

**BRANCH-ENVIRONMENTAL ENGINEERING****Specialization: Environmental Engineering/ Environmental Science & Engineering**

Second Semester							
Course Name	Theory				Practical		
	Hours/ Week L/T	Credit Theory	University Marks	Internal Evaluation	Hours/ Week L/T	Credit Practical	Marks
<b>Specialization Core-1</b> Air & Noise Pollution	4-0	4	100	50	-	-	-
<b>Specialization Core-2</b> Solid Waste Management	4-0	4	100	50	-	-	-
<b>Elective I (Specialization related)</b> 1. Hazardous Waste Management 2. Industrial Pollution Control 3. Advanced Water & Waste Water Treatment System 4. Green Technology	4-0	4	100	50	-	-	-
<b>Elective II (Departmental related)</b> 1. Environmental Impact Assessment 2. Environmental Management 3. Occupational Health & Safety 4. Environmental System Modeling & Optimization	4-0	4	100	50	-	-	-
<b>Elective III (from any department)</b> 1 Environmental Hydraulics 2. Engineering Hydrology 3. Application of Remote Sensing & GIS for Environmental Engineering 4. Instrumental Methods for Environmental Analysis	4-0	4	100	50	-	-	-
<b>Lab-2 (Specialization lab to be decided by the department)</b>					4	4	150
<b>Seminar/Project</b>					4	4	150
<b>Total</b>							
<b>Total Marks: 1050</b>							
<b>Total Credits: 28</b>							

## **AIR AND NOISE POLLUTION**

### **MODULE I**

Source of air pollution; classification of aerosols, Gases vapors, natural pollutants; properties of air pollutants; Meteorological factors influencing dispersion of air pollutants; Gaussian plume model for dispersion of air pollutants and its applications;

### **MODULE II**

Effects on man material, vegetation, art treasure; Air pollution disasters; Economic Effects of air pollution; Global Effects of Air pollution; Air pollution due to automobiles and emission control; General concept of transport planning for prevention of air pollution;

### **MODULE III**

Control technology for particulate and gaseous pollutants. Basics of noise pollution; Measurement of noise; permissible noise levels in different zones; Effects of noise.

### **TEXT BOOKS:**

1. Air pollution control theory by Martin Crawford - McGraw-Hill, 1976
2. Air pollution control by A.C. Stern.
3. Air pollution control by H.C. Perkins - McGraw-Hill, 1974
4. Air pollution control by Joe O. Ledbetter- Dekker, 1972
5. Atmospheric Chemistry and Physics: From Air Pollution to Climate Change, 2nd Edition by John H. Seinfeld, Spyros N. Pandis.
6. Fundamentals of air pollution engineering. Environmental engineering by Seinfeld, John H.

## SOLID WASTE MANAGEMENT

### MODULE I

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.

### MODULE II

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.

### MODULE III

Landfills: Definition, Essential components, Site selection, Land filling methods, Leachate and landfill gas management. Biomedical Waste: Generation, identification, storage, collection, transport, treatment, common treatment and disposal, occupational hazards and safety measures. Biomedical waste legislation in India

### MODULE IV

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. 7 hr

### References

- 1) Manual on municipal solid waste management – Government of India publication.
- 2) Integrated solid waste management – George Tchobanoglous.
- 3) Solid waste management – A. D. Bhide.
- 4) Solid waste management handbook– Pavoni.

## HAZARDOUS WASTE MANAGEMENT

### Module I

Sources of hazardous waste: types and sources hazardous wastes - need for hazardous waste management -elements of integrated hazardous waste management and roles of stakeholders and ngos - salient features of Indian legislations on management and handling of hazardous wastes, biomedical wastes, lead acid batteries, e-waste.

### Module II

Characterization of hazardous waste :hazardous waste generation rates and variation - composition, physical, chemical and biological properties of hazardous wastes - hazardous characteristics – tcip tests - waste sampling and characterization plan - source reduction of wastes -recycling and reuse.

### Module III

Handling of hazardous waste: handling and segregation of wastes at source - storage and collection hazardous. Wastes -need for transfer and transport - transfer stations optimizing waste. Allocation - compatibility, storage, labelling and handling of hazardous wastes.

### Module IV

Processing of hazardous waste: objectives of waste processing - material separation and processing technologies -biological and chemical conversion technologies - thermal conversion technologies and energy recovery - incineration - solidification and stabilization of hazardous wastes - treatment of biomedical wastes and e-waste. Disposal of hazardous waste: waste disposal options - disposal in landfills - landfill classification- construction and operation of secured landfills -bioreactors - ocean dumping - land disposal – soil remediation.

