	Energy Management	3	0	0	3	3
10	PEV710	Mass Transfer in Air - Water - Soil interaction	3	0	0	3	3
11	PEV711	Marine Pollution Monitoring	3	0	0	3	3
12	PEV712	Environmental Economics	3	0	0	3	3
13	PEV713	Sustainable Development and Environment	3	0	0	3	3

TOTAL NO. OF CREDITS = 78

SEMESTER - I

PMA103 PROBABILITY AND STATISTICS
Common to M.Tech (AME/CM/EE)

L	T	P	C
3	1	0	4

GOAL

The course will help the students to understand the concepts of probability and statistics and its applications in the field of environmental engineering.

OBJECTIVES

The course should enable the students to

1. Understand the basic concepts of sampling distributions and estimation.
2. Learn about the testing of hypothesis.
3. Gain the knowledge in Analysis of variance.
4. Know the probability functions and the Random variables.
5. Learn about the basic concepts of linear programming.

OUTCOME

The students should be able to:

1. Use the sampling principlus in the field of environmental engineering.
2. Find the significance of large samples by using hypothesis testing.
3. Implement the variance design principles in sampling.
4. Interpolate datas by using probability theories.
5. Explain linear programming in the field of environmental engineering.

UNIT I SAMPLING DISTRIBUTIONS AND ESTIMATION 12

Sampling distributions - Point and interval estimates for population proportions, mean and variance - Maximum likelihood estimate method - Method of moments.

UNIT II TESTING OF HYPOTHESIS 12

Basic definitions of statistical hypothesis - Tests of significance for large samples - single proportion, difference of proportion, single mean and difference of mean - Small samples - t, Chi-square and F distributions.

UNIT III DESIGN OF EXPERIMENTS 12

Analysis of variance - One way and Two way Classifications. Completely randomized design - Randomized block design - Latin square design.

UNIT IV PROBABILITY AND RANDOM VARIABLES **12**

Discrete and Continuous random variables - Moments - Moment generating functions - Standard distributions - Binomial, Poisson, Geometric, Negative Binomial, Uniform, Normal, Exponential, Gamma and Weibull distributions - Two dimensional random variables - Joint, Marginal and Conditional distributions. Multiple and partial correlation and Regression.

UNIT V LINEAR PROGRAMMING **12**

Basic concepts - Graphical and Simplex method - Transportation problem - Assignment problem

TOTAL: 60

REFERENCES:

1) Taha, H.A., "Operations Research - An Introduction ", Prentice Hall of India Ltd., 6th Edition, New Delhi, 1997.

2) Dr.A.Singaravelu, Dr.S.Siva Subramanian and Dr.C.Ramachandran, "Probability and Queuing Theory", Meenakshi agency, 20th edition, January 2013.

3) Kapur, J.N. and Saxena, H.C. "Mathematical Statistics ", S. Chand and Co. Ltd., New Delhi, 1997.

4) T.Veerarajan, "Probability, Statistics and Random Processes", Tata McGraw-Hill, second edition, 2006.

PEV101 CHEMISTRY FOR ENVIRONMENTAL ENGINEERING

L	T	P	C
4	0	0	4

GOAL

To educate the students in the area of air, water and soil for the better understanding of environmental aspects of chemistry.

OBJECTIVES

The course should enable the student to:

1. Understand the fundamentals of chemistry behind air, water and soil and know the instrumental techniques.
2. To know the degradation of foodstuffs detergents, pesticides, hydrocarbons, etc.
3. Get awareness on risk evaluation of chemicals.
4. Understand atmospheric chemistry.
5. Study about the minerals in soil and the ion-exchange reactions in soil.

OUTCOMES

The students will be able to:

1. Understand the properties and uses of air water and soil and get hands on experience for sample analysis using the instrumental techniques.

2. Utilize the degradation process for environmental protection.

3. Know the precautionary steps to be taken when handling the chemicals.

4. Get rid of pollution leading towards safer and peaceful environment.

5. Utilize soil chemistry for a better environment.

UNIT I FUNDAMENTALS **15**

Colloids - Redox potentials - partition co-efficient - Been - Lambert's Law - Limitations - UV visible spectroscopy - basic principles - application - Atomic bsorption spectroscopy - Principles - applications Gas chromatograph - Principles and applications - Principles of green chemistry - Error Analysis of Environmental Data.

UNIT II DEGRADATION **8**

Transport and transformation of chemicals - DO, BOD and COD - Photo catalysis - Degradation of food stuffs, detergents, pesticides and hydrocarbons.

UNIT III AQUATIC CHEMISTRY **7**

Metals, complex formation, oxidation and reduction and sorption - Eh - pH diagrams - chemical speciation - QSAR - Risk evaluation of chemicals.

UNIT IV ATMOSPHERIC CHEMISTRY **8**

Regions of atmosphere - Chemical and photochemical reactions - photochemical smog, ozone layer depletion - green house gases and global warming - Acid rain.

UNIT V SOIL CHEMISTRY **7**

Soil properties, clay minerals - acid-base and ion-exchange reactions in soil - salt affected soil and its remediation.

TOTAL = 45

TEXT BOOKS:

1. C.N. Sawyer, P.L. MacCarty and G.F. Parkin, Chemistry for Environmental Engineering and Science, Tata McGraw-Hill, Fifty edition, New Delhi, 2003.

2. D.W. Connell, Basic concepts of Environmental Chemistry, Lewis publishers, New York, 1997.

REFERENCES:

1. G.W. Vanloon and S.J. Duffy "Environmental chemistry - a global perspective, Oxford University Press, New York, 2000.

2. Colin Baird, "Environmental Chemistry", Freeman and Company, New York, 1997.

3. S.E. Manahan, Environmental Chemistry,Sixty Edition,Lewis Publishers,New York,1994.

PEV102 MICROBIOLOGY FOR ENVIRONMENTAL ENGINEERING

L	T	P	C
4	0	0	4

GOAL

To educate the students in microbiology and its applications in environmental engineering, and to train them in experiments related to microbiological examination of water.

OBJECTIVES

The course should enable the student to:

1. Study the classification of microorganisms.
2. Understand the distribution of microorganisms in water, air, and soil and their problems.
3. Be acquainted with the process of metabolism of microorganisms.
4. Understand the role of microorganisms in waste water treatment.
5. Get acquainted with the toxicity and its effects of microorganisms.

OUTCOMES

The students will be able to:

1. Gain knowledge on different types of microorganisms.
2. Identify the diseases caused by different microorganisms.
3. Use certain microorganisms for treatment process and to destroy harmful microorganisms.
4. Use microorganisms for different waste water treatments.
5. Identify the toxic nature of microorganisms.

UNIT I INTRODUCTION **5**

Classification of microorganisms - prokaryotic, eukaryotic, structure, characteristics, nucleic acids - DNA, RNA, replication. Culturing of microorganisms, Recombinant DNA technology.

UNIT II MICROBIOLOGY OF ENVIRONMENT **10**

Distribution of microorganisms - Water, Air and Soil, Indicator organisms, coliforms - fecal coliforms, E coli, Streptococcus, Clostridium, Significance in water. Algae in water supplies - problems and control. Concentration and detection of virus, Transmissible diseases.

UNIT III METABOLISM OF MICROORGANISMS **10**

Nutrition and metabolism in microorganisms, growth phases, carbohydrate, protein, lipid metabolism-aerobic and anaerobic-respiration, fermentation, glycolysis, Kreb's cycle, hexose monophosphate pathway, electron transport system, oxidative phosphorylation, environmental factors, enzymes, Bioenergetics.

UNIT IV ROLE OF MICROORGANISMS IN WASTEWATER TREATMENT **10**

Microbiology of biological treatment processes - aerobic and anaerobic, Biodegradation of toxic pollutants - mechanism - ?-oxidation, ?-oxidation, nitrification and denitrification, eutrophication.

UNIT V TOXICOLOGY **10**

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

TOTAL = 45

TEXT BOOKS:

1. Maier, R.M., I.L. Pepper and C.P. Gerba, "Environmental Microbiology", Academic Press, New York, 1999.
2. Tortora, G.J, B.R. Furke, and C.L. Case, "Microbiology - An Introduction" (4th Edition), Benjamin/ Cummings Publ. Co., Inc., California, 1992.

REFERENCES:

1. Frank C. Lu and Sam Kacew, LU's Basic Toxicology, Taylor & Francis, London (4th Ed.), 2002.
2. Baker, K.H. and D.S. Herson, Bioremediation, McGraw-Hill Inc., New York, 1994.

PEV103 AIR POLLUTION AND CONTROL

L	T	P	C
4	0	0	4

GOAL

To educate the students understand about the types of air pollutants, their sources and their control to make the ambient air relatively free from the pollutants.

OBJECTIVES

The course should enable the students to:

1. Learn about the different types of air pollutants, their sources and effects.
2. Understand the design principles involved in settling chambers, cyclones, electrostatic precipitators in controlling particulate contaminants.
3. Study about the design principles involved in adsorption, absorption, condensation, biofiltration for controlling gaseous pollutants present in air.
4. Study and understand about the automobile air pollution and its control, ultraviolet photolysis, indoor air pollution and its control.
5. Study and understand the effects of noise pollution and the associated control measures involves.

