

**University of Pune**

**Syllabus of**

**Master of Engineering-Civil (M.E. Civil)**

**With Specialization in**

**ENVIRONMENTAL ENGINEERING**

**2013-2014**

## SEMESTER-I

Sr. No.	Code	Subject	Teaching Scheme	Examination Scheme					Credits
			Lect. / Pr.	Paper		TW	Oral/ Presentation	Total	
				In sem. Assessment	End sem. Assessment				
1.		Environmental Legislation & Management Systems	4	50	50	--	--	100	4
2.		Environmental Chemistry & Micro-Biology	4	50	50	--	--	100	4
3.		Physico-Chemical Process for Water and Waste Water Treatment	4	50	50	--	--	100	4
4.		Research methodology	4	50	50	--	--	100	4
		*Elective I	5	50	50	--	--	100	5
		Lab Practice-I	4	--	--	50	50	100	4
		<b>TOTAL</b>	<b>25</b>	<b>250</b>	<b>250</b>	<b>50</b>	<b>50</b>	<b>600</b>	<b>25</b>

## SEMESTER—II

Sr. No.	Code	Subject	Teaching Scheme	Examination Scheme					Credits
			Lect. / Pr.	Paper		TW	Oral/ Presentation	Total	
				In sem. Assessment	End sem. Assessment				
5.		Industrial Waste Water Management	4	50	50	--	--	100	4
6.		Air pollution & Control	4	50	50	--	--	100	4
7.		Solid waste and Hazardous Waste Management	4	50	50	--	--	100	4
		**Elective-II	5	50	50	--	--	100	5
		Lab Practice-II	4	--	--	50	50	100	4
		Seminar-I	4	--	--	50	50	100	4
		<b>TOTAL</b>	<b>25</b>	<b>200</b>	<b>200</b>	<b>100</b>	<b>100</b>	<b>600</b>	<b>25</b>

### SEMESTER—III

Sr. No.	Code	Subject	Teaching Scheme	Examination Scheme					Credits
			Lect. / Pr.	Paper		TW	Oral/ Presentation	Total	
				In sem. Assessment	End sem. Assessment				
8.		Environmental Sanitation	4	50	50	--	--	100	4
9.		EIA	4	50	50	--	--	100	4
		***Open Elective	5	50	50	--	--	100	5
		Seminar-II	4	--	--	50	50	100	4
		Project Stage -I	8	--	--	50	50	100	8
		<b>TOTAL</b>	<b>25</b>	<b>150</b>	<b>150</b>	<b>100</b>	<b>100</b>	<b>500</b>	<b>25</b>

## SEMESTER—IV

Sr. No.	Code No.	Course Title	Teaching Scheme	Examination SchemeMarks				Credits
				Paper	TW	Oral/Prese ntation	Total	
		Seminar-III	5	--	50	50	100	5
		Project Work Stage -II	20	--	150	50	200	20
		<b>TOTAL</b>	<b>25</b>	<b>--</b>	<b>200</b>	100	<b>300</b>	25

**Notes:-**

Examination Scheme

Compulsory subjects: Credits 4

Total marks: 100

In semester assessment: 50 (comprising of 2 tests + quiz + assignments+----) to be done by institute

End semester assessment: 50 (theory paper) conducted by the University

Suggested pattern:

In semester assessment: On 4 units

End semester assessment: Question 1 or Question 2 of 18 marks on Units 1-4 with internal options

Question 3 or 4: Unit 5- 16 marks

Question 5 or 6: Unit 6- 16 marks (total 50 marks)

Elective: Credits 5 (section 1 Technical + section 2 Non-tech)

Total marks: 100 (entire assessment to be done at the institute level)

Elective subjects: Credits 2 (Technical)

In semester assessment: 50 % weightage (comprising of 2 tests + quiz + assignments+----)

End semester assessment: 50%

Elective subjects: Credits 1 (Non-Technical)

In semester assessment: 50 % weightage (comprising of 2 tests + quiz + assignments+----)

End semester assessment: 50%

## **SEMESTER - I**

### **1. Environmental Legislation and Management System**

#### **Teaching Scheme**

**Lectures: 4 hours/week**

#### **Examination Scheme**

**Theory Paper: 100 Marks**

**Credits: 4**

**In Semester Assessment: 50 Marks**

**End Semester Assessment: 50 Marks**

#### **MODULE-1**

**(7/8 hours)**

Indian Constitution and Environmental Protection – National Environmental policies – Precautionary Principle and Polluter Pays Principle – Concept of absolute liability – multilateral environmental agreements and Protocols – Montreal Protocol, Kyoto agreement, Rio declaration, Functions and Constitutions of SPCB and CPCB.

#### **MODULE-2**

**(7/8 hours)**

Water (P & Cp) Act, 1974: Power & functions of regulatory agencies - responsibilities of Occupier, Provision relating to prevention and control, Scheme of Consent to establish, Consent to operate – Conditions of the consents – Outlet – Legal sampling procedures, State Water Laboratory – Appellate Authority – Penalties for violation of consent conditions etc. Provisions for closure/directions in apprehended pollution situation.

#### **MODULE-3**

**(7/8 hours)**

Air (P & Cp) Act, 1981: Power & functions of regulatory agencies - responsibilities of Occupier, Provision relating to prevention and control, Scheme of Consent to establish, Consent to operate – Conditions of the consents – Outlet – Legal sampling procedures, State Air Laboratory – Appellate Authority – Penalties for violation of consent conditions etc. Provisions for closure/directions in apprehended pollution situation.

#### **MODULE-4**

**(7/8 hours)**

Environment (Protection) Act 1986: Genesis of the Act – delegation of powers – Role of Central Government - Latest EIA Notification – Sitting of Industries – Coastal Zone Regulation - Responsibilities of local bodies mitigation scheme etc., for Municipal Solid Waste Management.

**MODULE-5****(7/8 hours)**

Fundamentals of Environmental Management and ISO 14000 series: Background and development of ISO 14000 series. Environmental management Plans, principles and elements. The ISO 14001- Environmental management systems standard. Environmental law in India: Environmental policy and laws.

**MODULE-6****(7/8 hours)**

Role of Judiciary and NGO: International concern for environment, Role of judiciary in environmental protection, Environmental audit, ISO certification, Environmental management system, International and national efforts at environmental protection; Environmental policy. Relevant Provisions of Indian Forest Act, Public Interest Litigation - Writ petitions - Supreme Court Judgments in Landmark cases.

**MODULE – 7****(7/8 hours)**

Important powers and functions of the MPC board under both the water and air acts, Role of SPCB in implementation of various notifications issued by Central Govt. under Environment (Protection) Act, 1986, Hazardous waste (Management and Handling) Rules, 1989, Bio-Medical Waste (M & H) Rules, 1998, Notifications issued by Govt. of Maharashtra for the protection and improvement of environment.

**MODULE – 8****(7/8 hours)**

Responsibilities of Pollution Control Boards under Hazardous Waste rules and that of occupier, authorization – responsibilities of generators and role of Pollution Control Boards, Procedure of public hearing for obtaining Environmental Clearance. Role of NGO in Nature Conservation.

**Reference Books:**

1. CPCB, "Pollution Control acts, Rules and Notifications issued there under "Pollution Control Series – PCL/2/1992, Central Pollution Control Board, Delhi, 1997.
2. Shyam Divan and Armin Roseneranz "Environmental law and policy in India "Oxford University Press, New Delhi, 2001.
3. Greger I. Megregor, "Environmental law and enforcement", Lewis Publishers, London 1994.
4. Constitution of India [ Referred articles from part-III, part-IV and part-IV A ]

5. Pares Distn. Environmental Laws in India (Deep, Lated edn.)
6. Handbook of environmental management and technology: Gwendolyn Holmes, Ben Ramnarine Singh, Louis Theodore.
7. The ISO 14000 Handbook: Joseph Cascio.
8. ISO 14004: Environmental management systems: General guidelines on principles, systems and supporting techniques (ISO 14004:1996 (E)).
9. ISO 14001: Environmental management systems: Specification with guidance for use (ISO 14001:1996b(E)) ( International organization for standardization-Switzerland).

## 2. Environmental Chemistry & Microbiology

### Teaching Scheme

Lectures: 4 hours/week

### Examination Scheme

Theory Paper : 100 Marks

Credits: 4

In Semester Assessment: 50 Marks

End Semester Assessment: 50 Marks

### MODULE – 1

(7/8 hours)

**Fundamentals of Chemistry for Environmental Engineering:** Introduction, Basic Concepts from General Chemistry, Physical Chemistry, Equilibrium Chemistry, Organic, Biochemistry, Colloid Chemistry and Nuclear Chemistry.

