FACULTY OF ENGINEERING

M.E (Environmental Engineering)
Chemical Engineering
(W.e.f 2008-2009)

UNIVERSITY OF PUNE

COURSE STRUCTURE FOR M.E. (Chemical - Environmental Engineering)
(For 2008 Course) (W.e.f. June – 2008)

SEMISTER I

CODE	SUBJECT	TEACHING SCHEME		EXAMINATION SCHEME					CREDITS
		Lect.	Pr	Paper	TW	Oral	Pr	Total	
509131	Applied Statistics for Environmental Engineers	3	-	100	-	-	-	100	3
509132	Environmental Geosciences	3	-	100	-	-	-	100	3
509133	Environmental Chemistry	3	-	100	-	-	-	100	3
509134	Elective I	3	-	100	-	-	-	100	3
509135	Elective II	3	-	100	-	-	-	100	3
509136	Lab Practice I	-	6	-	50	-		50	3
509137	Seminar I	-	4	-	50	-	-	50	2
Total of First Term		15	10	500	100	-	-	600	20

SEMISTER II

CODE	SUBJECT	TEACHING SCHEME		EXAMINATION SCHEME					CREDITS
		Lect.	Pr	Paper	TW	Oral	Pr	Total	
509138	Wastewater Treatment & Design	3	-	100	-	-	-	100	3
509139	Solid Waste Management	3	-	100	-	-	-	100	3
509140	Industrial Waste Treatment	3	-	100	-	-	-	100	3
509141	Elective III	3	-	100	-	-	-	100	3
509142	Elective IV (Open)	3	-	100	-	-	-	100	3
509143	Lab Practice II	-	6	-	50	-		50	3
509144	Seminar II	-	4	-	50	-	-	50	2
Total of Second Term		15	10	500	100	-	-	600	20

SEMISTER III

CODE	SUBJECT	TEACHING SCHEME		EXAMINATION SCHEME					CREDITS
		Lect.	Pr	Paper	TW	Oral	Pr	Total	
609107	Seminar III (Based on Project)	-	4	-	50	-	-	50	2
609108	Project Stage I	-	18	-	50	-		50	6
Total of Third Term		-	22	-	100	-	-	100	08

SEMISTER IV

CODE	SUBJECT	TEACHING SCHEME		EXAMINATION SCHEME					CREDITS
		Lect.	Pr	Project	TW	Oral	Pr	Total	
609109	Project Stage II	-	18	-	150*	50		200	12
Total of Fourth Term		-	18	-	150	50	-	200	12

* The Term Work of Project stage II of semester IV should be assessed jointly by the pair of internal and external examiners. Along with the oral examination of the same.

Note- The Contact Hours for the calculation of load of teacher Seminar- 1 Hr / week / student & Project - 2 Hr / week / student

LIST OF ELECTIVES

Elective I	Elective II	Elective III	Elective IV
1.Modeling of Environmental systems	1. Membrane Technology in Environmental Engineering	1. Ecology and Risk Assessment	**Open Elective**
2.Groundwater Contamination and Pollution Transport	2. Environmental Auditing & EMS	2. Water Quality Modeling	
3. Environmental Policies and Legislations	3.Agricultural Pollution and Control	3. Modern Trends in Environmental Engineering	
4.Air & Noise Pollution Control	4.Environmental Impact Assessment & Economics	Environmental Biotechnology	

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SEMISTER I

M.E.ENVIRONMENTAL

509131 Applied Statistics for Environmental Engineers

Teaching scheme	Examination Scheme
Lecture: - 3h/week	Theory: - 100 Marks

EMPIRICAL STATISTICS: Measures of Central tendency, dispersion, skew ness and kurtosis - Principle of least squares - Correlation and regression - rank correlation.

SAMPLING DISTRIBUTIONS AND ESTIMATION: Sampling distributions - Point and interval estimates for population proportions, mean and variance – Maximum likelihood estimate method - Method of moments.

TESTING OF HYPOTHESIS: Sampling distributions - Tests based on Normal, t, Chi-square and F distributions - Analysis of variance – one-way and two-way classifications.

DESIGN OF EXPERIMENTS: Completely randomized design - Randomized block design – Latin square design - 2 power 2 factorial design.

LINEAR PROGRAMMING: Basic concepts - Graphical and Simplex methods - Transportation Problem - Assignment Problem.