### REFERENCES

- 1.CPHEEO,"Manual on Municipal Solid waste management", Central Public HealthandEnvironmental Engineering Organisation, Government of India, New Delhi, 2000.
- 2.Micheael D. LaGrega, Philip L Buckingham, Jeffrey C. E vans and "Environmental Resources Management", Hazardous waste Management, McGraw-Hill International edition, New York, 2001.
- 3.Vesilind P.A., Worrell W and Reinhart, "Solid waste engineering", Thomson Learning Inc., Singapore, 2002.

## **INDUSTRIAL POLLUTION CONTROL**

### **Module I**

Water pollution laws and standards - industrial wastewater treatment, processes and equipment.

### **Module II**

Water pollution control in different Chemical industries, Air Pollution Laws, Air pollutants monitoring equipment and method of analysis, Air pollution control methods in industries,

### **Module III**

sludge treatment and disposal.

### **Text Books:**

1. Rao M.N. & Rao H, Air Pollution, Tata Mcgraw Hill
2. Mahajan S.P., Pollution Control in Process Industries, Tata Mcgraw Hill
3. Mccaff&Eddy , Waste Water Treatment
4. Peavy , Environmental Engineering
5. Rao C.S., Environmental Pollution Control Engineering, New Age Int. Pub.
6. Gerard Kiely, Environmental Engineering, Mcgraw Hill

### **Reference Books:**

1. Nelson &Nemerow, Industrial Water Pollution-Origin, Characteristics and Treatment, Addison, Wesley Publishing Co.
2. Sincero A.P. &Sincero G.A., Environmental Engineering, A Design Approach, Prentice Hall Of India
3. Babbitt H.E, Sewage & Sewage Treatment, John Wiley
4. Abbasi S.A, &Ramasami E, Biotechnical Methods of Pollution Control, Universities Press (India) Ltd.
5. S C. Bhatia, Handbook of industrial pollution control vol-1 and 2.

## ADVANCE WATER AND WASTEWATER TREATMENT SYSTEM

### Module I

Gas transfer: Aeration systems, Energy requirement, Design of aeration systems. Membrane. Filtration, Terminology, Process classification, Membrane configurations, Membrane operation for micro filtration, Ultra filtration and Reverse osmosis, Area requirement, Membrane fouling and its control, Application of membranes. Electro dialysis: Theory, Area and power requirement, Disposal of concentrate waste streams.

### Module II

Grit removal: Types of grit chambers, Characteristics, quantities, processes and disposal of grit, Design of grit chambers, Flotation: Objective, Types of flotation systems, Design considerations. Chemical precipitation for removal of phosphorous, heavy metals and dissolved inorganic substances.

### Module III

Microbial growth kinetics, Modelling suspended and attached growth treatment processes. Suspended growth processes for biological nitrification and de- nitrification, Biological nitrogen and phosphorous removal. Anaerobic sludge blanket processes, Design considerations for up flow Anaerobic Sludge Blanket process. Theory and design of Sludge treatment, sludge thickening, sludge drying, incineration, aerobic and anaerobic digestion of sludge.

### Module IV

Wetland and aquatic treatment systems; Types, application, Treatment kinetics and effluent variability in constructed wetlands and aquatic systems, Free water surface and subsurface constructed wetlands, Floating plants (water hyacinths and duckweed), Combination systems, Design procedures for constructed wetlands, Management of constructed wetlands and aquatic systems.

### References

1. Wastewater Engineering treatment and reuse– Metcalf Eddy.
2. Theory and Practice of water and Wastewater treatment – Ronald Droste.
3. Physico-chemical processes of water purification – Weber
4. Wastewater Treatment for Pollution Control – Soli Arceivala.

## GREEN TECHNOLOGY

### Module I

Concept of Green Buildings: Green building initiatives, its origin, characteristics of a green building, green buildings in India, certification of green buildings rating systems (BREEAM, USGBC, LEED, IGBC, TERI-GRIHA,) criteria for rating, sustainability. Sources of Energy: Renewable and non-renewable sources of energy; coal, petroleum, nuclear, wind, solar, hydro, geothermal sources; potential of these sources, hazards, pollution; global scenario with reference to demand and supply in India. Energy arises

### Module II

Carbon Emission: Forecasting, control of carbon emission, air quality and its monitoring carbon foot print; environmental issues, minimizing carbon emission. Green Building Materials: Depleting natural resources of building materials; renewable and recyclable resources; energy efficient materials; green cement, biodegradable materials, smart materials, engineering evaluation of these materials.