### MODULE – 2

(7/8 hours)

**Chemistry of pollutants:** Chemistry of pollutants in the Atmosphere, Solid, liquid, gaseous and radioactive pollutants in the atmosphere, formation of physical processes of pollutants in the atmosphere, Effects of temperature, solar radiation and wind current on the various pollutants, Effect of gravitational force and rain scrubbing on air pollutants, Chemical properties of air pollutants chemisorptions, effect of solar radiation on acidic basic characteristics,

### MODULE – 3

(7/8 hours)

**Chemistry of Various Organic and Inorganic Compounds:** Carcinogenic compounds and their effects. Hydrocarbons: Chemistry of hydrocarbon decay, environmental effects, effects on macro and micro organisms.

**Surfactants:** Cationic, anionic and nonionic detergents, modified detergents.

**Pesticides:** Classification, degradation, analysis, pollution due to pesticides and DDT problems.

### MODULE – 4

(7/8 hours)

**Synthetic Polymers:** Microbial decomposition, polymer decay, ecological and consideration, Photosensitize additives.

**Lead and its compounds:** Physical and chemical properties, behavior, human exposure, absorption, influence. Aflatoxin occurrence, chemical composition and properties metabolism, acute toxicity, carcinogenicity

**MODULE – 5** **(7/8 hours)**

**Optical Methods:** Principles of Optical Methods such as Absorption, Spectrophotometer, Flame photometry, Fluorometry. Principles of Chromatographic Methods such as Gas chromatography, High Performance Liquid Chromatography and Ion Chromatography.

**MODULE – 6** **(7/8 hours)**

**Environmental Microbiology:** Scope and Areas of Environmental Microbiology, Cell and its Structure, Introduction to Enzyme and Metabolic Reactions, Aerobic and anaerobic respiration, Classification.

**MODULE – 7** **(7/8 hours)**

**Microscopy and Micrometry:** Observations, Measurements and Isolation of Microorganism, Different Cultures, Media and Techniques of Staining and Enumeration of microorganism.

**MODULE – 8** **(7/8 hours)**

**Applied Microbiology:** of Soil, Air, Water and Biological Processes of Wastewater Treatments, Industrial Microbiology.

**Reference Books:**

1. C.N. Sawyer, P.L. McCarty and G. F. Parkin, Chemistry for Environmental Engineering and Science, Tata McGraw-Hill, Fifth edition, New Delhi, 2003.
2. G.W. Vanloon and S.J. Duffy 'Environmental chemistry – a global perspective, Oxford University press, New York., 2000.
3. Tortora. G.J, B.R. Furke, and C.L. Case, "Microbiology-An Introduction" (4th Ed.), Benjamin/Cummings Publ. Co., Inc., California, 1992.
4. Pelczar, M. J.Chan E.C.S. and Krieg, N. R. Microbiology, Tata McGraw Hill, New Delhi,1993
5. Benefield L. D., Judkins J.F. and Weaned R.L., Process Chemistry for Water and Wastewater Treatment, Prentice Hall, Inc. London, 1987.

6. R.E. McKinney, "Microbiology for Sanitary Engineers", McGraw Hill Book Company, 1962.
7. W.G. Walter and R.H. McBee, "General Microbiology", East West Edition, 1969.

### 3. Physico-Chemical Process for Water and Waste Water Treatment

#### Teaching Scheme

Lectures: 4 hours/week

#### Examination Scheme

Theory Paper : 100 Marks

Credits: 4

In Semester Assessment: 50 Marks

End Semester Assessment: 50 Marks

#### MODULE – 1

(7/8 hours)

**Process Dynamics, Reactions and Reactors:** Reactors Used for the Treatment of Wastewater, Mass transport processes, The Mass-Balance Principle, Reactions kinetics and reaction rates, Configurations of ideal and non-ideal reactors, Principle of ideal reactor design, Completely mixed batch reactors, Completely mixed flow reactors, Determination of rate parameters in CMF reactors, Plug Flow Reactors.

#### MODULE – 2

(7/8 hours)

**Coagulation and Flocculation:** Coagulation Process, Stability of colloids, Repulsive and Attractive Potentials, destabilization of Colloids, Transport of colloidal particles, Orthokinetic and Perikinetic flocculation, Destabilization in Water and Wastewater Treatment by Al(III) and Fe(III).

#### MODULE – 3

(7/8 hours)

Synthetic Organic polymers, Activated Silica, Selection of a coagulant, Sedimentation Processes, Zone Settling, Compression, Sedimentation tank design for water and wastewater, Design of tube settlers, Concept and design aeration and gas transfer.

#### MODULE – 4

(7/8 hours)

**Water and wastewater purification systems:** biological and chemical processes for water and wastewater purification. Secondary and Tertiary treatment systems with their design. Aeration and gas transfer.

#### MODULE – 5

(7/8 hours)

**Filtration:** Filtration process; Principle Mechanisms of filtration, Filter Hydraulics backwash hydraulics, Rate control Patterns and Methods, Head loss patterns at Constant Rate, Slow sand and Rapid sand Filtration and their performances, Design of Gravity filters, Design and

Operating variables for deep Granular Filters: Filter media, Fluidization and bed expansion in backwashing, Under drainage systems with design, operational problems.

**MODULE – 6** **(7/8 hours)**

**Disinfection:** History and modes of disinfection, rates of disinfection, disinfection concentration Factors affecting disinfection such as temperature, pH and organic matter, Chemical Disinfectants – chlorine and Chlorine derivatives; Non Chemical Methods for Disinfection : Ozonation; UV radiation.

**MODULE – 7** **(7/8 hours)**

**Reverse Osmosis:** Osmosis and Osmotic Pressure, Water and Solute Diffusion, Properties of Cellulose Acetate Membranes, Feed temperature and pH, Solute rejection, System Design, Pretreatment and Flux Maintenance, Application.

**Chemical Oxidation:** Limitation of Oxidative Processes and Oxidizing agents in Water and Wastewater Treatment, Principle and Theories of Chemical Oxidation, Concept and definition, Thermodynamic and kinetic consideration, Role of pH in Chemical Oxidation, Balancing Redox reaction

**MODULE – 8** **(7/8 hours)**

**Adsorption processes:** types of adsorption, factors influencing, adsorption equilibrium and development of adsorption isotherms, activated carbon adsorption kinetics, analysis and design of Granular Activated carbon and PAC contactors.

**Miscellaneous methods: Ion Exchange:** Exchange processes, Exchange Materials, Synthetic Exchange resins, Exchange reaction, Equilibria, Exchange Isotherm

**Reference Books:**

1. Weber, W.J., Physicochemical processes for water quality control, John Wiley and sons, Newyork, 1983.
2. Peavy, H.S., Rowe, D.R. and Tchobanoglous, G. Environmental Engineering, McGraw Hills, New York 1985.
3. Metcalf and Eddy, Wastewater Engineering, Treatment and Reuse, Tata McGraw-Hill Publication, New Delhi, 2003.
4. Water & Waste Water Engineering by Fair and Gayer. C.A. Sastry, Water Treatment Plants, Narosa Publishing House, Bombay, 1996.

## 4. Research Methodology

### Teaching Scheme

Lectures: 4 hours/week

### Examination Scheme

Theory Paper: 100 Marks

Credits: 4

In Semester Assessment: 50 Marks

End Semester Assessment: 50 Marks

Duration: 2 hours

### MODULE-1

(10 hours)

#### Research Problem :

Meaning of research problem, Sources of research problem, Criteria / Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem.

### MODULE-2

(10 hours)

#### Basic Instrumentation:

Instrumentation schemes, Static and dynamic characteristics of instruments used in experimental set up, Performance under flow or motion conditions, Data collection using a digital computer system, Linear scaling for receiver and fidelity of instrument, Role of DSP if collected data contains noise.

### MODULE-3

(10 hours)

#### Applied statistics:

Regression analysis, Parameter estimation, Multivariate statistics, Principal component analysis, Moments and response curve methods, State vector machines and uncertainty analysis.

### MODULE-4

(10 hours)

#### Modeling and prediction of performance:

Setting up a computing model to predict performance of experimental system, Multiscale modeling and verifying performance of process system, Nonlinear analysis of system and asymptotic analysis, Verifying if assumptions hold true for a given apparatus setup, Plotting family of performance curves to study trends and tendencies, Sensitivity theory and applications.