Reference Books

1. Berthouex, P.U., “Statistics for Environmental Engineers ", Lewis Publ., 1994.
2. Freund, J.E. and Miller, I.R., “Probability and Statistics for Engineers ", Prentice – Hall of India, 5th Edition, New Delhi, 1994.
3. Gupta, S.C. and Kapur, V.K., “Fundamentals of Mathematical Statistics ", Sultan Chand & Sons, New Delhi, 1999.
4. Ang, A.H.S. and Tang W.H., “Probability concepts in Engineering Planning and Design – Basic Principles Vol.1 ", John Wiley and Sons, Inc. New Delhi, 1975.
5. Taha, H.A., " Operations Research: An Introduction ", Prentice - Hall of India, 6th Edition, New Delhi, 1997.
6, Wayne, R. Ott Environmental Statistics and Data Analysis, CRC Press. (1995).

509132 Environmental Geosciences

Teaching scheme	Examination Scheme
Lecture: - 3h/week	Theory: - 100 Marks

The Earth Systems and Biosphere: Conservation of matter in various geo-spheres – lithosphere, hydrosphere, atmosphere and biosphere. Energy budget of the earth. Earth's thermal environment and seasons. Ecosystem flow of energy and matter. Coexistence in communities – food webs. Earth's major ecosystem-terrestrial and aquatic. General relationship between landscape, biomes and climate. Climates of India, Indian Monsoon, El Nino. Tropical Cyclones and Western Disturbances. Elementary ideas about weather systems, concepts, of radiation balance and energy balance in atmosphere, Climatic variability and climate change, earths process and geological metrological Hazardous, Natural hazardous and extreme weather events, Food and droughts in introductory ideas about air pollutions and global warming.

Earth's Processes and Geological Hazards: Earth's processes; concepts of residence, time and rate of natural cycles. Catastrophic geological hazards. Study of floods, landslides, earthquakes, volcanism and avalanche. Perception of the hazards and adjustments to hazardous activities.

Mineral Resources and Environment: Resources and Reserves, Minerals and population. Oceans and new areas for exploration of mineral resources. Ocean and recycling of resources. Environmental impact of exploitation, processing and smelting of minerals.

Environmental Geochemistry: Concepts of major, trace and REE. Classification of trace elements, mobility of trace elements, Geochemical cycles. Biochemical factors in environmental health. Human use, trace elements and health. Possible effects of imbalance of some trace elements. Diseases induced by human use of land.

Acid Mine Drainage: Formation of AMD**,** Chemistry of AMD, Microbiology of AMD, Iron Oxidation**,** Effect of AMD

Remote Sensing and GIS: Principles of Remote Sensing and its application of Environmental Science. Application of GIS in Environmental Management.

Reference *Books*:

1. Valdiya, K.S. 1987, Environmental Geology.

2. Keller, E.A. Environmental Geology & Turk and Turk.

3. Environmental Geology – DR Coates, John Wiely & Sons, NY 1981

509133 Environmental Chemistry

Teaching scheme	Examination Scheme
Lecture: - 3h/week	Theory: - 100 Marks

Concept and Scope of Environmental Chemistry : Definition and explanation for various terms, segments of environment. 26 principles and cyclic pathways in the environments.

Chemistry of Biologically Important Molecules: Chemistry of Water : Unusual physical properties, hydrogen bonding in biological systems, unusual solvent properties, changes in water properties by addition of solute. Protein structure and biological functions, enzymes, enzyme metabolism, biosynthesis of DNA and RNA, mutations and Gene control during embryogenesis

Soil Chemistry: Formation, constituents and properties of soils, adsorption of contaminants in soil.

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. **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.

Physico–Chemical methods for analysis of environmental samples : Physico-chemical parameters; Definition and determination of conductivity, pH, emf, COD, BOD, Viscosity, surface tension, estimation of various elements at major, minor trace, ultra trace level concentrations; Choice of a technique; Principle, merits and demerits of the techniques – Neutron Activation Analysis, isotope dilution analysis, calorimetric, colourimetry, Atomic Absorption Spectroscopy, Gas chromatography, HPLC, Ion exchange Chromatography and Polarography.