OUTCOME

The students will be able to:

1. Realize the seriousness of the various air pollutants and understand how they are getting dispensed in the atmosphere due to meteorological parameter.

2. Apply the design parameters to design settling chambers, cyclones, electrostatic precipitators to control the particulates.

3. Design the absorption columns, adsorption towers, Bio-scrubbers, incinerators etc, suitable for various industries.

4. Suggest fuel modifications for controlling automobile air pollutants and suggest green building concepts to minimize indoor air pollution.

5. Measure the noise level and check the standards, and to suggest the control measures in industries.

UNIT I INTRODUCTION 10

Air resource management system - Air quality management, Scales of air pollution problem - Sources and classification of pollutants and their effect on human health vegetation and property - Global implications of air pollution - Meteorology Fundamentals - Atmospheric stability - Micrometeorology - Atmospheric turbulence - mechanical and thermal turbulence - Wind profiles - Atmospheric Diffusion - Atmospheric diffusion theories - Steady-state atmospheric diffusion equation - Plume rise - Diffusion models - Software applications - Ambient air quality and emission standards - Air pollution indices - Indoor Air Pollutants - Models - Air Quality Sampling and Monitoring.

UNIT II CONTROL OF PARTICULATE CONTAMINANTS 12

Settling chambers - Filters, gravitational, Centrifugal - multiple type cyclones, prediction of collection efficiency, pressure drop, wet collectors, Electrostatic Precipitation theory - ESP design - Operational Considerations - Process Control and Monitoring - Case Studies.

UNIT III CONTROL OF GASEOUS CONTAMINANTS 13

Absorption - principles - description of equipment-packed and plate columns - design and performance equations - Adsorption - principal adsorbents - Equipment descriptions - Design and performance equations - Condensation - design and performance equation - Incineration - Equipment description - design and performance equations - Biological Air Pollution Control Technologies - Bio-Scrubbers, Biofilters - Operational Considerations - Process Control and Monitoring - Case Studies.

UNIT IV EMERGING TRENDS 6

Process Modification - Automobile Air Pollution and its control - Fuel Modification - Mechanical Particulate Collectors - Entrainment Separation - Internal Combustion Engines - Membrane Process - Ultraviolet Photolysis - High Efficiency Particulate Air Filters - Technical & Economic Feasibility of selected emerging technologies for Air pollution control - Control of Indoor Air Quality - Radioactive pollution and its control.

UNIT V NOISE CONTROL 4

Noise Standards - Measurement - Modeling - Control and preventive measures.

TOTAL = 45

TEXT BOOKS:

1. Lawrence K. Wang, Norman C Perelra, Yung-Tse Hung, "Air Pollution Control Engineering", Tokyo, 2004.
2. Noel de Nevers, Air Pollution Control Engg., McGraw-Hill, New York, 1995.

REFERENCES:

1. David H.F Liu, Bela G. Liptak "Environmental Engineers' Handbook", Lewis Publishers, 1997.
2. Anjaneyulu, Y, "Air Pollution & Control Technologies", Allied Publishers (P) Ltd., India, 2002.
3. Richard W. Boubel, Donald L. Fox and D. Bruce Turner, "Fundamentals of Air Pollution" 3rd Edition, Academic Press, 1994.
4. Karl B. Schnelle, Jr., and Partha R. Dey, "Atmospheric Dispersion Modeling Compliance Guide", McGraw-Hill, 2000.

PEV104 WATER AND SEWAGE CONVEYANCE

L	T	P	C
4	0	0	4

GOAL

To educate the students in detailed design concepts related to water transmission mains, water distribution system, sewer networks and storm water drain, with emphasis on computer application.

OBJECTIVES

The course should enable the student to :

1. Study the properties of fluid and its flow through pipes.
2. Study about Water conveyance system for transmission and distribution and learn to design Water transmission mains.
3. Study about sewerage system for collection and transmission of sanitary sewage and learn to design Sanitary Sewer.
4. Study about storm water drainage and to design storm water drain.
5. Learn about Computer applications in water and sewage conveyance.

OUTCOMES

The students will be able to:

1. Understand the properties of fluid and the concepts of hydraulics.
2. Design Water conveyance System and Water Transmission mains.
3. Gain knowledge on Sewerage System and to design Sanitary Sewer.
4. Gain knowledge on Storm Water Drainage and to design Storm water drain.
5. Get acquainted with Computer applications in water and sewage conveyance.

UNIT I PRINCIPLES OF HYDRAULICS **10**

Fluid properties, fluid flew - continuity principle, energy principle and momentum principle; frictional head loss in free and pressure flow, major and minor heads loss, formula for estimation of head loss - pumping of fluids - selection of pumps - Flow measurement.

UNIT II WATER TRANSMISSION AND DISTRIBUTION **10**

Planning factors - Water transmission main design - pipe material - economics - water hammer analysis; water distribution pipe networks - methods for analysis and optimization - Laying and maintenance, insitu lining - appurtenances - corrosion prevention - minimization of water losses - leak detection.

UNIT III WASTEWATER COLLECTION AND CONVEYANCE **10**

Planning factors - Design of sanitary sewer; partial flow in sewers, economics of sewer design; sewer appurtenances; material, construction, inspection and maintenance of sewers; Design of sewer outfalls-mixing conditions; conveyance of corrosive wastewaters.

UNIT IV STORM WATER DRAINAGE **5**

Planning - run-off estimation, rainfall data analysis, storm water drain design - rain water harvesting.

UNIT V CASE STUDIES AND COMPUTER APPLICATIONS **10**

Computer applications for water transmission, water distribution and sewer design.

TOTAL = 45

TEXT BOOK:

1. G.S. Bajwa, Practical Handbook on Public Health Engineering, Deep Publishers, Shimla, 2003.

REFERENCES:

1. "Manual on water supply and Treatment", CPHEEO, Ministry of Urban Development, GoI, New Delhi, 1999.
2. "Manual on Sewerage and Sewage Treatment", CPHEEO, Ministry of Urban Development, GOI, New Delhi, 1993.
3. B.A. Hauser, Practical Hydraulics Handbook, Lewis Publishers, New York, 1991.

PEV105 SOLID AND HAZARDOUS WASTE MANAGEMENT

L	T	P	C
4	0	0	4

GOAL

To educate the students on the principles involved in the management of municipal solid waste and hazardous wastes - from source identification up to disposal.

OBJECTIVES

The course should enable the student to :

1. Study about the sources and types of solid and hazardous wastes and their management.
2. Learn about waste sampling, waste generation rates and source reduction of wastes.
3. Get acquainted with the storage and collection of wastes along with handling of hazardous waste.
4. Be familiar with the waste processing technologies such as biological and chemical conversion technologies and energy recovery.
5. Study about the various ways of hazardous waste disposal.

OUTCOMES

The students will be able to:

1. Identify the sources and types of solids and hazardous wastes.
2. Be aware of waste sampling and source reduction of wastes.
3. Be aware of hazardous waste handling.
4. Develop knowledge on different waste processing technology and energy recovery.
5. Develop knowledge on hazardous waste disposal.

UNIT I INTRODUCTION **9**

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

UNIT II WASTE CHARACTERISATION AND SOURCE REDUCTION **6**

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

UNIT III STORAGE, COLLECTION AND TRANSPORT OF WASTES **9**

Handling and segregation of wastes at source - storage and collection of municipal solid wastes - Analysis of Collection systems - Need for transfer and transport - Transfer stations Optimizing waste

allocation - compatibility, storage, labeling and handling of hazardous wastes - hazardous waste manifests and transport.

UNIT IV WASTE PROCESSING TECHNOLOGIES **12**

Objectives of waste processing - material separation and processing technologies - biological and chemical conversion technologies - methods and controls of Composting - thermal conversion technologies and energy recovery - incineration - solidification and stabilization of hazardous wastes - treatment of biomedical wastes.

UNIT V WASTE DISPOSAL **9**

Waste disposal options - Disposal in landfills - Landfill Classification, types and methods - site selection - design and operation of sanitary landfills, secure landfills and landfills bioreactors - leachate and landfill gases management - landfill closure and environmental monitoring - closure of landfills - landfill remediation.

TOTAL : 45

TEXT BOOK:

1. George Tchobanoglous, Hilary Theisen and Samuel A, Vigil "Integrated Solid Waste Management, McGraw-Hill International edition, New York, 1993.

REFERENCES:

1. CPHEEO "Manual on Municipal Solid Waste Management, Central Public Health and Environmental Engineering Organisation, Government of India, New Delhi, 2000.
2. Micheael D. LaGrega, Philip L Buckingham, Jeffrey C. E vans and Environmental Resources Management, Hazardous Waste Management, McGraw-Hill International edition, New York, 2001.
3. Vesilind P A, Worrell W and Reinhart, Solid Waste Engineering, Thomson Learning Inc., Singapore, 2002.
4. David H.F.Liu and B.G.Liptak, "Envorinmental Engineers' Handbook" Lewis Publishers, 1997.