**MODULE-5****(10 hours)****Developing a Research Proposal:**

Format of research proposal, Individual research proposal, Institutional proposal of a student – a presentation and assessment by a review committee consisting of Guide and external expert only. Other faculty members may attend and give suggestions relevant to topic of research.

**MODULE-6****(10 hours)****Computer Applications:**

- a) Computer applications for matrix operations, solution of ordinary and partial differential equations.
- b) Computer applications for solution of transcendental equation, regression analysis and numerical integration.

**Reference Books:**

1. 'Research methodology: an introduction for science & engineering students', by Stuart Melville and Wayne Goddard
2. 'Research Methodology: An Introduction' by Wayne Goddard and Stuart Melville
3. 'Research Methodology: A Step by Step Guide for Beginners', by Ranjit Kumar, 2<sup>nd</sup> Edition
4. 'Research Methodology: Methods and Trends', by Dr. C. R. Kothari
5. 'Operational Research' by Dr. S.D. Sharma, Kedar Nath Ram Nath & co
6. Software Engineering by Pressman

## SEMESTER-I

### Elective-I

#### Teaching Scheme

Lectures: 5 hours/week

#### Examination Scheme

Theory Paper: 100 Marks

Credits: 5

In Semester Assessment: 100 Marks

#### Technical Subjects:

1.	Environmental Biotechnology.	--	2 Credits
2.	Water Quality Modelling.	--	2 Credits
3.	Air Quality Modelling.	--	2 Credits
4.	Design of Environmental Structures	--	2 Credits

#### Non-Technical Subjects:

1.	Mass Communication, Photography and Videography	--	1 Credit
2.	Cyber Security.	--	1 Credit

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### 1. Environmental Biotechnology -- 2 Credits

#### MODULE - 1: (1 credit, 15 hours, 2 modules)

##### Module – A

(7/8 Lectures)

Environmental Biotechnology -Principles and concepts - scope and importance, usefulness to mankind. Biotechnological remedies for environmental pollution - decontamination of groundwater – Bioremediation - Production of proteins – biofertilizers - Physical, chemical and microbiological factors of composting – health risk – pathogens – odor management

##### Module – B

(7/8 Lectures)

Genetic engineering structure of DNA, RNA, Replication of DNA, genetic code, Transcription, Protein synthesis, Biotechnological remedies for environmental pollution, decontamination of groundwater – bioremediation. Microbial cell/enzyme technology – adapted microorganisms – biological removal of nutrients – algal biotechnology– extra cellular polymers - Biogas technology.

#### MODULE - 2: (1 credit, 15 hours, 2 modules)

##### Module – A

(7/8 Lectures)

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

Environmental effects and ethics of microbial technology – genetically engineered organisms- Microbial containment-Risk assessment.

## **Module – B**

**(7/8 Lectures)**

**Microbiology of waste water treatment.** a) Aerobic processes: Activated sludge, oxidation ditches, trickling filters, towers, rotating discs, rotating drums, oxidation ponds. b) Anaerobic processes : Anaerobic digestion, anaerobic filters, Up flow anaerobic sludge blanket reactor. biofertilizers , Physical, chemical and microbiological factors of composting

### **Reference Books:**

1. Microbial Biotechnology : A. N. Glazer and H. Nikaido .
2. Molecular Biotechnology : Gleek and Pasternack.
3. Biotechnology : A Text Book of Industrial Microbiology, T. D. Brock,
4. Industrial Microbiology : Prescott and Dunn.
5. Biotechnology : B. D. Singh , Kalyani Publishers.
6. T.V.Ramachandra, Soil & Ground Water Pollution from Agricultural activities, TERI
7. Biological degradation and Bioremediation of toxic chemicals: Chaudhury, G.R., Dioscorides Press,Oregon, 1994.
8. Biological degradation of wastes: Martin. A.M, Elsevier Applied Science, London, 1991.
9. Soil Microbiology Ecology: Blaine Metting. F (Jr.,) Marcel Dekker Inc., 1993.

## 2. Water Quality Modeling.

-- 2 Credits

### MODULE – 1: (1 credit, 15 hours, 2 modules)

#### MODULE – A (7/8 Lectures)

**Modeling Concepts :** Casual and statistical models-Characteristics- Steps in model development - Importance of model building.- conservation of mass and mass balance – calibration and verification of models; Transport phenomena – Advection, diffusion, dispersion, simple transport models; chemical reaction kinetics – Law of mass action, Rate constants, reaction order, types of reactions, equilibrium principles

#### MODULE – B (7/8 Lectures)

**Water Quality Modeling:** Water quality models – Historical development – Mass balance equation – Streeter - Phelps Equation – Modification to Streeter – Phelps Equation – Waste load allocations – Dissolved oxygen in Rivers and estuaries;

### MODULE - 2: (1 credit, 15 hours, 2 modules)

#### MODULE – A (7/8 Lectures)

**Water Quality Models:** Surface and sub surface water quality models, Lake Water Quality Models: Models for Nitrogen, Bacteria, Phosphate and toxicants - Ground Water Quality Modeling - Contaminant solute transport equation, Numerical methods.

#### MODULE – B (7/8 Lectures)

**Water Quality Index:** Categories of water quality index. Determination of water quality index (WQI): Industrial and municipal effluent index, ambient water quality index, combined water quality index and Delphi method.

#### Reference Books:

1. Thomann and Muller, Principles of surface water quality modelling and control
2. Chapra, Surface water quality modelling
3. Steven C. Chapra, Surface Water Quality Modelling, Tata McGraw-Hill Companies, Inc., New Delhi, 1997.

4. J.L. Schnoor, Environmental Modelling Fate and Transport of Pollutants in Water, Air and Soil, 4. John Wiley & Sons Inc., New York, 1996.
5. E.V. Thomson, Principles of Surface Water Quality Modelling and Control, Happer and Row Publishers New York, 1987.
6. M.D. Palmer, Water Quality Modelling, the World Bank Washington DC.

### 3. Air Quality Modeling

-- 2 Credits

#### MODULE - 1: (1 credit, 15 hours, 2 modules)

##### Module – A

(7/8 Lectures)

**Air Pollution Modeling:** Chemistry of air Pollutants - Atmospheric reactions, sinks for air pollution –Transport of air Pollutants – Meteorological settling for dispersal of air pollutants- vertical structure of temperature and stability, atmosphere, transport and diffusion of stack emission –atmospheric characteristics significant to transport and diffusion of stack emission – stack plume characteristics.

##### Module – B

(7/8 Lectures)

**Air Quality Models:** Types modeling technique, modeling for non reactive pollutants, single source, short term impact, multiple sources and area sources, fixed box models- diffusion models –

#### MODULE - 2: (1 credit, 15 hours, 2 modules)

##### Module – A

(7/8 Lectures)

Gaussian plume derivative- modification of Gaussian plume equation- long term average- multiple cell model – receptor oriented and source oriented air pollution models- model performance, accuracy and utilization.

##### Module – B

(7/8 Lectures)

Air quality index: categories of air quality index, determination of air quality index (AQI): National AQI, Extreme value indices, Regional indices.

#### Reference Books:

1. J. L. Schnoor, Environmental Modeling Fate and Transport of Pollutants in Water, Air and Soil, John Wiley & Sons Inc., New York, 1996.
2. Arthur C. Stern, Air Pollution, Air Pollutants, their transformation and Transport, (Ed.), (Third Ed.) Volume I, Academic Press, 2006.

## **4. Design of Environmental Structures**

**-- 2 Credits**

### **MODULE - 1: (1 credit, 15 hours, 2 modules)**

#### **Module – A**

**(7/8 Lectures)**

Structural Design of Elevated Service Reservoirs: Rectangular, Circular type. Design of staging for wind and earthquake forces, container with flat base and domed bottom. Membrane analysis, Effect of Joint reactions due to continuity.

#### **Module – B**

**(7/8 Lectures)**

Structural design of water retaining structures like Primary Clarifier (Circular & Rectangular) for WTP & STP; Biological Reactors (Circular & Rectangular) for STP for worst load conditions;

### **MODULE - 2: (1 credit, 15 hours, 2 modules)**

#### **Module – A**

**(7/8 Lectures)**

Structural design of various components of WTP & STP (Underground / partially below & above ground).