Reference Books :

1. Environmental Pollution Analysis : Khopkar
2. Instrumental Methods of Analysis : G. W. Ewing.
3. Chemistry for Environmental Engineers by C.D. Sawyar Mcgraw Hill (latest edition)
4. Environmental Chemistry : J. W. Moore and E. A. Moore.

Elective I
509134 Modeling of Environmental systems

Teaching scheme	Examination Scheme
Lecture: - 3h/week	Theory: - 100 Marks

Definition, Classification, Examples and Models of Environmental Systems. modeling objectives and choices, sensitivity analysis and sources of error, introduction to numerical methods, reaction type and orders of reactions conservation of mass, energy and momentum, river/stream quality

Introduction to air quality models; Air pollution meteorology; Atmospheric turbulence; Gaussian Plume model and Modifications; Simulations of special meteorological and topographic conditions; urban diffusion models, Model Calibration. Sensitivity Analysis, Applications,

Climate change and the Models for Climatic change

Introduction to river, estuarine and lake hydrodynamics, Dissolved Oxygen
Models; Temperature Models, prediction of fate of organism and toxic substances.

Models for management applications.

Reference Books

1. R.V. Thompson and J.A. Muller Principles of Surface water Quality Modeling and Control Harper International Edition, N.D. 1987.
2. Richard W. Boubel, Donald L. Fox, D. Bruce Turner and Arthur C. Stera: Fundamentals of Air Pollution, Academic Press, 1994.
3. J.H. Seinfeld: Air Pollution, Physical and Chemical fundamentals, McGraw Hill 1990.
4. G.M.Masters, Introduction to Environmental Engineering & Science, Prentice Hall, New Delhi, 1997
5. J.G. Henry and G. W. Heike, Environmental Science & Engineering", Prentice Hall International Inc., New Jersy, 1996.
6.Process Dynamics in Environmental System by W.J. Weber and F. Digiamo 1995 Wiley Intisene

Elective I
509134 Groundwater Contamination and Pollution Transport

Teaching scheme	Examination Scheme
Lecture: - 3h/week	Theory: - 100 Marks

Introduction: Ground water and the hydrologic cycles-Ground water as a resource-Ground water contamination-Ground water as a Geotechnical problem-Ground water and geologic processes. Physical properties and principles-Darcy's Law-Hydraulic Head and Fluid Potential-piezometers and Nests. Hydraulic conductivity and permeability-Homogencity 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.

Hydrologic Cycle And Flownet: Flow nets-Graphical construction-Flow nets by numerical simulation, steady state Regional Ground water Flow-Steady state hydrologic-budgets-Fluctuations in ground water levels.

Resource Evalution: Development of Ground water Resources-Exploration for Acquifers-the response of Ideal acquifers to pumping-Measurement of parameters -Laboratory tests-Piezometer test-pumping tests-Estimation of saturated hydraulic conductivity-Numerical simulation for acquifer yield prediction-Artifical recharge and induced infiltration-Land subsidence-sea water intrsion

Chemical Properties And Principles: 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 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.

Solute Transport : Water Quality Standards-Transport Process-Nonreactive Constituents In Homogeneous Media And Heterogenous Media-Transport In Fracture Media-Hydeochemical Behaviour Of Contaminants-Trace Metals-Nitrogen-Trace Nonmetals Organic Substances-Measurement Of Parameters-Velocity-Dispersivity-Chemical Partitioning-Sources Of Contamination- Land Disposal Of Solid Wastes-Sewage Disposal On Land.

Reference Books :

1. Randall J. Charbeneau, " Ground Water Hydraulics and Pollutant Transport ", 2000.
2. Allen Freeze, R. and John A. Cherry, "Ground Water ". Prentice Hall.Inc.1979.

Elective I

509134 Environmental Policies and Legislations

Teaching scheme	Examination Scheme
Lecture: - 3h/week	Theory: - 100 Marks

Introduction: Role of national, international, and UN agencies in dealing with the environmental aspects. Standards and setting criteria.

Historical aspects: major legislations: USEPA 1969 to Clean Water and Air Act.Significant legislations in developing and developed countries.

Legislations in Indian context: Indian Forest Act 1950, 1980, and amendments. Acts related to air and water pollution.

Norms & Standards : OHSHAS 18001 and its significance. ISO 14000 and its significance, other acts in ESE and case studies. Feasibility Studies and Management issues.