PEV106 ENVIRONMENTAL ENGINEERING LABORATORY

L	T	P	C
0	0	4	2

GOAL

To educate the students in assessing water and waste water quality in terms of Chemical and biological parameters.

OBJECTIVES

The course should enable the students to

1. Conduct experiments for characterization and determination of various properties of water, wastewater, air and soil.
2. Conduct various experiments of characterization, growth and determination of bacteria.

OUTCOME

The students will be able to analyze

1. Various parameters like pH, Total Solids, Total dissolved solids, iron and manganese, BOD, COD and chlorides, sulphate and dissolved oxygen in water and waste water. They will be able to analyze air samples and soil samples.
2. Various parameters like sampling of microorganisms, growth of bacteria, and bacteriological analysis of water.

ENVIRONMENTAL CHEMISTRY LABORATORY

1.	Physical and Chemical Analysis of Water	12
	pH, Conductivity, Turbidity, Solids, Chlorides, Sulphates, Alkalinity, Fluorides, Nitrate and heavy metals.	
2.	Physical and Chemical Analysis of Wastewater	8
	Phosphate, COD, BOD, Organic and ammonical nitrogen, Oil & grease.	
3.	Air Quality Analysis	6
	SPM, SO2, CO, NOx	
4.	Soil Analysis	4
	pH, Conductivity, Cation exchange capacity, Sodium Absorption ratio	30

ENVIRONMENTAL MICROBIOLOGY LABORATORY

1.	Preparation of media, serial dilution and plating, Growth curve	6
2.	Sampling of Microorganisms from air, water and soil, staining - simple and gram staining.	6
3.	Effect of pH, temperatures and nutrients on growth of bacteria	2
4.	Bacteriological analysis of water - Coliforms and streptococcus fecalis by MPN and membrane filter techniques	10
5.	Study of aquatic organisms - Algae, protozoa and fungi	6
		30

SEMESTER - II

PEV201 PHYSICAL AND CHEMICAL TREATMENT OF WATER AND WASTEWATER

L	T	P	C
4	0	0	4

GOAL

To make the students to understand and analyse the various pollutants present in water and wastewater and to understand, study, select the suitable physical and chemical treatment methods and design the treatment units.

OBJECTIVES

The course should enable the students to:

1. Study the characteristics of water and wastewater, and to analyse the need for treatment.
2. Differentiate between physical and chemical treatment methods and to study about the principles involved in physical treatment methods including nano-filtration and ultra- filtration.
3. Understand and study the various chemical treatment methods like precipitation, solidification, solvent extraction, oxidation, reduction etc.
4. Study the design principles of conventional water and wastewater treatment plants having flocculators, settling tanks and rapid sand filters.
5. Study the procedure to select an industrial water treatment process, wastewater reclamation system and the O & M aspects.

OUTCOME

The students will be able to:

1. Characterise the water and wastewater based on the characteristics and decide upon the treatment units.
2. Identify the different types of physical and chemical treatment methods including nano-filtration and ultra-filtration for treating water and wastewater.
3. Decide upon the chemical treatment methods to be adopted for treating the industrial wastewater.
4. Design the various units for treating water and wastewater of various industries.
5. Apply the procedure to select a particular industrial water treatment process including the wastewater reclamation system and the O & M aspects.

UNIT I INTRODUCTION **3**

Pollutants in water and wastewater - characteristics, Standards for performance - Significance and need for physico-chemical treatment.

UNIT II PHYSICAL TREATMENT PRINCIPLES **10**

Principles of Screening - Mixing, Equalisation - Sedimentation - Filtration - modeling - back washing - Evaporation - Incineration - gas transfer - mass transfer coefficients. Adsorption - Isotherms - Principles, equilibria and kinetics, reactors, regeneration, membrane separation, Reverse Osmosis, nano filtration ultra filtration and hyper filtration - electrodialysis, distillation - stripping and crystallization - Recent Advances.

UNIT III CHEMICAL TREATMENT PRINCIPLES **9**

Principles of Chemical treatment - Coagulation flocculation - Precipitation - flotation, solidification and stabilization - Disinfection. Ion exchange, Electrolytic methods, Solvent extraction - advance oxidation / reduction - Recent Advances.

UNIT IV DESIGN OF CONVENTIONAL TREATMENT PLANTS **15**

Selection of unit operations and processes - Design of conventional water treatment plant units - Aerators - chemical feeding - Flocculation - clarifier - filters - Rapid sand filter, slow sand filter, pressure filter - chlorinators. Displacement and gaseous type. Layouts - flow charts - Hydraulic Profile - O & M aspects - case studies, Residue management - Upgradation of existing plants - Recent Advances.

UNIT V DESIGN OF INDUSTRIAL WATER TREATMENT AND RECLAMATION **8**

Selection of process - Design of softeners - Demineralisers - Wastewater reclamation - Reverse osmosis plants - Residue management - O and M aspects - Recent Advances - case studies.

TOTAL = 45

TEXT BOOK:

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

REFERENCES:

1. Manual on water supply and Treatment CPHEEO, Ministry of Urban Development, GOI, New Delhi, 1999.
2. Lee, CC and Shun dar Lin, Handbook of Environmental Engineering Calculations, McGraw-Hill, New York, 1999.
3. Qasim, S. R., Motley, E.M., Zhu, G. Water works Engineering - Planning, Design and operation, Prentice Hall, New Delhi, 2002.
4. Casey, T.J. Unit treatment processes in water and wastewater Engineering, John Wiley and Sons, London, 1993.

PEV202 BIOLOGICAL TREATMENT OF WASTEWATER

L	T	P	C
4	0	0	4

GOAL

To educate the students on principles and design of various biological treatment units used for wastewater treatment.

OBJECTIVES

The course should enable the student to:

1. Be familiar with the concept of aerobic and anaerobic treatment of waste water.
2. Be acquainted with the origin of various units of Aerobic treatment of waste water.
3. Be acquainted with the design and concepts of various units of Anaerobic treatment of waste water.
4. Gain knowledge on sludge treatment and disposal.
5. Understand the operations, maintenance and management of sewage treatment plants.

OUTCOME

The students will be able to:

1. Describe the concept of aerobic and anaerobic treatment of waste water.
2. Develop knowledge on the design of various unit of Aerobic treatment of waste water.
3. Develop knowledge on the design of various unit of Anaerobic treatment of waste water.
4. Identify the ways of treatment of sludge and its disposal.
5. Be aware of the operation, maintenance and management of sewage treatment plants.

UNIT I INTRODUCTION **10**

Objectives of biological treatment - significance - aerobic and anaerobic treatment - kinetics of biological growth - Factors affecting growth attached and suspended growth - Determination of Kinetics coefficients for organics removal - Biodegradability assessment - selection of process.

UNIT II AEROBIC TREATMENT OF WASTEWATER **10**

Design of sewage treatment plant units - screen chamber, Grit chamber with proportional flow weir, sedimentation tank - Trickling filters, Rotating Biological contactor, activated sludge process & variations, aerated lagoons, waste stabilization ponds - nutrient removal systems - natural treatment systems - Disinfected disposal options - reclamation and reuse - Flow charts, layout, hydraulic profile - Recent advances.

UNIT III ANAEROBIC TREATMENT OF WASTEWATER **10**

Attached and suspended growth, Design of units - UASB, up flow filters, Fluidised beds - Septic tank and disposal - Nutrient removal systems - Layout and Hydraulic profile - Recent advances.

UNIT IV SLUDGE TREATMENT AND DISPOSAL **5**

Design of Sludge management facilities, sludge thickening, sludge digestion, Biogas generation, sludge dewatering (mechanical and gravity) - upgrading existing plants - ultimate residue disposal - Recent Advances.

UNIT V OPERATIONS, MAINTENANCE, MANAGEMENT AND CASE STUDIES **10**

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

TOTAL = 45

TEXT BOOK:

1. Metcalf & Eddy, Inc. "Wastewater Engineering, Treatment and Reuse, Third Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2003.

REFERENCES:

1. Arceivala, S.J., Wastewater treatment for pollution control, TMH, New Delhi, 1998.
2. Manual on "Sewerage and Sewage Treatment" CPHEEO, Ministry of Urban Development, GOI, New Delhi, 1999.
3. Qasim, S.R, Wastewater Treatment Plant, Planning, Design & Operation Technomic Publications, New York, 1994.

PEV203 INDUSTRIAL WASTE WATER MANAGEMENT

L	T	P	C
4	0	0	4

GOAL

To educate the students to know about the different types of industries and their wastewater generation, characteristics and treatment including strategies for pollution prevention.

OBJECTIVES

The course should enable the students to :

1. Study and understand about the various types of industries, their nature of wastewater generated and the associated environmental impacts.
2. Study about the source reduction techniques, waste audit and preparation of Environmental statement.
3. Study and understand wastewater treatment methods like equalisation, neutralisation, chemical oxidation, evaporation, Ion exchange etc.
4. Study about the concepts of common effluent treatment plants, residue management, sludge digestion and management of R.O rejects.