#### **Module – B**

**(7/8 Lectures)**

Design considerations including loads such as traffic load, backfill load, live load etc. for Appurtenances like man-holes, concrete bedding and thrust blocks for sewers, rising mains etc.

### **Reference Books :**

1. T.Y. Lin & Ned H. Burns – Design of Prestressed Concrete Structures, John Wiley Publication
2. N. Krishna Raju – Prestressed Concrete, Tata McGraw Hill Publication Co
3. Edward Nawy – Prestressed Concrete – A Fundamental Approach, Prectice Hall International
4. B.C. Punmia, Ashok K. Jain, Arun K. Jain – Reinforced Concrete Structures Vol. II, Laxmi Publications, New Delhi
5. Publications, New Delhi
6. N.C. Sinha, S.K. Roy – Fundamentals of Reinforced Concrete, S. Chand & Co. Ltd, New

Delhi.

7. P.C. Varghese – Advanced Reinforced Concrete Design, Prentice Hall of India Pvt. Ltd., New Delhi
8. IS: 456: Indian Standard code of practice for plain and reinforced concrete, Bureau of Indian Standards, New Delhi.
9. IS: 1343: Indian Standard code of practice for Prestressed concrete, Bureau of Indian Standards, New Delhi.
10. IS: 1893: Indian Standard Code of practice for criteria for Earthquake resistant design of structures, Bureau of Indian Standards, New Delhi.
11. IS: 3370-Indian Standard code of practice for concrete structures for storage of liquids, Bureau of Indian Standards, New Delhi.

**SEMESTER -- I**  
**LAB PRACTICE I**

**Teaching Scheme**  
**Lect./Pr. : 4 hours/week**

**Examination Scheme**  
**Term work: 50 Marks**  
**Oral / Presentation: 50 Marks**  
**Credits: 4**

The term work will consist of a journal giving details of the following with analysis from Industrial wastewater

- 1] Study on Sampling and preservation of samples.**
- 2] Preparation of Standard Solutions.**
- 3] Demand analysis for the following from Industrial wastewater.**
  - (a) Dissolved oxygen.
  - (b) Chemical oxygen Demand
  - (c) Biochemical oxygen demand
- 4] Nutrient Analysis from sewage and Industrial Wastewater using UV-Visible Spectrophotometer**
  - (a) Total Nitrogen
  - (b) Nitrogen ammonia
  - (c) Nitrogen (Nitrate)
  - (d) Nitrogen (Nitrites)
  - (e) Phosphates Total & other form
- 5] Following analysis from water and Wastewater**
  - a) Sulphates,
  - b) Nitrates,
  - (c) Oil & Grease
  - (d) Phenols
  - (e) Volatile acids
- 6] Study of Stack monitoring process.**
- 7] GIS Applications in Environmental Engineering**

Introduction to GIS, concepts and data base structure, introduction to GIS software.  
Introduction to Remote Sensing. Applications in Environmental Engineering.

## SEMESTER II

### 5. Industrial Waste Water Treatment Management

#### Teaching Scheme

Lectures: 4 hours/week

#### Examination Scheme

Theory Paper: 100 Marks

Credits: 4

In Semester Assessment: 50 Marks

End Semester Assessment: 50 Marks

#### MODULE – 1

(7/8 hours)

**Sources of Pollution:**– Sources and Characteristics of industrial wastewater – Environmental impacts – Regulatory requirements – generation rates —Prevention vs Control of Industrial Pollution– Toxicity and Bioassay tests ,Source reduction techniques – Waste Audit -Evaluation of pollution prevention options.

#### MODULE – 2

(7/8 hours)

**Wastewater Treatment:**,Waste minimization - Equalization - Neutralization – Oil separation – Flotation –Precipitation – Heavy metal Removal – adsorption – Aerobic and anaerobic biological

Treatment – Sequencing batch reactors – High Rate reactors -

#### MODULE – 3

(7/8 hours)

**Advanced Treatment Methods:** Nitrification and De-nitrification – Phosphorous removal – Heavy metal removal – Membrane Separation Process – Air Stripping and Absorption Processes.

#### MODULE – 4

(7/8 hours)

Special Treatment Methods Chemical oxidation –Ozonation – Photocatalysis – Wet Air Oxidation – Evaporation – Ion Exchange – Membrane Technologies – Nutrient removal Disposal of Treated Waste.

**MODULE – 5****(7/8 hours)**

**Industrial Waste Study:** Manufacturing process and sources of effluent from the process of industries like chemical, fertilizer, petroleum, petro -chemical, paper, sugar, distillery, tannery, food processing, dairy and steel manufacturing.

**MODULE – 6****(7/8 hours)**

**Industrial Waste Management:** Characteristics and composition of effluent and different methods of treatment & disposal of effluent for the following industries:

Steel, Petroleum Refineries, Tanneries, Atomic Energy Plants and other Mineral Processing Industries.

**MODULE – 7****(7/8 hours)**

**Common Effluent Treatment Plants (CETPs):** Location, Need, General Design considerations and principles, Operation & Maintenance Problems, Zero effluent discharge systems, Wastewater reuse, Waste Audit.

**MODULE – 8****(7/8 hours)**

Complete design of wastewater treatment plant of any industry listed above with all components, details, drawings and cost estimation.

Dyestuff and dye manufacturing industries with method of treatment—adsorption, Treatment with polymer coagulation.

**Reference Books:**

1. W. Wesley Eckenfelder Jr., Industrial Waste Water Pollution Control.
2. Arceivala, S.J., Wastewater Treatment for Pollution Control, McGraw-Hill, 1998.
3. Frank Woodard, Industrial waste treatment Handbook, Butterworth Heinemann, New Delhi, 2001.
4. M. N. Rao & Datta, Waste water treatment.
5. N.L. Nemerow, Liquid waste of Industry, Addison Wesley. 1996
6. Callegly, Forster and Stafferd, Treatment of Industrial Effluent, Hodder and Stoughton. 1988
7. Hardam S. Azad, (ED), Industrial Wastewater Management Hand Book 1988.
8. Indian standards: IS: 2490 (1963), IS: 3306 (1065).

## 6. Air Pollution and Control

### Teaching Scheme

Lectures: 4 hours/week

### Examination Scheme

Theory Paper : 100 Marks

Credits: 4

In Semester Assessment: 50 Marks

End Semester Assessment: 50 Marks

### MODULE – 1

(7/8 hours)

**Introduction:** Definition, Sources and classification of Air Pollutants, Photochemical smog, Effects of air pollution on health, vegetation & materials, air quality, Global effects of air pollution.

### MODULE – 2

(7/8 hours)

**Meteorology:** The atmosphere, zones of atmosphere, scales of meteorology, meteorological parameters, Heat, Wind, Pressure, Moisture and humidity, Rainfall and precipitation, Temperature lapse rate, Maximum mixing depth (MMD), Plume behavior, Effect of topography on pollutant dispersion, effect of air pollutant on meteorology, Air pollution modeling, Minimum stack height.

### MODULE – 3

(7/8 hours)

**Modeling of Dispersion of Air Pollutants:** Dispersion of Air pollutants. Theories on modeling of Air pollutants. Gaussian model etc. Equations of the estimation of pollutant concentrations. Plume Rise – Equations for estimation. Effective stack height and mixing depths.

### MODULE – 4

(7/8 hours)

**Particulate Pollution Control Methods:** Dilution, Source control, Control by using equipments such as Settling chambers, Cyclones, Fabric Filters, Electrostatic precipitators Wet Scrubbers/Wet Collectors, design and principle of these air pollution control units.

### MODULE – 5

(7/8 hours)

**Gaseous pollution control:** Types of gaseous pollution control methods – absorption, adsorption and combustion processes. SO<sub>x</sub> Control Technology, Desulfurization of flue gas

emissions, NO<sub>x</sub> Control Technology, Automobile pollution, sources of pollution, composition of auto exhausts, Control methods.

#### **MODULE – 6**

**(7/8 hours)**

##### **Air pollution Monitoring and Management:**

Environmental guidelines for siting of Industries, Environment Management plan, stack emission standard, ambient air quality standards, stack emission monitoring, ambient air quality monitoring, ambient air quality survey.

#### **MODULE – 7**

**(7/8 hours)**

**Automobile Pollution:** Vehicular emissions, Motor fuel combustion, Automobile emission control.

**Odour pollution:** Theory of Odour, Sources of Odour, Measurement of Odour, Odour control method.

#### **MODULE – 8**

**(7/8 hours)**

**Indoor Air Pollution:** Causes of air pollution, Sources and effects of indoor air pollutants, changes in indoor air quality, Control of indoor air pollutants, air cleaning systems, Cigarette smoke.