Related Issues : Principles of sustainable development and implications of finite biosphere and complexities for engineering design and decision-making. Design of controlled environments to enhance health and protection of natural resources for sustainable development. Resource problems and design with ecological, economic, demographic and social dimensions. Techniques to integrate knowledge and define policy.

Reference Books:

1. Meyers A. Robert (Eds.) Encyclopedia of Environmental Analysis and Remediation Vol. 1-8, John Wiley & Sons, 1998.
2. Handbook of Accident prevention, ILO Publication, 1998.
3. Encyclopaedia of Industrial Safety and Health, 1999.
4.G.M.Masters, Introduction to Environmental Engineering & Science, Prentice Hall, New Delhi, 1997
5. J.G. Henry and G. W. Heike, Environmental Science & Engineering", Prentice Hall International Inc., New Jersy, 1996.

Elective I
509134 Air & Noise Pollution Control

Teaching scheme	Examination Scheme
Lecture: - 3h/week	Theory: - 100 Marks

Introduction, Sources, Classification and Effects of Air Pollutants; Sampling and Monitoring Techniques, Indoor & Out door (Industrial and Vehicular Emissions) Air Quality Assessment ; Dispersion Model; Air Pollution Control Techniques. Air Pollution Laws and Regulations.

Design of Air Pollution Control Systems: Application of physical and chemical processes in the design of air pollution control systems such as mechanical collectors, filters, scrubbers, cyclone separators, explosion vents, relief valves, electrostatic precipitators, and others; Implication for design. Problems on design of equipment, Component detailing collection efficiency.

General control of Gaseous pollutants, Principles of absorption, Adsorption, Basic design of absorption and adsorption units, Incineration and after burner, Control of sulphuric dioxide, NOx.

Noise Pollution, Characteristics. Sources, their Effects and Control Measures.

Reference Books :

1. Air Pollution Control Engineering by N.D. Nevers (1995) MC Graw Hill
2. Air Pollution by H.C. Perkins MC Graw Hill (latest edition)
3. Noise Pollution by Tripathy, Debipras (latest edition)

Elective II
509135 Membrane Technology in Environmental Engineering

Teaching scheme	Examination Scheme
Lecture: - 3h/week	Theory: - 100 Marks

Introduction to Membrane Processes, Membranes and Modules:
Principles of Membrane processes; Types and uses of membranes; Recent development in membranes; Types and uses of modules; Washing procedures.

Applications of Membrane Processes in Environmental Engineering:
Membrane bioreactors; Prevaporation and its applications; Reverse Osmosis, Ultrafiltration and Microfiltration and their applications; Dialysis and Electrodialysis and their applications; Others.

Preparation of Synthetic Membranes: Introduction, preparation of synthetic membranes, phase inversion membranes, preparation technique for immersion precipitation, preparation technique for composite membranes,

Characterization of Membranes: Introduction, membrane characterization, characterization of porous membranes, characterization of ionic membranes, characterization of non porous membranes.

Module and process design: Introduction, plate and frame model, spiral wound module, tubular module, capillary module, hollow fiber model, comparison of module configurations.

Case studies of Selected Environmental Processes with Membrane Technology

Reference Books :

1. M.H.V. Mulder, Membrane Separations. Kluwer Publictions
2. S.P. Nunes, and K.V. Peinemann, membrane Technology in the chemical industry, Wiley-VCH.
3. R. Rautanbach and R.Albrecht, Membrane Process, John Wiley & Sons.
4. R.Y.M. Huang, Perevoparation Membrane Separation Processes, Elsevier.
5. J.G. Crespo, K.W. Boddekes, Membrane Processes in Separation and Purification, Kluwer Academic Publications.
6. Larry Ricci and the staff of chemical engineering separation techniques, Mc Graw Hill publications.

Elective II

509135 Environmental Auditing & EMS

Teaching scheme	Examination Scheme
Lecture: - 3h/week	Theory: - 100 Marks

Concepts of Environmental Audit, Objectives of audit. Types of audits, Features of effective auditing, Programme Planning, Organisation of auditing programme, Pre-visit data collection, Audit protocol, Onsite audit, Data Sampling: Inspections, Evaluation and presentation, Exit interview.

Audit Report – Action Plan – Management of audits. Waste management contractor audits, Life cycle approach.