### Module III

Green Building Planning and Specifications for green buildings .Design of Green Buildings; Sustainable sites, impact of building on environment, life cycle assessment. Design on Bioclimatic and solar passive architecture, considerations of energy consumption, water use, and system reliability, indoor air quality, noise level, comfort, cost efficiency in building design

### Module IV

Construction of Green Buildings: Energy efficient construction, practices for thermal efficiency and natural lighting. Eco- friendly water proofing; ECB codes building rating, maintenance of green buildings. 08 Hrs 8. Case studies of residential and commercial green buildings.

### Text Books:

1. Tropical housing and buildings climate design (1973). By Koenig's Berger Ltd, ingeesle, T-G Alan mayhew, s zokoloyS.v University press (India) pot-Ltd Hyderabad.

## ENVIRONMENTAL IMPACT ASSESSMENT

### Module I

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

### Module II

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

### Module III

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

### Module IV

Environmental Management Plan Environmental Management Plan - preparation, implementation and review – Mitigation and Rehabilitation Plans – Policy and guidelines for planning and monitoring programmes – Post project audit – Ethical and Quality aspects of Environmental Impact Assessment. Sectoral EIA. EIA related to the following sectors - Infrastructure –construction and housing Mining – Industrial - Thermal Power - River valley and Hydroelectric – coastal projects-Nuclear Power. EIA for coastal projects.



**References:**

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

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## **ENVIRONMENT MANAGEMENT**

### **Module I**

Ecological aspects: Salient features of major Eco Systems, Energy Transfer, Population Dynamics, Ecological imbalance, Preservation of Biodiversity. Land Pollution, Water Pollution due to sewage, industrial effluents and leachate, Groundwater contamination and control measures. Pollution due to Nuclear Power Plants, Radioactive Waste, Thermal pollution, causes and control. Noise Pollution: Decibel Levels, Monitoring, Hazards, Control measures

### **Module II**

Environmental Impact Assessment (EIA) Definitions and Concept, Scope, Objectives, Types of impacts, Elements of EIA, Baseline studies, Methodologies of EIA, Prediction of impacts and its methodology, Uncertainties in EIA, Status of EIAs in India. Environmental Auditing: Definitions and concepts, Scope and Objectives, Types of audit, Accounts audit, Environmental audit statement, Qualities of environment auditor. Environmental Impact Statement (EIS), Sustainable development. Environmental Management Plan: Definition, Importance, Development, Structuring, Monitoring, Cost aspects. Strategy for siting of Industries.

### **Module III**

Environmental Ethics: Ethics in society, Environmental consequences, Responsibility for environmental degradation, Ethical theories and codes of Ethics, Changing attitudes 4 hr Unit 5 ISO and ISO 14000 Series Introduction, Areas covered in the series of standards, Necessity of ISO certification. Environmental management system: Evolution, Need, Elements, Benefits, ISO 14001 requirements, Steps in ISO 14001 certification, ISO 14001 and sustainable development, Integration with other systems (ISO 9000, TQM, Six Sigma), Benefits of integration

### **Module IV**

Environmental Legislation; Water (prevention and control of pollution) act 1974, The environmental act 1986, The Noise Pollution (Regulation and Control) Rules, 2000. Environmental economics, Environmental Labelling, Life-Cycle Assessment

**Reference Books:**

1. "Environmental Impact Assessment", Canter (U.S.A) Mc Graw Hill publications, 1996.
2. "Environmental Auditing", Published by CPCB. New Dehli.
3. "Environmental Audit", A.K. Mhaskar, .Media Enviro Publications, 2002.
4. "ISO Standards".
5. "Environment Management Centre Website".
6. "Ecology", E.P. Odum. (Second edition)Oxford and IBH publishing Co.Pvt.Ltd, 1975.

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## OCCUPATIONAL HEALTH & SAFETY

### Module I

Introduction to safety philosophy: sequence of accident occurrence, occupational injuries-effects of industrial accidents, analysis of accidents, injury data, accident investigations & reporting, accident costing .Safety & health management: employer & employee responsibilities, record-keeping & reporting requirements, safety organization, responsibilities of safety officer, supervisors and safety committees.