##### **Reference Books:**

1. H. C. Perkins, Air Pollution.
2. Peavy and Rowe, Environmental Engineering, Mc-Graw Hill Publication.
3. N.D. Nevers, Air Pollution Control Engineering, Mc-Graw Hill Publication.
4. M. N. Rao et al. Air Pollution, Tata Mc-Graw Hill Publication.
5. Noel de Nevers, Air Pollution control Engineering, Mc-Graw Hill Publication, New York.
6. Richard W. Boubel et al., Fundamentals of Air Pollution, Academic Press, New York.
7. KVSG Murali Krishna. Air pollution and control, Kaushal and Company, Jagannaickpur, Kakinada-2.
8. Davis. Environmental Engineering, Mc-Graw Hill Publication.
9. C.S. Rao., Environmental Pollution Control Engineering, Wiley Eastern Limited, New Delhi (1991).

10. John H. Seinfeld, *Air Pollution: Physical and Chemical Fundamental*, Mc-Graw Hill book Co. 1988.
11. Paul N. Cheremisinoff, Richard A. Young, *Air Pollution Control and Design Handbook, Part-I*, Marcel Dekker Inc., New York 1977).
12. Paul N. Cheremisinoff (ed.), *Encyclopedia of Environmental Control Technology, Vol. 2, Air Pollution Control*, Guld Publishing Company. (1989).

## 7. Solid and Hazardous Waste Management

### Teaching Scheme

Lectures: 4 hours/week

### Examination Scheme

Theory Paper: 100 Marks

Credits: 4

In Semester Assessment: 50 Marks

End Semester Assessment: 50 Marks

### MODULE – 1

(7/8 hours)

**Solid waste management:** Objective, Functional elements, Environmental impact of mismanagement. Solid waste: Sources, types, Composition, Quantities, Physical, chemical and Biological properties.

### MODULE – 2

(7/8 hours)

**Solid Waste Generation Rate:** Definition, Typical values for Indian cities, Factors affecting. Storage and collection: General considerations for waste storage at source, Types of collection systems. Transfer station: Meaning, Necessity, Location and Economic analysis, Transportation of solid waste: Means and Methods, Routing of vehicles.

### MODULE – 3

(7/8 hours)

**Sorting and Material Recovery:** Objectives, Stages of sorting, sorting operations, Guidelines for sorting for materials recovery, typical material recovery facility for a commingled solid waste.

### MODULE – 4

(7/8 hours)

**Composting of solid waste:** Principles, Methods, Factors affecting, Properties of compost, Vermicomposting. Energy recovery from solid waste: Parameters affecting, Biomethanation, Fundamentals of thermal processing, Pyrolysis, Incineration, Advantages and disadvantages of various technological options.

### MODULE – 5

(7/8 hours)

**Landfills:** Definition, Essential components, Site selection, Land filling methods, Leachate and landfill gas management.

**MODULE – 6****(7/8 hours)**

**Indian Scenario:** Present scenario and measures to improve system for different functional elements of solid waste management system. Elements of financial management plan for solid waste system.

**MODULE – 7****(7/8 hours)**

Economy and financial aspects of solid waste management. Disposal options for Biomedical waste, Other Waste Types: Nuclear and Radio Active Wastes.

**MODULE – 8****(7/8 hours)**

**Hazardous waste management:** Problems and issues of hazardous waste management, Need for hazardous waste management—Legislations on management and handling of HW, Toxicology and risk assessment, Hazardous Characteristics – TCLP tests – waste sampling- reduction of wastes at source – Recycling and reuse, labeling and handling of hazardous wastes, incineration – solidification and stabilization of hazardous wastes.

**Reference Books:**

1. Hilary Theisen and Samuel A, Vigil, George Tchobanoglous, Integrated Solid Waste Management, McGraw- Hill, New York, 1993
2. CPHEEO, Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organization, Government of India, New Delhi, 2000
3. Michael D. LaGrega, Philip L Buckingham, Jeffrey C. E vans and Environmental
4. Resources Management, Hazardous waste Management, Mc-Graw Hill International edition, New York, 2001.
5. Vesilind P.A., Worrell W and Reinhart, Solid waste Engineering, Thomson Learning Inc., Singapore, 2002.
6. Charles A. Wentz, Hazardous Waste Management, Second Edition, Pub: McGraw Hill International Edition, New York, 1995.
7. Solid waste management –A. D. Bhide.
8. Solid waste management handbook – Pavoni.

## SEMESTER-II

### Elective-II

#### Teaching Scheme

Lectures: 5 hours/week

#### Examination Scheme

Theory Paper: 100 Marks

Credits: 5

In Semester Assessment: 100 Marks

#### Technical Subject:

- |                                      |    |           |
|--------------------------------------|----|-----------|
| 1. Agricultural Pollution Control.   | -- | 2 Credits |
| 2. Environmental Audit.              | -- | 2 Credits |
| 3. Contaminated Site Remediation     | -- | 2 Credits |
| 4. Environmental Disaster Management | -- | 2 Credits |

#### Non-Technical Subject:

- |   |    |          |
|---|----|----------|
| 1. Mass Communication,<br>Photography and Videography | -- | 1 Credit |
| 2. Cyber Security.                                    | -- | 1 Credit |

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### 1. Agricultural Pollution Control. -- 2 Credits

#### MODULE – 1 (1 credit, 15 hours, 2 modules)

##### Module – A

(7/8 Lectures)

**Environmental issues in agriculture:** Types of farming systems, agro meteorology, water and nutrients requirement.

**Agricultural Activities and Environmental Impacts:** Major Agricultural Practices, Irrigation Drainage Systems, Impact of Agricultural Activities on Environment, Crops, Diseases, Nutrients and its Control. Irrigation practices its negative impacts on Soil (land degradation)

##### Module – B

(7/8 Lectures)

**Fertilizers:** types of fertilizers, pesticides and other agrochemicals, soil and water conservation practices.

Environmental Impacts of Fertilizers: Different types of Fertilizers Inorganic, Organic and Synthetic fertilizers. Effects on Environment due to use of fertilizers, Environmental Impacts of Pesticides Properties of Pesticides: Adsorption solubility in Water and Volatilization

Soil Conservation; Vegetative practices And Mechanical Practices. Ground water Characterization and suitable remedial measures for avoiding its Contamination Pollution control monitoring strategies and plans.

## **MODULE – 2 (1 credit, 15 hours, 2 modules)**

### **Module – A (7/8 Lectures)**

**Water logging and salinity:** Water logging: Its effects, Water logging control, Environmental effects due to water logging Remedial Measures

Preventive and Curative Water logging measures.

Soil Salinity: Classes of Saline and Alkali Soil, Improvement of Saline and Alkaline Soil Leaching and Reclaiming Saline soil

### **Module – B (7/8 Lectures)**

**Wastewater reuse in agriculture:** management and control of agricultural waste; recycling and reuse. Waste water Reuse in Agriculture: Types of Reuse, Reuse of urban waste water in Agriculture and horticulture from skewed area. Reuse considering techno economic aspect Preliminary Primary and secondary treatment and tertiary treatment to removed residual pollutants. Mechanized and Physicochemical Processes

**Agricultural air pollution control:** Odorous emissions related to storage and handling of animal wastes .Biotechnology in reduction of CO<sub>2</sub> emission, Bioscrubbers, Biobeds, Biotrickling filters and their applications.

**Novel methods of pollution control:** Vermitechnology, Methane production, Root zone treatment, Membrane technology, Biodegradable plastics.

### **Reference Books:**

1. Microbial Biotechnology : A. N. Glazer and H. Nikaido .
2. Molecular Biotechnology : Gleck and Pasternack.
3. Biotechnology : A Text Book of Industrial Microbiology, T. D. Brock,
4. Industrial Microbiology : Prescott and Dunn.
5. Biotechnology : B. D. Singh , Kalyani Publishers.
6. T.V. Ramachandra, Soil & Ground Water Pollution from Agricultural activities, TERI.