5. Know and understand about some case studies like Tannerics, Textiles, Pulp and paper Thermal Power plants etc.

OUTCOME

The students will be able to:

1. Know and explain about the various types of industrial.
2. Apply the source reduction techniques, carryout waste audit and prepare Environmental statement to enable the industries to apply for consent renewals.
3. Select appropriate treatment techniques or combination of techniques knowing the wastewater characteristics.
4. Apply the CETP concepts wherever required and manage the sludge produced while treating the wastewater.
5. Prepare a report for specific industry starting from process description. Wastewater Source identification, characterisation and treatment methods including source reduction technique application.

UNIT I INTRODUCTION 6

Industrial scenario in India - Industrial activity and Environment - Uses of Water by industry - Sources and types of industrial wastewater - Industrial wastewater and environmental impacts - Regulatory requirements for treatment of industrial wastewater - Industrial waste survey - Industrial wastewater generation rates, characterization and variables - Population equivalent - Toxicity of industrial effluents and Bioassay tests.

UNIT II INDUSTRIAL POLLUTION PREVENTION 8

Prevention vs Control of Industrial Pollution - Benefits and Barriers - Source reduction techniques - Waste Audit - Evaluation of Pollution prevention options - Environmental statement as a tool for pollution prevention - Waste minimization Circles.

UNIT III INDUSTRIAL WASTEWATER TREATMENT 12

Equalisation - Neutralization - Oil separation - Flotation - Precipitation - Heavy metal Removal - Refractory organics separation by adsorption - Aerobic and anaerobic biological treatment - Sequencing batch reactors - High Rate reactors - Chemical oxidation Ozonation - Photocatalysis - Wet Air Oxidation - Evaporation - Ion Exchange - Membrane Technologies - Nutrient removal.

UNIT IV WASTEWATER REUSE AND RESIDUAL MANAGEMENT 7

Individual and Common Effluent Treatment Plants - Joint treatment of industrial wastewater - Zero effluent discharge systems - Quality requirements for Wastewater reuse - Industrial reuse - 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.

UNIT V CASE STUDIES **12**

Industrial manufacturing process description, wastewater characteristics, source reduction options and waste treatment flow sheet for Textiles - Tanneries - Pulp and paper - metal finishing - Petroleum Refining - Pharmaceuticals - Sugar and Distilleries - Food Processing - fertilizers - Thermal Power Plants and Industrial Estates.

TOTAL = 45

TEXT BOOK:

1. Eckenfelder, W.W., "Industrial Water Pollution Control", McGraw-Hill, 1999.

REFERENCES:

1. Arceivala, S.J., "Wastewater Treatment for Pollution Control", Tata McGraw-Hill, 1998.
2. Frank Woodard Industrial waste treatment Handbook, Butterworth Heinemann, New Delhi, 2001.
3. World Bank Group "Pollution Prevention and Abatement Handbook - Towards Cleaner Production', World Bank and UNEP, Washington D.C.1998.
4. Paul L. Bishop "Pollution Prevention:- Fundamentals and Practice", McGraw-Hill International, 2000.

PEV204 ENVIRONMENTAL IMPACT ASSESSMENT

L	T	P	C
4	0	0	4

GOAL

To educate the students on the scope, steps involved and various methods related to assessment of environmental impact due to development projects.

OBJECTIVES

The course should enable the students to

1. Study about the importance of EIA and EIS, and LCA assessments.
2. Study the components of EIA and the software tools used in the EIA.
3. Gain the knowledge in environmental impact prediction and mathematical modeling for the impact prediction.
4. Know about the awareness Environmental management plan and the Risk assessment.
5. To gain knowledge on EIA, report writing for various industries.

OUTCOME

The students will be able to:

1. Understand the basic concepts and importance of EIA and its documentation.
2. Follow the steps of EIA process and will be able to access the EIA software tools.
3. Work on the impact prediction, and mathematical modeling while preparing EIA assessment.
4. Gain knowledge in pollution control laws and will be able to implement it in working sectors.
5. Prepare the EIA report for various industries.

UNIT I INTRODUCTION **7**

Environmental Impact Assessment (EIA) - Environmental Impact Statement - EIA in Project Cycle - Legal and Regulatory aspects in India according to Ministry of Environment and Forests - Types and limitations of EIA - Cross sectoral issues and terms of reference in EIA - Participation of Public and Non-Governmental Organizations in environmental decision making.

UNIT II COMPONENTS AND METHODS **12**

Components of EIA - Processes - screening - scoping setting - analysis - mitigation. Matrices - Networks - Checklists - Connections and combinations of processes - Cost benefit analysis - Analysis of alternatives - Software packages for EIA - Expert systems in EIA.

UNIT III PREDICTION, ASSESSMENT OF IMPACTS AND REPORTING **10**

Prediction tools for EIA - Mathematical modeling for impact prediction - Assessment of impacts - air - water - soil - noise - biological - socio-cultural environments - Cumulative Impact Assessment - Documentation of EIA findings - planning - organization of information and visual display materials - Report preparation.

UNIT IV ENVIRONMENTAL RISK ASSESSMENT AND MANAGEMENT PLAN **10**

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. Hazard identification - Risk characterisation - Risk based decision making - HAZOP analysis - Emergency Preparedness Plans - Design of risk management programs.

UNIT V CASE STUDIES **6**

Case studies related to the following sectors - Infrastructure - Mining - Industrial - Thermal Power - River valley and Hydroelectric - Nuclear Power.

TOTAL = 45

TEXT BOOKS:

1. Canter, L.W., Environmental Impact Assessment, McGraw-Hill, New York, 1996.
2. Lawrence, D.P., Environmental Impact Assessment - Practical solutions to recurrent problems, Wiley-Interscience, New Jersey, 2003.

REFERENCES:

1. John G. Rau and David C. Wooten, "Environmental Impact Analysis", McGraw-Hill Book Company, 1980.
2. Petts, J., Handbook of Environmental Impact Assessment, Vol., I and II, Blackwell Science London. 1999.
3. Biswas, A.K., and Agarwala, S.B.C. Environmental Impact Assessment for Developing Countries, Butterworth Heinemann, London. 1994.
4. The World Bank Group, Environmental Assessment Source Book Vol. I, II and III. The World Bank, Washington, 1991.
5. Kolluru Rao et.al "Risk assessment and management handbook", McGraw-Hill Inc., 1996.

ELECTIVES

PEV701 ENVIRONMENTAL QUALITY MODELLING

L	T	P	C
3	0	0	3

GOAL

To educate the students on the basic principles, development and application of air and water quality models with computer applications.

OBJECTIVES

The course should enable the students to:

1. Understand the basics and the importance of mathematical modeling.
2. Gain knowledge of computer based systems
3. Gain knowledge in various qualities of water models related to various hydrological bodies.
4. Gain knowledge in various air quality models related to various air pollutants.
5. Work on software packages associated with water and air quality samples.

OUTCOME

The students will be able to:

1. Gain working knowledge of mathematical modeling.
2. Work on the mathematical models and its computer applications in industries.
3. Work with various water quality models and its softwares in industries
4. Work with various airquality models and its softwares in industries.
5. Gain real time working knowledge in air and water quality models through case studies.

UNIT I INTRODUCTION **12**

Basics of mathematical Modeling - Modeling as a tool. Procedures of model development. Importance of model building. Characteristics of deterministic models. Classical approach to constrained and unconstrained optimization. State of the art in environmental engineering systems models - climate and system modeling - Erosion and sediment transport.

UNIT II COMPUTER BASED SOLUTIONS **10**

Formulation of linear optimization models. Linear programming. Sensitivity testing and duality. Solution techniques and computer programming; Formulation of linear optimization models. Application of models - simulation, parameter estimation and experimental design.

UNIT III WATER QUALITY MODELLING **9**

Rivers and streams water quality modeling river hydrology and flow-low flow analysis - dispersion and mixing-flow, depth; water quality modeling process-model sensitivity - assessing model performance; Models for dissolved oxygen, pathogens; Groundwater modeling.

UNIT IV AIR QUALITY MODELLING 9

Air Pollution modeling and prediction, modeling technique, modeling for non reactive pollutants, single source short term impact; multiple sources and area sources, model performance, accuracy and utilization.

UNIT V CASE STUDIES 5

Software package applications; Air quality modeling and water quality modeling

TOTAL = 45

TEXT BOOKS:

1. John Wainwright and Mark Mulligan, Environmental Modeling Finding Simplicity in Complexity, John Wiley and sons Ltd, USA, 2004.
2. Dynamic Modeling of Environmental Systems by Deaton and Wine brake, Wiley & Sons, 2002.

REFERENCES:

1. Stevan C. Chapra, Surface water quality modeling, McGraw-Hill Inc., New York, 1997.
2. Boubel R.W., For, D.L., Turner D.B. & Stern, A.C. "Fundamentals of Air Pollution, Academic Press, New York, 1994.
3. Karl B. Schnelle, Jr., and Partha R. Dey, "Atmospheric Dispersion Modeling Compliance Guide", McGraw-Hill, 2000.
4. Noel De Nevers, "Air Pollution Control Engineering", McGraw-Hill International Editions, 2nd Edition, 2000.