Introduction, Principles and Elements of Successful environmental management. ISO Principles, EMS, Creating an environmental management system in line with ISO 14000. Benefits of an environmental management system.

Principles and elements of successful environmental management: Leadership, Environmental management planning, Implementing an environmental management system, Measurement and evaluations required for an environmental management system, Environmental management reviews and improvements.

Legal and regulatory concerns. Integrating ISO 9000 and ISO 14000.

Reference Books *:*

1. Maheswar Dayal, “Renewable Energy Environment & Development”, Konark Pub. Pvt. Ltd., 1998.
2. Girdhar Gyani and Amit Lunia, “Planning & Implementation of ISO 14001, Environmental Management System”, Raj Publishing House, Jaipur, 2000
3. Joseph Caseion (Ed.) “The ISO 14000 Handbook”, CEMM Information Services.
4 Don Sayre, “INSIDE ISO 14000 – The Competitive Advantage of Environmental Management”, Vinity Books International, New Delhi, 2001
5. Ritchie, I & Hays, W., “A Guide to Implementation of the ISO 14000 Series on Environmental Management”, Prentice Hall, New Jersy, 1998.

Elective II
509135 Agricultural Pollution and Control

Teaching scheme	Examination Scheme
Lecture: - 3h/week	Theory: - 100 Marks

Environmental issues in agriculture, types of farming systems, agro meteorology, water and nutrients requirement, types of fertilizers, pesticides and other agrochemicals, soil and water conservation practices, water logging and salinity; causes and effects. Wastewater reuse in agriculture, management and control of agricultural waste; recycling and reuse.

Reference Books:

Elective II
509135 Environmental Impact Assessment & Economics

Teaching scheme	Examination Scheme
Lecture: - 3h/week	Theory: - 100 Marks

Environmental impact assessment: Introduction, Concepts and aims, Impact statement, Methods and Processes, Mitigation processes .Prediction and assessment of impact on air, water and noise.

Public participation in environment decision making. Environment education and awareness, Environmental economics, Economics of Pollution control, Cost benefit analysis.

Prediction and assessment of impacts on the biological, cultural and socio-economic environment, Introduction and basic concepts. Environmental impact assessment of major development projects, industries, mining, thermal power plants, atomic power stations, transport (rail, road, highway), tourism (Hotels, beaches and resorts , EIA of different xenobiotics (chemicals, fertilizers, heavy metals).

Economy and Environment, Economic operation and environmental issues, adversities on the economy. Markets and Environmental Assets Incomplete markets, externalities, non-exclusion, non-rivalry and public good, non-convexities, asymmetric information.

Economic Incentive and Environmental Protection: (i) Price rationing: Charges and subsidies, (ii) Liability rules: Non-compliance fees, bonds and deposit refunds.(iii) Quantity rationing: Marketable permits.(iv) Evaluation criteria(v) Practical Conditions for use of economic incentives.

Pollution Taxes, Efficiency properties of a tax on emissions, problems with pollution taxes.

Tradable Pollution Permits, Basic theory of tradable pollution permits, issues in tradable permits. Transboundrary pollution problem, international organizations for environmental protection. WTO agreements on environment. Agrochemical pollution and measures undertaken: national and inter national scenario, bio-diversity and economy.

Reference Books

1. W. Canter " Environmental Impact Assessment" Mc Graw Hill (1996).

2. Peter Watten (Eds.) - `Environmental Impact Assessment Theory and Practice',

Unwin Hyman, London (1988)

3. John G. Rau and David C. Woolen (Eds.) `Environmental Impact Analysis Hand Book', McGraw Hill, (1980).

4.Levy, Leboyer, C. Psychology and Environment (1982). London : Sage.

5. Cone, J.D. and Hayes, S.C. Environmental Problems / Behavioural Solutions (1980) California : Brooks Kole.

6. Altman, I. And Stokols, D. (Eds.) Handbook of Environmental Psychology (1987). New York : Wiley.

509136 Lab Practice I

Teaching Scheme	**Examination Scheme**
Practical: 6 Hrs/Week	T.W. : 50 marks

Each student should perform at least 8 experiments/ assignments from the list given below and submit the journal which will form the term-work for the subject

1. Use of water test kits for the determination of various water pollution parameters
2. To measure common parameters using Ion Selective Methods
3. To measure common parameters using other conventional methods
4. Analysis of water quality
5. Analysis of water samples for metals using AA Spectrometer
6. Analysis of Phosphate by using ascorbic acid method