## **2. Environmental Auditing**

**-- 2 Credits**

### **MODULE – 1 (1 credit, 15 hours, 2 modules)**

#### **Module – A**

**(7/8 Lectures)**

**Environmental Audit:** Definition of Environment Audit and its importance for industries. Environmental management system audits Types of audits, General audit methodology and basic structure of audit. Elements of an audit process and its importance. Concept of ISO14000

#### **Module – B**

**(7/8 Lectures)**

Requirements of Rule 14 for Environmental Audit under Environmental protection Act 1986, Definitions of a. Signatory, b. Consumption Audit, c. Pollution audit, d. Hazardous audit, d. Solid waste audit, e. Disposal audit, f. Cost audit, g. Investment audit, h. Voluntary.

### **MODULE – 2 (1 credit, 15 hours, 2 modules)**

#### **Module – A**

**(7/8 Lectures)**

##### **Pre-audit Activities for the Manager**

Selecting the audit team, planning the audit

##### **Pre-audit Activities for the Auditor**

Drawing up the audit specification, obtaining information before the audit, Checklists, Case studies of red category industries.

#### **Module – B**

**(7/8 Lectures)**

##### **Conducting the Audit**

The opening meeting, Evaluation of the EMS, Interviewing, Site tour and observations

##### **Evaluating the Audit Results**

Evaluation of the audit results, the closing meeting, Recommendations, the audit report

##### **Environmental Reporting**

Purpose of producing an environmental report, writing the report, Independent validation

#### **References Books:**

1. Larry W. Canter," Environment Impact Assessment ", McGraw-Hill Book Company, New York.

2. G.J. Rau and C.D. Weeten, "Environmental Impact Analysis Hand book, McGraw Hill, 1980.
3. Vijay Kulkarni and T V Ramchandra. "Environmental management" Capital Publishing Co.
4. Mhaskar A.K., "Environmental Audit" Enviro Media Publications.
5. S.K. Dhameja, "Environmental Engineering and Manage ment" S.K. Kalaria and Sons Publishers.

### 3. Contaminated Site Remediation

-- 2 Credits

#### MODULE – 1 (1 credit, 15 hours, 2 modules)

##### Module – A

(7/8 Lectures)

Subsurface Contamination: Sources, Contaminants, Regulations and Remedial Approach, Sources of Contamination, Types of Contaminants, Relevant Regulations, Other Considerations, Remediation Approach

##### Module – B

(7/8 Lectures)

**Contaminated Site Characterization:** General Methodology, Preliminary Site Assessment, Exploratory Site Investigation, Detailed Site Investigation, Expedited or Accelerated Site Characterization

#### MODULE – 2 (1 credit, 15 hours, 2 modules)

##### Module – A

(7/8 Lectures)

**In-Situ Waste Containment:** Vertical Barriers, Bottom Barriers, Surface Caps or Covers, Groundwater Pumping Systems, Subsurface Drains

##### Module – B

(7/8 Lectures)

**Soil Remediation Technologies:** Soil Vapor Extraction, Soil Washing, Stabilization/Solidification, Electro kinetic Remediation, Thermal Desorption, Vitrification, Bioremediation, Phytoremediation, Soil Fracturing.

**Groundwater Remediation Technologies:** Pump and Treat, In-Situ Flushing, Permeable Reactive Barriers, In-Situ Air Sparging, Monitored Natural Attenuation, Bioremediation.

#### References Books:

1. Sharma, H. D., and Reddy, K. R., “Geo-environmental Engineering: Site Remediation, Waste Containment and Emerging Waste Management Technologies,” John Wiley & Sons, Inc., 2004 (ISBN: 0-471-21599-6); See:  
<http://www.wiley.com/WileyCDA/WileyTitle/productCd-0471215996.html>.
2. Sharma, H.D.& Lewis, S. P. Waste Containment Systems, Waste Stabilization and Landfills Wiley 1994.

3. Evans, D. & Jefferies, S. A. Remedial Processes for Contaminated Land: Principles and Practice (Ciria Report C549) Ciria 2001
4. <http://www.enr.gov.nt.ca/live/documents/content/siteremediation.pdf>

#### **4. Environmental Disaster Management**

**-- 2 Credits**

##### **MODULE – 1 (1 credit, 15 hours, 2 modules)**

###### **Module – A**

**(7/8 Lectures)**

###### **Environmental Hazards & Disasters.**

- a) Meaning of Environmental hazards, Environmental Disasters and Environmental stress.
- b) Concept of Environmental Hazards, Environmental stress & Environmental Disasters.
- c) Different approaches & relation with human Ecology (i) Landscape Approach (ii) Ecosystem Approach (iii) Perception approach d) Human ecology & its application in geographical researches.

###### **Module – B**

**(7/8 Lectures)**

Natural disasters -Cyclones, earthquakes, tsunami, volcanoes, Forest fires, etc.

Manmade disasters - oil spills, nuclear power plant explosion, building & industrial fires, chemical spills, soil & ground water contamination, structural collapse etc.

##### **MODULE – 2 (1 credit, 15 hours, 2 modules)**

###### **Module – A**

**(7/8 Lectures)**

Disaster management cells & plans at international, national, state & district levels. Disaster management cycle. Role players in Disaster management

###### **Module – B**

**(7/8 Lectures)**

Prevention & mitigation of disasters. Tools- planning, regulations incentives, public education & awareness, insurance, immunization campaigns, environmental management, ect. Application of GIS & RS in Disaster management. Case studies

##### **References Books:**

1. R. B. Singh (Ed) Environmental Geography, Heritage Publishers New Delhi,1990.
2. Savinder Singh Environmental Geography, Prayag Pustak Bhawan, 1997.
3. Kates, B.I & White, G.F The Environment as Hazards, oxford, New York, 1978.
4. R. B. Singh (Ed) Disaster Management, Rawat Publication, New Delhi, 2000.
5. H. K. Gupta (Ed) Disaster Management, Universiters Press, India, 2003.

6. R. B. Singh, Space Technology for Disaster Mitigation in India (INCED), University of Tokyo, 1994.
7. Dr. Satender , Disaster Management t in Hills, Concept Publishing Co., New Delhi, 2003.
8. A. S. Arya Action Plan For Earthquake, Disaster, Mitigation in V.K. Sharma (Ed) Disaster Management IIPA Publication New Delhi, 1994.
9. R. K. Bhandani an overview on Natural & Man made Disaster & their Reduction, CSIR, New Delhi.
10. M. C. Gupta Manuals on Natural Disaster management in India, National Centre for Disaster Management, IIPA, New Delhi, 2001.
11. Reference <http://www.du.ac.in/>

## **SEMESTER – II**

### **LAB PRACTICE II**

#### **Teaching Scheme**

**Lect./Pr. : 4 hours/week**

#### **Examination Scheme**

**Term work: 50 Marks**

**Oral / Presentation: 50 Marks**

**Credits: 4**

#### **Part A: Microbiological techniques.**

1. Microscopy, staining techniques.
2. Isolation and growth of bacteria.
3. Microbiological quality of water - MPN and membrane filtration technique and E coli test.

#### **Part B: Metal Analysis from Industrial wastewater using Atomic Adsorption Spectrophotometer**

- (1) Arsenic            (2) Nickel            (3) Chromium

**Part C:** Visits, Detailed Study, and report submission of any TWO of the following Industries with respect to Total water consumption, Sources of Wastewater generation its characteristics and Treatment methods Dairy, Fertilizer, Distillery, Sugar, Pulp & Paper, Iron & Steel, Metal Plating, Oil Refinery,

**Part D:** Visit to Air Polluting Industries like Thermal Power plant /Cement Manufacturing Industry etc. and Detailed Study with report submission on Air Pollution Control Devices with their design principles.

#### **Part E: Introduction to Soft Computing Techniques**

Study and application of software in Design of Water Treatment plants and Sewage Treatment plant and Effluent treatment plant and Sewarages Systems.

**Part F:** Visit, detailed Study and report submission to MSW Management Plant of Municipal area

## SEMESTER – III

### 8. Environmental Sanitation

#### Teaching Scheme

Lectures: 4 hours/week

#### Examination Scheme

Theory Paper: 100 Marks

Credits: 4

In Semester Assessment: 50 Marks

End Semester Assessment: 50 Marks

#### MODULE – 1

(7/8 hours)

**Epidemiology:** Communicable diseases, Micro-organisms, Methods of communication, Diseases communicated by discharges of intestines, nose and throat, other communicable diseases and their control.

#### MODULE – 2

(7/8 hours)

**Insects and Rodent Control:** Mosquitoes, life cycles, factors of diseases control methods – natural and chemical, Fly control methods and prevention of fly breeding, Rodents and public health, plague control methods, engineering and bio-control methods, disinfectants (Phenols, Lime, Chlorine, Ammonium compounds), Insecticides (DDT, BHC).