PEV702 INSTRUMENTAL MONITORING OF ENVIRONMENT

L	T	P	C
3	0	0	3

GOAL

To educate the students on the various instruments used for analysis of air water and soil.

OBJECTIVES

The course should enable the students to:

1. Understand the basics of instrumental measurement and its preliminary corrections while doing the experiments
2. Gain knowledge on various spectroscopic instruments
3. Gain knowledge on chromatographs and working principles of various types of chromatographs.
4. Gain knowledge on basic and working principle of Electro and radio analytical methods.
5. Understand the principle behind continuous monitoring and the various instruments used for continuous monitoring.

OUTCOME

The students will be able to:

1. Perform the experiments individually for various environmental parameters
2. Work on the various spectrographic instruments used for environmental quality monitoring.
3. Work with various chromatographs in environmental quality monitoring areas.
4. Use and access various electro and radio instruments in various environmental quality monitoring area.
5. Understand the principles behind continuous monitoring, for analyzing the various gaseous emissions and water.

UNIT I INTRODUCTION 7

Instrumental Methods, Selection of method, Precision and Accuracy, Errors in measuring signals, Noise/signal ratio, base line drift, Indicator tubes.

UNIT II SPECTROSCOPIC METHODS 11

Electromagnetic radiation, matter radiation interactions, Colorimetry and spectrophotometry, fluorimetry, nephelometry and turbidimetry, flame photometry Atomic Absorption Spectrometry (AAS), Atomic Emission Spectrometry (AES) - Inductively coupled plasma (ICP) and Direct Current Plasma (DCP) spectrometry. ICP - MS (Mass spectrometry).

UNIT III CHROMATOGRAPHIC METHODS 10

Classical methods, Column, Paper and thin layer chromatography (TLC), Gas Chromatrography (GC), GC-MS, High performance liquid chromatography (HPLC) and Ion chromatrography (IC).

UNIT IV ELECTRO AND RADIO ANALYTICAL METHODS 10

Conductometry, potentiometry, coulometry, amperometry polarography, Neutron Activation Analysis (NAA), X-ray Fluorescence (XRF) and X-ray Diffraction (XRD) methods.

UNIT V CONTINUOUS MONITORING INSTRUMENTS 7

Non-dispersive infra-red (NDIR) analyzer for CO, chemiluminescent analyzer for NOx, Fluorescent analyzer for SO2, Auto analyzer for water quality using flow injection analysis; permeation devices.

TOTAL = 45

TEXT BOOK:

1. Ewing "Instrumental Methods of Chemical Analysis", 5th Edn., McGraw-Hill, New York, 1995.

REFERENCE:

1. Willard, H., Merritt, L., Dean, D.A. and Settle. F.A. "Instrumental methods of analysis, 7th Edition, Worlds Worth, New York, 2004.

PEV703 REMOTE SENSING AND GIS FOR ENVIRONMENTAL APPLICATIONS

L	T	P	C
3	0	0	3

GOAL

To educate the students on the principles and application of remote sensing and GIS in environmental engineering.

OBJECTIVES

The course should enable the student to:

1. Be acquainted with the concepts of Remote sensing, EMR interaction with Environmental issues.
2. Be familiar with remote sensing platform systems, its satellites and sensors.
3. Gain knowledge on data processing using image processing software.
4. Gain knowledge on GIS and GIS software.
5. Be familiar with monitoring environment using remote sensing and GIS.

OUTCOME

The students will be able to:

1. Develop knowledge on concept of remote sensing.
2. Be aware of remote sensing platforms and sensors.
3. Identify the steps in Image processing software.
4. Relate the problems in GIS software.
5. Describe the environmental application using remote sensing and GIS.

UNIT I PRINCIPLES OF ELECTRO MAGNETIC RADIATION 5

Concepts of Remote Sensing - Energy sources and radiation principles, Energy interactions in the atmosphere - Spectral reflectance of earth surface features.

UNIT II REMOTE SENSING PLATFORMS 12

Aerial Photographs, Photographic Systems - Visible, Infra Red and Microwave sensing - Active and passive sensors - Satellites and their sensors, Indian Space Programme - Satellite data products.

UNIT III DATA PROCESSING 10

Photogrammetry - Satellite data analysis - Visual Interpretation, Interpretation equipments - Digital Image Processing - Image rectification, enhancement, classification, data merging and biophysical modeling - Image Processing software.

UNIT IV GEOGRAPHIC INFORMATION SYSTEM 6

Introduction to GIS concepts - Data base structure - Data analysis - GIS software

UNIT V REMOTE SENSING AND GIS APPLICATIONS **12**

Management and monitoring of environment, conservation of resources, coastal zone management - Limitations.

TOTAL = 45

TEXT BOOK:

1. Lillesand, T.M. and Kiefer, R.W., Remote Sensing and Image Interpretation, John Wiley and Sons, New York, 2004.

REFERENCES:

1. Burrough, P.A. and McDonnell, R.A., Principles of Geographic Information Systems, Oxford University Press, New York, 2001.
2. Lintz, J. and Simonet, Remote Sensing of Environment, Addison Wesley Publishing Company, New Jersey, 1998.

PEV704 ECOLOGICAL ENGINEERING

L	T	P	C
3	0	0	3

GOAL

To educate the students on the principles of ecology as applied to environmental engineering.

OBJECTIVES

The course should enable the student to:

1. Get introduced to the evolution, principles and concepts of ecosystem and their classifications.
2. Study various ecological models of ecosystems, and study their structural and functional interactions of the systems.
3. Gain knowledge on the process of sustainable loading of ecosystem.
4. Understand the application of ecosystems on the treatment of waste water.
5. Get acquainted with ecology and integrated ecological engineering through case studies.

OUTCOME

The students will be able to:

1. Describe the concept of evolution, principles and concepts of ecosystem.
2. Be aware of various ecological models and their functional interaction of the systems.
3. Develop knowledge on sustainable loading of ecosystem.
4. To apply the concept of ecosystems on the treatment of waste water.
5. Acquire knowledge on integrated ecosystems through case studies.

UNIT I INTRODUCTION TO ECOLOGY AND ECOLOGICAL ENGINEERING 10

Aim, scope and applications of ecology - Development and evolution of ecosystems - Principles and concepts pertaining to communities in ecosystem - Energy flow and material cycling in ecosystems - productivity in ecosystems - Rationale of ecological engineering and ecotechnology - Classification of ecotechnology - Principles of ecological engineering.

UNIT II SYSTEMS APPROACH IN ECOLOGICAL ENGINEERING 10

Principles, components and characteristics of systems - Classification of systems - Structural and functional interactions of environmental systems - Environmental systems as energy systems - Mechanisms of steady - state maintenance in open and closed systems - Modeling and ecotechnology - Elements of modeling - Modeling procedure - Classification of ecological models - Applications of models in ecotechnology - Ecological economics.

UNIT III ECOLOGICAL ENGINEERING PROCESSES 8

Self-organizing design and processes - Multi seeded microcosms - Interface coupling in ecological systems - Concept of energy - Determination of sustainable loading of ecosystems.

UNIT IV ECOTECHNOLOGY FOR WASTE TREATMENT 12

Ecosanitation - Principles and operation of soil infiltration systems - Wetlands and ponds - Source separation systems - Aquacultural systems - Agro ecosystems - Detritus based treatment for solid wastes - Applications of ecological engineering for marine systems.

UNIT V CASE STUDIES 5

Case studies of Integrated Ecological Engineering Systems and their commercial prospects.

TOTAL = 45

TEXT BOOK:

1. Kangas, P.C. and Kangas, P., Ecological Engineering, Principles and Practice, Lewis Publishers, New York, 2003.

REFERENCES:

1. Etnier, C. and Guterstam, B., Ecological Engineering for Wastewater Treatment, Lewis Publishers, New York, 1997.
2. White, I.D., Mottershed, D.N. and Harrison, S.J., Environmental Systems - An Introductory Text, Chapman Hall, London. 1994.
3. Mitsch, J.W. and Jorgensen, S.E., Ecological Engineering - An Introduction to Ecotechnology, John Wiley & Sons, New York. 1989.

PEV705 GROUND WATER CONTAMINATION AND TRANSPORT MODELING

L	T	P	C
3	0	0	3

GOAL

To educate the students on the hydraulics related ground water contamination and modeling ground water quality.

OBJECTIVES

The course should enable the student to:

1. Be familiar with the various sources of ground water contamination and its movement.
2. Gain knowledge on flow nets and steady state flow.
3. Get acquainted with the laboratory tests associated with ground water availability and quality.
4. Study the chemical properties and characteristics of ground water.
5. Study the behavior of the contaminants and their transport process.