7. Water analysis for physico-chemical characteristics

8. Analyze and modeling of selected problems and design of algorithms appropriate to their solution
9. Usage of conceptual, mathematical and computational models.
10. Manipulation of environmental data files on a personal computer.
12.. Graphical representation of environmental data and to draw inferences from them.
13. To study the differences between analytical and numerical solutions to environmental models.
14. Use of iteration technique in environmental modeling
15. To study the comparison between discrete and continuous models.
16. To validate a model and sensitivity analysis.
17. To understand the concept of spatial dependence and its modeling.

18 Classification and identification of minerals (Museum specimens)

19. Preparation of a climatic maps and diagrams

20. Identification of Rocks and specimens.

21.Ground water survey and Evaluation of water potentials.

22. Study of Topological sheets

23.Measurement of sounds by DB meter in silent, industrial, residential and commercial zones.

24.To analyse the automobile/diesel engine exhaust

509137 Seminar I

Teaching Scheme	Examination Scheme
Practical : 4 Hr/Week	T.W. : 50 marks

Each student is required to deliver a seminar in first semester on the state of the art of the topic of his/her choice, preferably the topic of his/her dissertation and submit it in form of a short report.

SEMISTER II

509138 Wastewater Treatment & Design

Teaching scheme	Examination Scheme
Lecture: - 3h/week	Theory: - 100 Marks

Mass transport processes, Mass balance analysis, types of reactions, reaction kinetics, Configurations of ideal and non-ideal reactors, principles of ideal reactor design. Basic principle of mass transfer, Gas-liquid mass transfer, Two film theory Introduction to process selection.

Coagulation processes, stability of colloids and destabilization, coagulants Flocculation theory, orthokinetic and perikinetic Design of slow and rapid mixers.

Sedimentation, particle settling theory, types of settling and related theory, types of clarifier, high rate clarification, design of clarifiers.

Introduction to depth filtration, filtration processes, principal mechanisms of filtration, filter hydraulics, backwash hydraulics, Rate control patterns and methods, design and operation of slow sand, rapid sand and dual media filters.

Adsorption processes, causes and types of adsorption, influencing factors, adsorption equilibria and development of adsorption isotherms, activated carbon adsorption kinetics, analysis and design of GAC and PAC contactors.

Ion exchange, exchange materials, exchange capacity, ion exchange chemistry and reactions, applications for hardness and TDS removal, design of ion exchange softener,

Disinfection, modes of disinfection, mechanisms, factors influencing, ideal disinfectant, chemistry of chlorination, ozone chemistry, estimation of ozone dosage, UV disinfection, Estimation of UV dose.

Corrosion processes, electrochemical nature of corrosion, types of corrosion, methods of corrosion control.

Objectives and fundamentals of biological treatment, types of biological treatment processes. Conventional activated sludge process, process kinetics and design considerations, process control measures, operational problems, Introduction to modifications. Trickling filter, classification, process design considerations. Fundamentals of anaerobic treatment, general design considerations, types of anaerobic reactors.

Reference Books :

1. METCALF & EDDY, INC. " Wastewater Engineering - Treatment, Disposal, and Reuse ", Third Edition, Tata McGraw-Hill Publishing CompanyLimited, New Delhi 1995.
2. CASEY. T.J. " Unit Treatment Processes in Water and Wastewater Engineering ", John Wiley & Sons England 1993.

509139 Solid Waste Management

Teaching scheme	Examination Scheme
Lecture: - 3h/week	Theory: - 100 Marks

Solid waste management: Objectives, Functional elements, Environmental impact of mismanagement. Solid waste: Sources, Types, Composition, Quantities, Physical, Chemical and Biological properties.

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, Economic analysis. Transportation of solid waste: Means and methods, Routing of vehicles.

Sorting and material recovery: Objectives, Stages of sorting, Sorting operations, Guidelines for sorting for material recovery, Typical material recovery facility for a commingled solid waste.

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.

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

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.

Reference Books:

1)Manual on municipal solid waste management – Government of India publication.
2)Integrated solid waste management – George Tchobanoglous. Mcgraw Hill
3) Solid waste management handbook– Pavoni.