#### MODULE – 3

(7/8 hours)

**Industrial sanitation:** Schools, Public Buildings, Hospitals, Eating establishments, Swimming pools – Study of factors like Light, Heat, Ventilation, Plumbing fixtures, Cleanliness and maintenance and comfort.

#### MODULE – 4

(7/8 hours)

**Industrial Hygiene:** Occupational Hazards, Industrial poisons, Dust, Noise, Heat, Compressed air, Vibrations and shocks- Industrial plant sanitation.

#### MODULE – 5

(7/8 hours)

**Rural Sanitation:** Rural areas, Population habits and environmental conditions, problems of water supply and sanitation aspects, low cost excreta disposal systems.

**MODULE – 6****(7/8 hours)**

Rural sanitation improvement schemes. Case studies on sanitation. Emergency Sanitation practices during Natural calamity

**MODULE – 7****(7/8 hours)**

**Water supply in buildings:** Plumbing terminology. Definitions, Water supply in building. The water connection, The water storage, Storage tanks-domestic storage tanks, Flushing Storage Tanks. Principles Governing Design of Water supply in buildings, Lay out. Estimating Requirements, Design of Water pipes.

**MODULE – 8****(7/8 hours)**

**Building Drainage:** Traps, Gully Traps, Intercepting Traps or Interceptors. Sanitary Fittings—Water Closets. Flushing Cistern: Wash Basin or Lavatory Basin, Sink, Urinals. The Plumbing System of Drainage—Single Stack System, One-Pipe System. Choice of System, Principles governing Design of Building Drainage, Layout. Quantity of Flow. Pipes for drainage, Drainage design of high rise buildings.

**Reference books:**

1. Victor Ehalers & Earnest W Steel, Municipal and Rural sanitation.
2. Bhatia H. S., Environmental Pollution and Control, Galgotia Publication Pvt. Ltd., New Delhi.

## 9. Environmental Impact Assessment

### Teaching Scheme

Lectures: 4 hours/week

### Examination Scheme

Theory Paper: 100 Marks

Credits: 4

In Semester Assessment: 50 Marks

End Semester Assessment: 50 Marks

### MODULE – 1

(7/8 hours)

**Evolution of EIA:** Environmental Impact Assessment: Introduction, Stages Of EIA, Origin of EIA, Establishments of Procedure: Legislative Option, Project Screening for EIA, Methods, Projects thresholds, Sensitive area criteria Matrices. Scope studies for Environmental Impact Studies (EIS). Preparation for EIS Planning, Public Participation and Review of EIS.

### MODULE – 2

(7/8 hours)

**Methods for impact assessment:** Background information, interaction matrix methodologies, network methodologies, environmental setting, environmental impact assessment methodology, documentation and selection process, environmental indices and indicators for describing affected environment, Life cycle assessment.

### MODULE – 3

(7/8 hours)

**Prediction and assessment of impact for air and noise environment:** Basic information of air quality, identification of type and quantity of air pollutant, existing air quality and air quality standards, impact prediction and assessment, mitigation. Basic information of noise, existing noise levels and standards, prediction of noise levels and assessment of impact, mitigations.

### MODULE – 4

(7/8 hours)

**Prediction and assessment of impact for water and soil environment:** Basic information of water quality (Surface water and ground water), water quality standards, identification of impact, prediction of impact and assessment, mitigations. Background information of soil environment, soil and ground water standards, prediction and assessment of impact for ground water and soil, mitigations.

**MODULE – 5****(7/8 hours)**

**Prediction and assessment of impact on cultural and socioeconomic environment:** Basic information on cultural resources, rules and regulations for cultural resources like archaeological, historical structures, Cultural system, prediction and assessment of impact, mitigations. Basic information of socioeconomic environment, description of existing socioeconomic environment, prediction and assessment of impact, mitigation, resettlement and rehabilitation.

**MODULE – 6****(7/8 hours)**

**Decision Methods for Evaluation of Alternative:** Public participation in environmental decision making, Regulatory requirements, environmental impact assessment process, objectives of public participation, techniques for conflict management and dispute resolution, verbal communication in EIA studies.

**MODULE – 7****(7/8 hours)**

Categorization of Industries for seeking environmental clearance from concerned authorities, procedure for environmental clearance, procedure for conducting environmental impact assessment report, Rapid and Comprehensive EIA, general structure of EIA document, Environmental management plan, post environmental monitoring.

**MODULE – 8****(7/8 hours)**

Latest EIA notification by Ministry of Environment and Forest (Govt. of India): Provisions in the EIA notification, Procedure for public hearing, post environmental monitoring, Procedure for obtaining Environmental clearance for construction projects.

**Reference Books :**

1. Canter R.L., Environmental Impact Assessment, Mc Graw Hill International Edition, 1997.
2. John G. Rau and David C. Wooten (Ed), Environmental Impact Analysis Handbook, McGraw Hill Book Company.
3. Peter Watten (Eds.) - 'Environmental Impact Assessment Theory and Practice', Unwin Hyman, London ( 1988).
4. Environmental Impact Assesment By R.RBarthwal ( New Age Intenational Publishers)
5. Environmental Impact Assesment By Abbasi

## SEMESTER-III

### Open Elective

#### Teaching Scheme

Lectures: 5 hours/week

#### Examination Scheme

Theory Paper: 100 Marks

Credits: 5

In Semester Assessment: 100 Marks

#### Technical Subject:

1. Green Buildings	--	2 Credits
2. Marine Pollution	--	2 Credits
3. Nano technology for water and wastewater treatment	--	2 Credits
4. Geo-environmental Engineering	--	2 Credits

#### Non-Technical Subject:

1. Mass Communication, Photography and Videography	--	1 Credit
2. Cyber Security.	--	1 Credit

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### 1. Green Buildings -- 2 Credits

#### MODULE – 1 (1 credit, 15 hours, 2 modules)

##### Module – A (7/8 Lectures)

Implications of Building Technologies Embodied Energy of Buildings: Framed Construction, Masonry Construction.

##### Module – B (7/8 Lectures)

Resources for Building Materials, Alternative concepts. Recycling of Industrial and Buildings Wastes. Biomass Resources for buildings.

#### MODULE – 2 (1 credit, 15 hours, 2 modules)

##### Module – A (7/8 Lectures)

Comforts in Building, Utility of Solar energy in buildings concepts of Solar Passive Cooling and Heating of Buildings. Low Energy Cooling. Green Composites for buildings, Concepts of Green Composites.

**Module – B****(7/8 Lectures)**

Water Utilization in Buildings, Low Energy Approaches to Water Management.

Management of Solid Wastes. Management of Sullage Water and Sewage. Urban Environment and Green Buildings. Green Cover and Built Environment.

**Text Books:-**

1. K.S.Jagadish, B. U. Venkataramareddy and K. S. Nanjundarao. Alternative Building Materials and Technologies. New Age International, 2007.
2. Low Energy Cooling For Sustainable Buildings. John Wiley and Sons Ltd, 2009.
3. Green My Home!: 10 Steps to Lowering Energy Costs and Reducing Your Carbon Footprint, by Dennis C. Brewer, ISBN:9781427798411, Publisher: Kaplan Publishing, Publication Date: October 2008.
4. B. Givoni, Man, Climate and Architecture Elsevier, 1969.
5. T. A. Markus and E. N. Morris Buildings Climate and Energy. Pitman, London, 1980.  
Arvind Kishan et al (Ed)
6. Climate Responsive Architecture. TataMcGraw Hill, 2001.
7. Sustainable Building Design Manual. Vol 1 and 2, Teri, New Delhi, 2004.
8. O. H. Koenigs Berger, T. G. Ingersoll, Alan Mayhew and S. V. Szokolay. Manual of Tropical Housing and Building. Orient Long man, 1975.

**Reference Books:-**

1. Osman Attmann Green Architecture Advanced Technologies and Materials. McGraw Hill, 2010.
2. Michael F. Ashby Materials and the Environment, Elsevier, 2009.
3. Jerry Yudelson Green building Through Integrated Design. McGraw Hill, 2009.
4. Mili M. Ajumdar (Ed) Energy Efficient Building in India. Teri and Mnes, 2001/2002.
5. T. N. Seshadri et al Climatological and Solar Data for India. CBRI and Sarita Prakashan, 1968.