OUTCOME

The students will be able to:

1. Develop knowledge on the various sources of ground water contamination and its movement.
2. Describe the concept of flow nets and steady state flow.
3. Be aware of the laboratory tests conducted on the ground water availability and quality.
4. Identify the chemical properties and characteristics of ground water.
5. Understand various contaminants and their transport process.

UNIT I INTRODUCTION **10**

Ground water and the hydrologic cycles - Ground water as a resource - Ground water contamination - Water quality standards - Sources of contamination - Land disposal of solid wastes - Sewage disposal on Land. Ground water and geologic processes. Physical properties and principles - Darcy's Law - Hydraulic Head and Fluid Potential - Piezometers and Nests. Hydraulic conductivity and permeability - Homogeneity and Anisotropy - Porosity and voids Ratio - Unsaturated flow and the water table - Steady state flow and Transient flow - Compressibility and effective stress - Transmissivity and storativity - Equations of Ground water Flow - Limitations of Darcian Approach - Hydro dynamic dispersion.

UNIT II HYDROLOGIC CYCLE AND FLOW NETS **4**

Flow nets - Graphical construction - Flow nets by numerical simulation. Steady state Regional Ground Water flow - steady state hydrologic budgets - Fluctuations in ground water levels.

UNIT III RESOURCE EVALUATION **9**

Development of Ground Water resources - Exploration for Aquifers - the response of Ideal aquifers to pumping - Measurement of parameters - Laboratory tests - Piezometer test - Pumping tests -

Estimation of saturated hydraulic conductivity - Numerical simulation for aquifer yield prediction - Artificial recharge and induced infiltration - Land subsidence - Sea water intrusion.

UNIT IV CHEMICAL PROPERTIES AND PRINCIPLES **9**

Constituents - Chemical equilibrium - Association and Dissociation of dissolved species - effects of concentration gradients - Mineral dissolution and solubility - Oxidation and reduction Process - Ion exchange and Adsorption - Environmental isotopes - Field Measurement of Index parameters. Chemical Evolution: Hydro Chemical sequences and facies - graphical methods - Hydro chemical Facies - Ground water in carbonate terrain - Ground Water in crystalline rocks - Ground Water in complex sedimentary systems - Geochemical interpretation of 14C Dates - Process rates and molecular diffusion.

UNIT V SOLUTE TRANSPORT **8**

Transport process - non-reactive constituents in homogeneous media and Heterogeneous media - Transport in Fracture media - Hydro chemical behaviour of contaminants - Trace metals - Trace nonmetals - Nitrogen, organic substances - Measurement of parameters - Velocity - Dispersivity - chemical partitioning.

UNIT VI USGS - MOC MODEL **5**

Modeling Principles - MOC Modeling. Case studies

TOTAL = 45

TEXT BOOK:

1. Todd David Keith, Ground water Hydrology, Fourth edition, John Wiley and Sons, New York, 2004.

REFERENCES:

1. Randall J. Charbeneau, "Ground water Hydraulics and Pollutant transport "Prentice Hall, Upper Saddle River, 1999.
2. Allen Freeze, R. and John A. Cherry, "Ground Water", Prentice Hall, Inc., 2001.

PEV706 ENVIRONMENTAL BIOTECHNOLOGY

L	T	P	C
3	0	0	3

GOAL

To educate the students on the principles and application of biotechnology in environmental engineering with special reference to waste treatment.

OBJECTIVES

The course should enable the students to:

1. Understand the basics of Environmental biotechnology

2. Enable the working principles behind the detoxification and various methods of detoxifying environmental pollutants
3. Understand the influence of microbial organisms in various treatment processes.
4. Understand the concepts of DNA technology, mutation and cloning of DNA technology.
5. Gain knowledge on risk assessment and the safety to be adopted in biotechnology industries.

OUTCOME

The students will be able to:

1. Gain knowledge, importance, and application of biotechnology in environmental field.
2. Identify various environmental pollutants in industries by the application of environmental biotechnology.
3. Apply the microbial technology in industries for various water; waste water and industrial effluents.
4. Implement the DNA technology, mutation construction and fusion technology in various environmental applications.
5. Prepare the report on risk assessment and can follow the safety measures to be adopted in biotechnology industries.

UNIT I INTRODUCTION 5

Principles and concepts of environmental biotechnology - usefulness to mankind, current status.

UNIT II DETOXIFICATION OF ENVIRONMENTAL POLLUTANTS 8

Degradation of high concentrated toxic pollutants - halogenated, non-halogenated, petroleum hydrocarbons, metals. Mechanisms of detoxification - oxidation, dehalogenation, biotransformation of metals, biodegradation of solid wastes.

UNIT III MICROBIAL TECHNOLOGY FOR WASTE TREATMENT 12

Biotechnological remedies for environmental pollution - decontamination of groundwater systems, subsurface environment - reclamation concepts - bioremediation. Production of proteins - biofertilizers. Physical, chemical and microbiological factors of composting - health risk - pathogens - odour management - Microbial cell-enzyme technology - adapted microorganisms - biological removal of nutrients - algal biotechnology and applications in agriculture - role of extracellular polymers. Biogas technology - case studies.

UNIT IV RECOMBINANT DNA TECHNOLOGY AND GENETIC APPLICATION 10

Concept of DNA technology - expression vectors - cloning of DNA - mutation - construction of microbial strains, radioactive probes, protoplast fusion technology - applications.

UNIT V ETHICAL AND REGULATORY ISSUES 10

Environmental effects and ethics of microbial technology - safety of genetically engineered organisms - microbial containment - Risk assessment, IPR - patents.

TOTAL = 45

TEXT BOOK:

1. Chaudhury, G. R. "Biological degradation and Bioremediation of toxic chemicals', Dioscorides Press, Oregon, 1994.

REFERENCES:

1. Martin. A.M, "Biological degradation of wastes", Elsevier Applied Science, London, 1991.
2. Blaine Metting. F (Jr.,) Soil Microbiology Ecology, Marcel Dekker Inc., 1993.
3. Wainwright, M, An Introduction to Environmental Biotechnology, 1999.
4. Old, R.W., and Primrose, S.B., Principles of Gene Manipulation, 5th Ed. Blackwell Sci. Publ., Cambridge, 2005.

PEV707 INDOOR AIR QUALITY

L	T	P	C
3	0	0	3

GOAL

To educate the students on air pollution and control in the indoor environment.

OBJECTIVES

The course should enable the students to:

1. Understand the knowledge on indoor activities and its pollution levels
2. Know about air pollution in indoor environments with respect to various buildings.
3. Gain knowledge on control of air pollutants
4. Understand the concepts and tools used in air pollution control.
5. Understand the knowledge on various air pollutants and its sources along with its control technologies.

OUTCOME

The students will be able to:

1. Assess the levels of indoor air pollution.
2. Design the air circulation and ventilation of various buildings prior to ambient air quality standards.
3. Use the air pollution control measures of arresting air pollutants in various buildings.
4. Use the concepts and tools in designing the ambient air pollutant control measures.
5. Implement pollution control technologies while designing the buildings.

UNIT I INTRODUCTION **7**

Indoor activities of inhabitants - residence time. Levels of many pollutants in indoor and outdoor air. Design and operation of buildings for improvements of public health. IAQ policy issues; sustainability; indoor air quality as a basic human right.

UNIT II INDOOR AIR POLLUTANTS **10**

Air pollutants in indoor environments, private residences, offices, schools, sand public buildings, factors that govern pollutant indoors concentrations, including ventilation. Characteristics, Consequences.

UNIT III CONTROL OF POLLUTANTS **10**

Control of several pollutant classes, such as radon, toxic organic gases, combustion byproducts, and microorganisms such as molds and infectious bacteria. Case study by an exploration of public policy related to indoor air.

UNIT IV CONCEPTS AND TOOLS **8**

Concepts and tools; exposure, material-balance models, statistical models Ventilation

UNIT V INDOOR AIR POLLUTION FROM OUTDOOR SOURCES **10**

Indoor air pollution from outdoor sources; particulate matter and ozone; Combustion byproducts; Radon and its decay products. Volatile organic components: odours and sick-building syndrome, Humidity Bio-aerosols: infectious disease transmission. Special indoor environments; A/C units in indoor, museums-labs; museums-labs, Measurement methods, Control technologies, Control strategies.

TOTAL = 45

TEXT BOOK:

1. Thaddes Godish, Indoor air and Environmental Quality, CRC Press, 2000

REFERENCES:

1. Nazaroff W.W and L Alvarez-Cohen, Environmental Engineering Science Wiley sons, New York, 2001.
2. Moroni Marco, Seifet Bernd and Lindrall Thomas, Indoor Air Quality: A Comprehensive Reference Book, Elsvier Science, Vol. 3, 1995.

PEV708 ENVIRONMENTAL POLICIES AND LEGISLATION

3 0 0 3

GOAL

To create the awareness and comprehensive knowledge in environmental law and legislations prior to environmental pollution and its control.

OBJECTIVES

The course should enable the students to

1. Understand the various Sections and subsections of civil and criminal law.
2. Study the importance of fundamental rights and directive principles of our constitution.