509140 Industrial Waste Treatment

Teaching scheme	Examination Scheme
Lecture: - 3h/week	Theory: - 100 Marks

Water use in industry, Industrial water quality requirements, Deterioration of water quality, Classification and characterization of Industrial wastewater, Monitoring of wastewater flow in industries, Quality and quantity variations in waste discharge, Water budgeting.

Waste volume reduction, Waste strength reduction, Neutralization, Proportioning, Equalization. Reuse and recycling concepts.

Treatment techniques for removal of specific pollutants in industrial wastewaters, e.g., oil and grease, cyanide, fluoride, calcium, magnesium, toxic organics, heavy metals, radioactivity.

Treatability aspects of raw industrial wastewater with domestic sewage, Partially treated industrial wastewater with domestic sewage, Completely treated industrial wastewater with domestic sewage. Stream and Effluent standards.

Common Effluent treatment plant: Concept, Objectives, Methodology, Cost benefit analysis, Design, Operation and maintenance.

Classification of industries. Manufacturing processes, Water usage, Sources, Quantities, and characteristics of effluents, Pollution effects, Methods of treatment, utilization and disposal, in industries viz. sugar, distillery, dairy, pulp and paper mill, fertilizer, tanning, steel industry, textile, petroleum refining, chemical and power plant.

Reference Books

1) Theories and Practices of Industrial waste treatment- Nelson Nemerow.
2) Waste water treatment: M.N.Rao & Datta.
3) IS Standard guide for treatment and disposal of various industries.

Elective III

509141 Ecology and Risk Assessment

Teaching scheme	Examination Scheme
Lecture: - 3h/week	Theory: - 100 Marks

Introduction; Principles and Concepts of Eco-system, Energy in Eco-system, Biogeochemical Cycles; Principles Pertaining to Limiting Factors; Principles and Concepts at the Community and Population Levels; Species in Eco-system; Devolution and Evolution of Eco system; Models in Ecology; Fresh Water Ecology; Marine Ecology; Estuarine Ecology; Terrestrial Ecology; Concepts and Principles in Sustainable Development and Biodiversity; Habitat, Damage Assessment; End Point Definition; Quantification of Uncertainty; Predictive Risk Assessment; Exposure, Organism- level Effects; Case Studies.

Reference Books:

1. Fundamentals of Ecology by Odhum (latest edition)
2. Ecological Engineering by Mitch / Iorgemaker (latest edition)

Elective III

509141 Water Quality Modeling

Teaching scheme	Examination Scheme
Lecture: - 3h/week	Theory: - 100 Marks

Basic Concept of Modeling. Hydrological Considerations in Water Quality Modeling. Low Flow Frequency Analysis. Sources of Pollution and Types of Wastes; Point and Non-point Sources.

General Mathematical Formulation of Water Quality Models for Streams and Rivers; Bod, Do, Bacterial Decay, and Nitrification.

Stream Surveys for Model Calibration and Verification; Application of river models for water quality management. Development of estuarine water quality models. Steady state lake models. Ocean outfalls and mathematical models of wastewater dispersion in oceans.

Reference Books:

1. Principles of Surface Water Quality Modeling and Control by E.V. Thomson (1987) Happer and Row Publishers New York.
2. Water Quality Modeling by M.D. Palmer the World Bank Washington DC. (latest edition)

Elective III

509141 Modern Trends in Environmental Engineering

Teaching scheme	Examination Scheme
Lecture: - 3h/week	Theory: - 100 Marks

Emerging fields in ESE: Cleaner Production Technologies, Environmental Bio-Technology, Bioremidiation, Risk Analysis, Software and Information Systems, Global Issues.

Environmental pollution monitoring sensors. Basic understanding of the interaction of electromagnetic radiation, sound, laser etc. with matter. Familiarization with a variety of sensors and platforms

Anthropogenic Endocrine Disruption. The Scientific Basis of the Endocrine Hypothesis. Scientific Uncertainty, Risk Analysis and Policy Response Unit – IV Land pollution- Definition and scope, necessity and importance, Treatment methods: Various methods of refuse processing, fertilizer, fuel and food values. Sanitary land filling - definition, methodology, trench, area, ramp, pit method, site selection, basic steps involved, cell design, prevention of site pollution, Leachate treatment, gas collection and recirculation.