## 2. Marine Pollution

--2 Credits

### MODULE – 1 (1 credit, 15 hours, 2 modules)

#### Module – A

(7/8 Lectures)

**Marine Pollution:** Definition, categories of additions, Pollutant and its classification. Organic wastes: BOD, COD, dilution factor, Fluctuations in DO, Consequences of organic discharges to estuaries with examples; Thames and Mersey estuary; Consequences of sludge dumping at sea with reference to Thames and Firth of Clyde. Sewage treatment: Primary, Secondary and Tertiary treatment processes. Solid waste pollution: Classification and disposal of solid wastes.

#### Module – B

(7/8 Lectures)

**Industrial pollution:** sources, nature and their treatment processes with reference to wastes from paper and pulp and soap manufacturing industries.

Marine corrosion: Definition, corrosion reactions, classification of corrosion, factors affecting corrosion of metals in sea water and prevention of marine corrosion. The state of some seas in the world (pollution aspect); The North Sea, the Mediterranean Sea and the Baltic Sea.

### MODULE – 2 (1 credit, 15 hours, 2 modules)

#### Module – A

(7/8 Lectures)

**Oil spills and cleanup:** sources, major accidental spills, fate of spilled oil on the sea, consequences of oil spills and treatment of oil spills. Pesticide pollution: inputs, fate in the sea, factors affecting the bioaccumulation of pesticides, DDT the most wide spread molecule, Impact of pesticides on the Environment, Mode of poisoning of pesticides, Methods to minimize pesticide pollution.

**Conservative pollutants:** Measures of contamination, toxicity, measurement of toxicity, acute and chronic exposure, Detoxification. Metal pollution in coastal waters (Hg, Pb, Cd, Cu, Zn and Fe). The present status of coastal pollution in India and future strategies.

**Radioactive Pollution:** Sources, Classification and effects of radiation; Protection and control from radiation: Maximum permissible dose concept, dose limits, Disposal of radioactive wastes; Beneficial aspects of radiation and food safety.

## **Module – B**

**(7/8 Lectures)**

**Indicator organisms:** Criteria for selection of indicator organism: Quantitation of pollution load, basic pre-requisites, response to different pollution load and time integration capacity, Macro algae, crustaceans and mollusks as indicator organisms for monitoring of trace metal pollution;

**Red tides:** distribution, types of poisoning, effects and methods to minimize red tides in the sea. Monitoring strategies of marine pollution: Critical pathway approach and Mass balance approach.

**Standards in water quality:** Assessment of pollution damage: The need, seriousness of damage, assessment of damage and problems of measuring impact.

### **Reference Books:-**

1. Chemical Oceanography (Vol: 3) 1975- Riley J.P and Skirrow, G.
2. The health of the oceans. 1976 Goldberg, E.D
3. Marine Pollution. 1986 Clark, R.B.
4. Quantitative aquatic biological indicators. 1980 Phillips J.D.H.
5. Thermal and radioactive pollution. 1994. Sharma, B.K and Kaur, H.
6. Water Pollution. 1994. Sharma, B. K and Kaur, H.
7. Marine and offshore corrosion. 1985. Chandler, K. A.

### **3. Nano -technology for water and wastewater treatment -- 2 Credits**

#### **MODULE – 1 (1 credit, 15 hours, 2 modules)**

##### **Module – A (7/8 Lectures)**

###### **Introduction:**

Background, what is nanotechnology, types of nanotechnology and nano-machines, top down and bottom up techniques, Molecular nanotechnology, atomic manipulation-nanodots, self-assembly, Dip pen nanolithography, Simple details of characterization tools- SEM, TEM, STM, AFM.

##### **Module – B (7/8 Lectures)**

###### **Characterisation of Nano materials:**

Nan particles and water, Responsible use of nano materials: an industry point of view, Policy aspects of innovation, Analytical techniques for characterisation of nano materials.

#### **MODULE – 2 (1 credit, 15 hours, 2 modules)**

##### **Module – A (7/8 Lectures)**

###### **Effective, High-Performance Water and Wastewater Purification Systems:**

Nano and micro engineered membrane technology, Applications of nanotechnology for drinking water, Biocatalysts for reductive treatment of water contaminated with priority pollutants, Video conferencing with Asian Institute of Technology nanotechnology laboratory.

##### **Module – B (7/8 Lectures)**

###### **Bionanotechnology and Nonmanufacturing:**

Virus-based single-enzyme nanoreactors, Measurement of bacterial-particle interactions with atomic force microscopy, Bioremediation: from environmental processes to production of functional bionanominerals, Microbial manufacture of silver nanoparticles for water disinfection, Microbial manufacture of chalcogen nanoparticles and quantum dots.

#### **Reference Books:-**

1. Nanotechnology-Basic Science and Emerging Technologies Mick Wilson, Kamali Kannangra Geoff Smith, Michelle Simons and Burkhard Raguse, Overseas Press.

2. Nanotechnology-A Gentle Introduction to the Next Big Idea Mark Ratner and Daniel Ratner, Prentice Hall
3. Nanotechnology: Rebecca L Johnson, Lerner Publications.
4. Introduction to Nanotechnology: Charles P. Poole Jr., Chapman and Hall/CR
5. Mick Wilson, Kamali Kannangara, Geoff Smith, "Nanotechnology: Basic Science and Emerging Technologies", Overseas Press, 2005.
6. Charles P. Poole Jr and Frank J. Owens, "Introduction to Nanotechnology", Wiley Interscience, 2003.
7. Mark A. Ratner, Daniel Ratner, "Nanotechnology: A gentle introduction to the next Big idea", Pearson Education, 2003.
8. Hari Singh Nalwa, "Nanostructured materials and Nanotechnology", Academic Press, 2001.
9. Alexei Nabok, "Organic and Inorganic Nanostructures", Artech House Publishers, 2005.

#### 4. Geo-environmental Engineering

–2 Credits

##### MODULE – 1 (1 credit, 15 hours, 2 modules)

###### Module – A

(7/8 Lectures)

**Fundamentals of Geoenvironmental Engineering:** Scope of geoenvironmental engineering - multiphase behavior of soil – role of soil in geoenvironmental applications – importance of soil physics, soil chemistry, hydrogeology, biological process, sources and type of ground contamination – impact of ground contamination on geoenvironment - case histories on geoenvironmental problems.

###### Module – B

(7/8 Lectures)

**Soil-Water-Contaminant Interaction:** Soil mineralogy characterization and its significance in determining soil behavior – soil-water interaction and concepts of double layer – forces of interaction between soil particles.

Concepts of unsaturated soil – importance of unsaturated soil in geoenvironmental problems - measurement of soil suction - water retention curves - water flow in saturated and unsaturated zone. Soil-water-contaminant interactions and its implications – Factors effecting retention and transport of contaminants.

##### MODULE – 2 (1 credit, 15 hours, 2 modules)

###### Module – A

(7/8 Lectures)

**Contaminant Site Remediation:** Site characterization – risk assessment of contaminated site - remediation methods for soil and groundwater – selection and planning of remediation methods – some examples of in-situ remediation.

###### Module – B

(7/8 Lectures)

**Advanced Soil Characterization:** Contaminant analysis - water content and permeability measurements – electrical and thermal property evaluation – use of GPR for site evaluation - introduction to geotechnical centrifuge modeling.

## References Books:

1. Reddi L.N. and Inyang, H. I., "Geoenvironmental Engineering, Principles and Applications" Marcel Dekker Inc. New York, 2000.
2. Sharma H.D. and Reddy K.R., "Geoenvironmental Engineering: Site Remediation, Waste Containment, and Emerging Waste Management Technologies" John Wiley & Sons, Inc., USA, 2004.
3. Rowe R.K., "Geotechnical and Geoenvironmental Engineering Handbook" Kluwer Academic Publications, London, 2000.
4. Yong, R. N., "Geoenvironmental Engineering, Contaminated Soils, Pollutant Fate, and Mitigation" CRC Press, New York, 2001.
5. Fredlund D.G. and Rahardjo, H., "Soil Mechanics for Unsaturated Soils" Wiley-Interscience, USA, 1993.
6. Hillel D., "Introduction to Environmental Soil Physics" Academic Press, New York, 2003.
7. Alvarez-Benedi J. and Munoz-Carpena, R., "Soil-Water Solute Process Characterization: An Integrated Approach" CRC Press, New York, 2005.
8. Sparks, D.L., "Environmental Soil Chemistry" Academic Press, New York, 2002.
9. Berkowitz, B. Dror, I. and Yaron, B., "Contaminant Geochemistry" Springer, Germany, 2008.