3. Study the various articles related to environmental law and powers and responsibilities of pollution control board.

4. Know about the awareness of various pollution and control laws related to water and air.

5. To gain knowledge on EIA, Ecolabelling, hazardous and biomedical waste handling.

OUTCOME

The students will be able to:

1. Describe the importance of civil and criminal law related to environmental legislation.

2. Gain knowledge on fundamental rights and directive principles of our constitution.

3. Understand the various environmental issues and handle the real time problems in industries.

4. Gain knowledge in pollution control laws and implement it in working sectors.

5. Understand and manage biomedical, hazardous waste, Ecolabelling, and EIA.

UNIT I INTRODUCTION **5**

Basics of jurisprudence - Environmental law relation with other disciplines - Criminal law - Common Law - Relevant sections of the Code of Civil Procedure, Criminal Procedure Code - Indian Penal Code.

UNIT II INDIAN CONSTITUTION AND ENVIRONMENT **8**

Introduction - Fundamental Rights - Directive Principles of State Policy - Article 48 (A) and 51-A(g) Judicial enforceability - Constitution and Resources management and pollution control - Indian Forest Policy (1990) - Indian Environmental Policy (1992).

UNIT III ADMINISTRATIVE REGIME & LEGAL REGIME **8**

Administrative regulations - constitution of Pollution Control Boards Powers, functions, Accounts, Audit etc. - Formal Justice Delivery mechanism Higher and Lower of judiciary - Constitutional remedies writ jurisdiction Article 32, 226 136 special reference to Mandamus and Certiorari for pollution abatement - Equitable remedies for pollution control.

UNIT IV POLLUTION CONTROL LAWS **8**

Administrative regulation under recent legislations in wear pollution control. Water (prevention & control of pollution) Act 1974 as amended by Amendment Act 1988. Water (prevention and control of pollution) Rules 1975 Water (prevention & Control or Pollution) Cess Act. 1977 as amended by Amendment Act 1987 and relevant notifications.

UNIT V ENVIRONMENTAL (PROTECTION) ACT 1986 **8**

Relevant notifications in connection with Hazardous Wastes (management and handling) Biomedical wastes (management and handling), Noise pollution, Eco-labeling, and E.I.A.

TOTAL = 45

TEXT BOOK:

1. Environmental, A., Divan and Noble M. Environmental Law and Policy in India (cases, Materials and Statutes) 1991 Tripathi Bombay.

REFERENCES:

1. Constitution of India Eastern Book Company Lucknow 12th Edn. 1997.
2. Constitutional Law of India - J.N. Pandey 1997 (31st Edn.) Central Law Agency, Allahabad.
3. Administrative Law U.P.D. Kesari 1998. Universal Book Trade, Delhi.
4. Environmental Law H.N. Tiwari, Allahabad Law Agency 1997.
5. Environmental Policy. Forest Policy, Bare Acts - Government Gazette Notification.

PEV709 ENERGY MANAGEMENT

L	T	P	C
3	0	0	3

GOAL

This course is aimed at providing the students the basics of energy conservation methods, energy auditing and the economical benefits.

OBJECTIVES

The course should enable the student to :

1. Get introduced to the principles and management of energy consumption and conservation.
2. Be familiar with energy auditing and assessment.
3. Understand conservation of energy in various industries.
4. Understand the concept of energy management and economics.
5. Analyze case studies on various industries based on energy and its conservation.

OUTCOME

The students will be able to:

1. Develop knowledge on the principles of energy consumption and conservation.
2. Develop knowledge in energy auditing and assessment.
3. Be aware of conservation of energy in various industries.
4. Be aware of the economics involved in energy conservation and management.
5. Relate the concepts of energy management to practical situations.

UNIT I SOURCE OF ENERGY **10**

Energy Scenario - Principles and Imperatives of Energy Conservation - Various Sources - Alternative - non conventional energy sources - Alternative energy sources-wind-Solar energy - Energy Consumption Pattern - Resource Availability - Role of Energy Managers in Industries.

UNIT II ENERGY AUDITING **15**

Energy Audit - Purpose, Methodology with respect of Process Industries - Power Plants, Boilers etc, - Characteristic Method Employed in Certain Energy Intensive Industries - Various Energy" Conservation Measures in Steam System - Losses in Boiler, Methodology of Upgrading Boiler Performance; Energy Conservation in Pumps, Fans, Aerators Compressors, Air conditioning and refrigeration systems, Function, Necessity

UNIT III ENERGY CONSERVATION **10**

Total Energy Systems - Concept of total Energy - Advantages & Limitations - Total Energy System & Application - Potential & Economics of total Energy systems, water heat recovery. Potential Areas for Conservation in Various Industries - Energy Management Opportunities in Electrical Heating, Lighting System, Cable Selection - Energy Efficient Motors - Factors Involved in Determination of Motor Efficiency.

UNIT IV ENERGY ECONOMICS **5**

Importance of Energy Management, Energy Economics - Discount Rate, Payback Period, Internal Rate of Return, Life Cycle Costing.

UNIT V APPLICATIONS **5**

Case studies on Sugar Industry, Thermal Power Plant; Petrochemical Industries, Educational Institutions.

TOTAL = 45

TEXT BOOK:

1. Trivedi, P R, Jolka K R, Energy Management, Commonwealth Publication, New Delhi, 1997.

REFERENCES:

1. Witte, Larry C, Industrial Energy Management & Utilization, Hemisphere Publishers, Washington, 1988.
2. CB Smith, Energy Management Principles, Pergamon Press, New York, 3rd Edition, 2004.
3. Hamies, Energy Auditing and Conservation; Methods, Measurements, Management & Case Study, Hemisphere, Washington, 1980.

PEV710 MASS TRANSFER IN AIR-WATER-SOIL INTERACTION

L	T	P	C
3	0	0	3

GOAL

To educate the students on the mechanism of material transfer between environmental components - air, water and soil.

OBJECTIVES

The course should enable the students to:

1. Gain knowledge on interaction of chemicals with various environmental components and their equilibrium phases.
2. Know about various transport mechanisms such as diffusion and mass transfer for various phases
3. Gain knowledge on exchange rate of gases and chemicals in air and the water bodies
4. Understand the exchange rate between water and the earthen material
5. Develop knowledge on mass transfer rates between air and soil.

OUTCOME

The students will be able to:

1. Understand interaction of chemicals and the equilibrium principles in industries.
2. Apply the working principles of mass transfer and diffusion in industries
3. Use the exchange rate principle theories to quantify the mixing rate of gases and chemicals in water and in air.
4. Use the concepts to quantify the exchange rate concentration between water and the earthen material
5. Implement the knowledge of mass transfer rates between air and soil in real time.

UNIT I EQUILIBRIUM AT ENVIRONMENTAL INTERFACE 10

Ideal solutions - air - water equilibrium occurrences - pure gases in contact with water - pure liquid in contact with air - partition coefficient for the air - water system. Earthen solid - waste equilibrium occurrences - pure solid and liquid chemicals in contact with water and earthen solids. Earthen solid - air equilibrium occurrences - water - liquid chemical equilibrium occurrences - thermal equilibrium at environmental interfaces.

UNIT II TRANSPORT MECHANISMS 9

Diffusion and mass transfer - molecular diffusion - eddy diffusion - mass transfer theories - mass transfer coefficients - binary mass transfer coefficients in two phases and two resistance theory of inter-phase mass transfer turbulence in the environment - fundamentals of heat transfer - analogy theories of momentum, heat and mass transfer.

UNIT III EXCHANCE RATES BETWEEN AIR AND WATER 8

De-sorption of gases and liquids from aerated basins and rivers - completely mixed basin - plug flow basin - gas exchange rates between the atmosphere and the surface of rivers - exchange of chemical across the air - water interface of lakes and oceans.

UNIT IV EXCHANGE RATES BETWEEN WATER AND THE EARTHERN MATERIAL 9

Dissolution of chemicals on the bottom of flowing streams - geometric forms - stream bottom mass transfer coefficients - natural convection dissolution - the upsurge of chemicals from the sediment - water interface of lakes - a Fikian analysis - annual upsurge rate at sediment - water interface - mass transfer coefficients at the sediment - water interface. Flux of chemicals between sediment and the overlying seawater - movement of chemicals through the benthic boundary layer.

UNIT V EXCHANGE RATES BETWEEN AIR AND SOIL 9

Turbulence above the air - soil interface - the Richardson number - chemical flux rates through the lower layer of the atmosphere - Thronthwaite - Holzman equation - evaporation of liquid chemicals spilled on land - chemicals flux rates through the upper layer of earthen material.

TOTAL = 45

TEXT BOOK:

1. Thibodeaux, L.J, "Environmental Chemo dynamics" Movement of Chemicals in Air, Water and Soil", 3rd Edition, Wiley-Interscience, New York, 2003.

REFERENCE:

1. Cusssler, E.L., "Diffusion: Mass Transfer in Fluid Systems, "Cambridge University Press, 1994.

PEV711 MARINE POLLUTION MONITORING

L	T	P	C
3	0	0	3

GOAL

To introduce the student to various features Coastal Engineering and activities and this includes Physical Ocean features, Bathymetric Survey, Ocean Pollution etc.