Composting – Aerobic and anaerobic composting, Factors affecting composting indore and Bangalore processes of composting. Incineration - Processes 3Ts to control high temperature incinerators, design approach prevention of air pollution.

Reference Books:

1. Special issue and reviews articles on the relevant topics in Science, Scientific American, Nature, Current Science and Environmental Science and Engineering.
2. C.S. Foster and D.A. Johnwase, Environmental Biotechnology, (Ellis Harwood) (1987).
3. B. Vallely, ‘1001Ways to Save the Planet’, (Ivy Books) Newyork (1990)
4. Solid Waste Management , Van Nostrand Reinhold Co. 1975.
5. C.L. ell, Solid Waste Management, John Wiley, 1975.
6. P.W. Powers. How to dispose of toxic substances and industrial Waste, Noyes Data Corporation, England, 1976.

Elective III

509141 Environmental Biotechnology

Teaching scheme	Examination Scheme
Lecture: - 3h/week	Theory: - 100 Marks

Concept of Environmental Biotechnology and Environmental Engineering, scope and importance. Genetic engineering structure of DNA, RNA, Replication of DNA, genetic code, Transcription, Protein synthesis.

Introduction to Genetic Engineering and Recombinant DNA Technology(RDT), Restriction endonucleases, Steps in gene cloning, cDNA and genomic library, Chemical synthesis of gene, Polymerase Chain Reaction (PCR), Vectors and their types, Selection of recombinant clones.

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. Treatment schemes for waste waters of dairy, distillery, tannery, sugar and antibiotic industry.

Air pollution and its control through biotechnology, Biotechnology in reduction of CO2 emission, Bioscrubbers, Biobeds, Biotrickling filters and their applications.

Microbiology of degradation of xenobiotic in environment – ecological considerations, decay behavior and degradative plasmids, hydrocarbons, substituted hydrocarbons, oil pollution, surfactants, pesticides. Biological detoxification of cynide, oxalate, urea, petrochemical industry effluents, toxic organics, phenols.

Bioremediation, Types of bioremediations, Bioaugmentation for bioremediation, Bioreactors, Bioremediation of herbicides, pesticides, hydrocarbons, oil spills.

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. Nikaids .
2. Molecular Biotechnology : Gleek and Pasternack.
3. Biotechnology : A Text Book of Industrial Microbilogy, T. D. Brock,
4. Industrial Microbiology : Presscott and Dunn.
5. Biotechnology : B. D. Singh , Kalyani Publishers.

509142 Elective IV (Open)

Teaching scheme	Examination Scheme
Lecture: - 3h/week	Theory: - 100 Marks

509143 Lab Practice II

Teaching Scheme	**Examination Scheme**
Practical: 6 Hrs/Week	T.W. : 50 marks

Each student should perform at least 8 experiments/ assignments from the list given below and submit the journal which will form the term-work for the subject

1. Analysis of soils for pH,
2. Analysis of soil for moisture,
3. Analysis of soil types,
4. Analysis of soil for EC, conductivity,
5. Analysis of soil for NPK, Na, Ca.
6. Development of flow sheet of effluent treatment plant.
7. Designing of plant using software such as EnviroPro / SuperPro
8. Field visit to a water treatment plant
9. Field visit to a wastewater treatment plant
10. To study the performance Ion Exchange Column
11. To study the adsorption Characteristics of the given cation exchange resins.

509144 Seminar II

Teaching Scheme
Practical : 4 Hr/Week

Examination Scheme
T.W. : 50 marks

Each student is required to deliver a seminar in first semester on the state of the art of the topic of his/her choice, preferably the topic of his/her dissertation and submit it in form of a short report.

609107 Seminar III (Based on Project)

Teaching Scheme
Practical : 4 Hr/Week

Examination Scheme
T.W. : 50 marks

Each student is required to deliver a seminar in third semester on the state of the art of the topic of his/her choice, preferably the topic of his/her dissertation and submit it in form of a short report.

609108 Project Stage I

Teaching Scheme
Practicals: 18 Hrs/Week

Examination Scheme

Students are required to prepare a report based on project of their choice.

609109 : Project Stage II

Teaching Scheme
Practical : 18 Hrs/Week

Examination Scheme
T.W.:50marks /
Project 200 Marks

Students are required to prepare report on project of their choice. They are required to submit project report and appear for the oral examination