### Module II

Risk management: Definitions of Hazards, Risks, Evolution of Methodical Analysis, System safety Analysis techniques, Performance measurement, Operational Reviews - Internal & External. Work practices in industries: Hazards in Chemical Operations, Material Handling Hazards, Lifting Machinery & Pressure Vessels, Material Safety Data Sheets, Classification of Chemicals, Hazardous Chemicals, Storage Practices, Radiation Safety, Petroleum Storage Requirements and Pesticide Safety.

### Module III

Indian statutes: Central Acts, Factory's Act, AP Factory Rules, Construction Safety Regulations, Petroleum Rules 2002, Electrical Act & Rules. Fire safety: basic elements, causes, industrial fires, explosions, effect on environment, property & human loss, prevention techniques, building design, fire protection systems, contingency plan, emergency preparedness, evacuation.

### Module IV

Industrial best practices: in electrical, mechanical, fire, machine guarding, personal protective equipment, occupational health, ergonomics ambulance, noise abatement methods, management of contractors. Occupational safety & management standards: Indian standards, ohsas 18001 standard and its elements, Ce certificate, social accountability standards, system implementation, benefits.

### Text Books:

1. Industrial safety and health, David L. Goetsch, Macmillan Publishing Company, 1993.
2. Handbook of environmental health and safety, Vol I & II, Herman Kooren, Michael Bisesi, Jaico Publishing House, 1999.

## ENVIRONMENTAL SYSTEM MODELLING AND OPTIMIZATION

### Module – I

System approach – concept of analysis, Problems formation, Model construction and deriving solution from models, modeling of waste water management system – model formation and solution. Modeling of pesticide management problems, Optimization model for planning municipal waste water treatment.

### Module –II

Lagrange multipliers – unconstrained and constrained optimization, Limitation, Sequential search algorithms – box algorithm, Limitations linear programming models, solution and sensitivity analysis, General linear programming models for air quality management and agricultural non-point source pollution.

### Module –III

Separable and integer programming application to multi objective planning. Application of integer programming to municipal solid waste management. Dynamic programming models – application to land use planning and air pollution emission control.

### Text Books :-

1. Environmental System Optimization – D.A. Haith – John Wiley
2. Optimization Theory and Application – S.S. Rao – Wiley Eastern
3. Hand book of Environmental and Ecological modeling, Halling – Sorensen B, Nielsen S.N and Jorgensen S.E, Lewis Publishers Inc., 1995
4. Fundamental of Atmosphere Modeling, Jacobson Mark. Z ,Kluwer Academic Press. 2002
5. In introduction to water quality modeling, James A. (Ed), (2nd Ed). 1992.
6. Techniques for Environmental System analysis – R.H. Pantell, Wiley, N.Y, 2001.
7. System analysis and Design – R.J Aguilar, Prentice Hall, Englewood cliffs, N.J. 1993

## ENVIRONMENTAL HYDRAULICS

### Module-I

Basic concept of fluid properties, flow formulation, turbulent and viscous flow, Energy and momentum equation, transition flow, uniform and non-uniform flow, open channel flow, gradually varied flow, channel control, critical flow, hydraulic jump.

### Module- II

Flow through orifices, gates, flow measurement through venturimeter, flow through channels, sewer pipes, pressure flow, Design and analysis of water distribution network, Hardy Cross and other method of analysis, Head loss computation.

### Module-III

Three reservoir problem, reactor hydraulics, concept of plug flow, mixed and turbulent flow through reactor, dispersion number, flow profile, pump hydraulics, measurement of suction head, NPSH, Losses through valves, energy computation, and plumbing hydraulics.

### Text Books:-

1. Peavy, Rowe, Techobanoglous- Environmental Engg.
2. V.L. Streeter- Fluid Mechanics.

## **ENGINEERING HYDROLOGY**

### **Module-I**

Hydrological cycle, Rainfall –Runoff data analysis, Precipitation, Evaporation, Evapotranspiration, Measurement of Evaporation, Infiltration, Stream flow measurement.

### **Module-II**

The ground water environment, Aquifer, Aquitard, Darcy's law, Permeability, Development of Laplace's basic ground water flow equation, Aquifer parameter, Well hydraulics – steady and unsteady flow equation, Jacob's Thies equation, Well functions, Ground water flow between water bodies.

### **Module-III**

Unit hydrograph, S- Hydrograph, Application of Hydrographical data for flood estimation, Gumbel's approach, Meskingham's equation, salt water intrusion and modelling,

### **Module-IV**

Ground water pollution, Transport of contaminates, advection, diffusion, Adsorption, model, Numerical modelling and solution, artificial recharge and rainwater harvesting.