OBJECTIVES

The course should enable the students to:

1. Gain knowledge on ocean features and ocean currents.
2. Be familiar with marine resources.
3. Be familiar with hydrographic surveying.
4. Be acquainted with the knowledge of marine environment and its pollution.
5. Gain knowledge on marine pollution mitigation, and related international treaties.

OUTCOME

The students will be able to:

1. Develop knowledge on various factors acting on waves and tides.
2. Be aware of various marine resources and its economical and environmental benefits
3. Conduct hydrographic surveying.
4. Be aware of various pollution impacts on ocean.
5. Aware of various types of pollution mitigation and international laws of marine pollution mitigation.

UNIT I OCEANOGRAPHY 10

General features of ocean - Conservation laws - Wave characteristics and theories - Sediment transport - Tides - Ocean Currents - Thermocline circulation - General circulation of ocean waters, Tsunamis, Storm surge - Principles of Marine geology

UNIT II COASTAL ENVIRONMENT 8

Living resources - coral reefs, mangroves, seagrass, seaweeds, fishery potential - nonliving resources - manganese nodules, heavy minerals - Beaches, Estuaries, Lagoons - Shoreline changes

UNIT III MARINE SURVERYING 6

Sea surveying planning and preparation - Oceanographic instrumentation - Hydrographic Surveying - Underwater surveying - Measurement of physical properties of ocean water - sea bed sampling

UNIT IV MARINE POLLUTION AND MONITORING 14

Physiochemical properties of sea water - Sources of marine pollution and impacts on coastal ecosystems, Oil pollution - oil spill detection, dispersion, impacts on adjacent area - Oil spill modeling, mitigation measures - Oil exploration and their effects - Marine outfalls - Impacts of Ports and Harbour on marine water quality - dredging - Human intervention in estuarine ecosystem - sea water classification - Physical modeling in Coastal Engineering - Ocean monitoring satellites - Applications of Remote sensing and GIS in marine studies.

UNIT V MARINE POLLUTION CONTROL 7

National and International treaties, protocols in marine pollution - Exclusive Economic Zone - Sustainable development.

TOTAL = 45

TEXT BOOK:

1. Kennish, M.J., Pollution impacts on Marine Biotic Communities, CRC press, New York, 1998.

REFERENCES:

1. Newman, M.C., Roberts Jr. M.H., Male R.C. (Editors), Coastal and Estuarine Risk Assessment, Lewis Publishers, Washington, D.C., 2002.
2. U.S. Army Corps of Engineers, Shore Protection Manual, Washington D.C., 2002.

PEV712 ENVIRONMENTAL ECONOMICS

L	T	P	C
3	0	0	3

GOAL

This course teaches the basics of valuing the cost of environment and discuss about options involved in implementing pollution control measures in terms of economical benefits.

OBJECTIVES

The course should enable the students to:

1. Develop knowledge on basics of economics
2. Know about various economic instruments in environmental protection
3. Gain knowledge on economic principles to quantify various natural resource exploitation
4. Understand the knowledge on economic methods to valuate environmental costs and benefits
5. Learn the various methods economic analysis of pollution prevention.

OUTCOME

The students will be able to:

1. Relate the basic economic concepts in environmental engineering.
2. Apply various regulatory and economic instruments such as pigovian taxes for the environmental protection
3. Use economic principles and tools to quantify various natural resource exploitation.
4. Economically analyze and quantify the pollution prevention options by using profitability analysis.
5. Apply profitability analysis for real life problem.

UNIT I INTRODUCTION **8**

Human Environment relationship - Valuation of asset - Normative criteria for decision making: Static and dynamic efficiency - Economy and the Environment - Resource use in Society - Consumer Choice theory - Efficiency and welfare - Monetary economy and markets - Competition and efficiency - monopoly - public goods - externalities - Trade and environment - International environmental agreements.

UNIT II ECONOMIC INSTRUMENTS FOR ENVIRONMENTAL PROTECTION **10**

Regulatory versus Economic Instruments - Charges and Subsidies - Non Compliance fees, bonds and deposit refunds - Marketable permits - Pigovian and Pollution Taxes - Polluter pays Principle - Evaluation of Instruments - Choice of instruments for Environmental policy.

UNIT III ECONOMICS OF NATURAL RESOURCE EXPLOITATION **10**

Types, scarcity and classification of Natural Resources - renewable and non renewable resources - Capital theory - Production costs and Environmental Costs - Economics of Forestry and fisheries exploitation - Utilitarianism and discounting - efficient and optimal use of environmental resources.

UNIT IV VALUATION OF ENVIRONMENTAL COSTS AND BENEFITS 10

Principles of Cost benefit analysis - Valuing the Environment - Direct and indirect methods - Surrogate markets - travel cost - Non-market valuation - Alternatives to valuation - Measuring Resource Scarcity - Costs of Sustainability - Assessment of Loss of Ecology - Uncertainties - Environmental accounting - Environmental indicators.

UNIT V METHODS OF PROFITABILITY ANALYSIS 10

Payback period - Present value estimation - Internal rate of return - Opportunity costs - Economic analysis of Pollution Prevention options - Lending Agencies - Case studies.

TOTAL = 45

TEXT BOOK:

1. Nick Haniey, Jaison F. Shogren and Ben White (1999), "Environmental Economics", theory and practice" Macmillan India Ltd, New Delhi.

REFERENCES:

1. Roger Perman, Yue Ma and James McGilvray (1997) "Natural Resources and Environmental economics", Second edition, Addison Wesley Longman Ltd., Singapore.
2. John Bowers (1997) "Sustainability and Environmental Economics", Addison Wesie Longman Ltd., Singapore.

PEV713 SUSTAINABLE DEVELOPMENT AND ENVIRONMENT

L	T	P	C
3	0	0	3

GOAL

To introduce the concept of sustainable development as a tool to establish functional linkages among the social, economic and environmental spheres.

OBJECTIVES

The course should enable the student to:

1. Be acquainted with the concept of sustainable development based on global environmental issues.
2. Be familiar with social, economical and environmental dimensions of sustainable development.
3. Gain knowledge on achieving sustainability using performance indicators.
4. Learn the steps of action plan for implementation of sustainable development.
5. Be familiar with the contribution of developed countries on sustainable development.

OUTCOME

The students will be able to:

1. Develop knowledge on sustainable development concepts.

2. Describe social, economical and environmental issues of sustainable development.

3. Be aware of the performance indicators to asses sustainable development.

4. Identify the steps in action plan for implementation of sustainable development.

5. Relate to the integrated approach for resource protection and management.

UNIT I CONCEPT OF SUSTAINABLE DEVELOPMENT 9

Environment and Development - Population, Poverty and Pollution - Global and Local environmental issues - Resource Degradation - Greenhouse gases - Desertification - Industrialization - Social insecurity, Globalization and environment. History arid emergence of the concept of sustainable development - Objectives of Sustainable Development.

UNIT II COMPONENTS AND DIMENSIONS OF SUSTAINABLE DEVELOPMENT 9

Components of sustainability - Complexity of growth and equity - Social, economic and environmental dimensions of sustainable development - Environment - Biodiversity - Natural Resources - Ecosystem integrity - Clean air and water - Carrying capacity - Equity, Quality of Life, Prevention, Precaution, Preservation and Public participation-structural and functional linking of developmental dimensions

UNIT III FRAMEWORK FOR ACHIEVING SUSTAINABILITY 9

Operational guidelines - Interconnected prerequisites for sustainable development - Empowerment of Women, Children, Youth, Indigenous People, Non-Governmental Organizations, Local Authorities, Business and Industry - Science and Technology for sustainable development - Performance indicators of sustainability and Assessment mechanism - Constraints and barriers for sustainable development.

UNIT IV SUSTAINABLE DEVELOPMENT OF SOCIO-ECONOMIC SYSTEMS 8

Demographic dynamics of sustainability - Policies for socio-economic development - Strategies for implementing eco-development programmes - Sustainable development through trade - Economic growth - Action plan for implementing sustainable development - Urbanization and Sustainable Cities - Sustainable Energy and Agriculture - Sustainable Livelihoods.

UNIT V SUSTAINABLE DEVELOPMENT AND INTERNATIONAL RESPONSE 10

Role of developed countries in the development of developing countries - International summits - Stockholm to Johanesburg - Rio Principles - Agenda 21 - Conventions - Agreements - Tokyo Declaration - Doubling statement - Transboundary issues - Integrated approach for resource protection and management.

TOTAL = 45

TEXT BOOK:

1. Sayer, J. and Campbell, B., The Science of Sustainable Development: Local Livelihoods and the Global Environment (Biological Conservation, Restoration & Sustainability), Cambridge University Press, London, 2003.

REFERENCES:

1. Kirkby, J., O'Keefe, P. and Timberlake, Sustainable Development, Earthscan Publication; London, 1993.
2. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publications, London, 1998.
3. Bowers, J., Sustainability and Environmental Economics - An Alternative Text, Longman London, 1997.