### **Text Books:**

1. Subramanyam - Engineering Hydrology
2. K.C. Patra – Hydrology
3. Sing. V.P – Elementary Hydrology
4. D.K.Todd – Ground Water Hydrology
5. Bear & Gaeob – Hydrology of Ground Water.
6. K.S. Reddy – Geo-Environmental Engineering
7. Raghunath - Ground Water Hydrology
8. Viesmann – Hydrology – Prentice Hall
9. Beers and Rowe- Ground water flow modelling

## APPLICATION OF REMOTE SENSING & GIS FOR ENVIRONMENTAL ENGINEERING

### Module –I

Remote Sensing: Introduction to Remote Sensing: Principles of Remote sensing, Types of Remote Sensing, Advantages of Remote Sensing, Physical basis of Remote Sensing, Applications of Remote Sensing ; History of Remote Sensing; The Electromagnetic spectrum; The nature and generation of Electromagnetic radiation (EMR ) Spectral Reflectance Curves. Interaction of EMR with the atmosphere and earth's surface features. Spectral signatures and characteristics, spectral reflectance curves for rocks, soil, vegetation and water features within near and near Infrared. Spectral signatures, Resolution. Remote Sensing observations and platforms: Ground, airborne and satellite based platforms; Some important Remote Sensing Satellites. Aerial Stereo coverage and Remote Sensing Satellites. Sensors: Passive and Active Sensors; Major Remote Sensing Sensors; single and multi band scanners Satellite band designations and principal applications; Colour / False Colour; Aerial Photography/ Aerial Photo Interpretation. USS sensor and other type of sensors. Details of sensors on BOARD LATEST EARTH RESOURCES SATELLITES VIZ.; LANDSAT 6/7/8, SPOT, IKONOS, IRS AND ERS.

### Module -II

Digital Image Processing: Pixels and Digital Number; Digital Image Structure; Format of Remote Sensing Data; Image Processing functions: Image Restoration, Image Enhancement, Image Transformation, Image Classification and Analysis; Image interpretation strategies. Visual Photo- Interpretation Techniques based on 'Photo elements' and 'Terrain elements'.

### Module -III

Geographic Information System: Introduction, Definition, Preparation of thematic map from remote sensing data, Map Projection and Coordinatesystem , GIS components: Hardware, software and infrastructures, GIS data types, Data acquisition ,Data Input and Data Processing, and management including topology DEM/ DTM generation.

### Module -IV

Integration of Remote Sensing and GIS techniques and its applications in Environmental Impact Assessment and Management including some case studies.



**Books and Reference:**

1. Remote Sensing and GIS - Anji Reddy M., The Book Syndicate, Hyderabad, 2000.
2. Principles of Geographical Information Systems - P A Burrough and R. A. McDonnell, OUP, Oxford, 1998.
3. Remote Sensing for Earth Resource- Rao, L.P., AEG Publication, Hyderabad, 1987.
4. Geographic Information System- Kang Tsung Chang, Tata Mc Graw Hill, Publication Edition, 2002.
5. Remote Sensing And Image Interpretation Thomas M. Lillesand, Ralph W. Kiefer, Jonathan W. Chipman, Wiley,2003
6. Journal by Insurance company surveyors and loss assessors – Mumbai – published by Insurance companies.

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## INSTRUMENTAL METHODS FOR ENVIRONMENTAL ANALYSIS

### Module-I

Principle of instrumentation, Application of Instrumental analysis, Optical analysis, Beer's Law, Spectrophotometry, Flame photometer method, Fluorescence, Spectrography, Atomic adsorption spectroscopy, Principle of AAS.

### Module-II

Chromatography : Classification, General principle, partitioning , Analyte, Column Chromatography, Thin Layer Chromatography, Application Gas Chromatography(GC), Principle and application of high precision liquid chromatography (HPLC), Ion Chromatography, Mass Spectroscopy

### Module-III

Electro chemical methods :-Polarograph, Tube Polarograph, Ion Selective Electrodes (ISE meter) Oscilloscopic Polarography, Cyclic voltametry. Biosensors for parameter monitoring.

### Text Books:-

1. Sawyer Mc carty - Chemistry for Environmental Engineers.
2. Barwell C.N. - Fundamental of Molecular Spectroscopy.
3. H. Willand and Deault – Instrumental method of analysis
4. Rezsok, R.L and Shields – Modern method of chemical analysis