

# BIJU PATNAIK UNIVERSITY OF TECHNOLOGY ORISSA

## M.TECH IN ENVIRONMENTAL ENGINEERING

### 1<sup>ST</sup> SEMESTER

Sl. No	Subject Code	Subject Name	L-T-P	Credits
1	ENPC101	Environmental Chemistry	3-0-0	3
2	ENPC102	Environmental Ecology & Microbiology	3-0-0	3
3	ENPC103	Water Supply and Treatment	3-1-0	4
4	ENPC104	Air and noise pollution	3-0-0	3
5		<b>Elective-I (Any One)</b>	3-0-0	3
	ENPE101	1.Design of Air Pollution Control Devices		
	ENPE102	2.Instrumental Methods for Environmental Analysis		
	ENPE103	3.Advance Mathematics		
6		<b>Elective-II (Any One)</b>	3-0-0	3
	ENPE104	1.Environmental System modeling & Optimization		
	ENPE105	2.Environmental hydrology		
	ENPE106	3.Environmental Economics		
7	ENPR101	Environmental Engineering Laboratory-I	0-0-6	4
8	ENPT101	Pre-Thesis work and Seminar	0-0-3	2
			<b>28</b>	<b>25</b>

### 2<sup>ND</sup> SEMESTER

	Subject Code	Subject Name	L-T-P	Credits
1	ENPC101	Waste Water Engineering	3-1-0	4
2	ENPC102	Solid & Hazardous Waste Management	3-0-0	3
3		<b>Elective-III (Any One)</b>	3-0-0	3
	ENPE201	1. Industrial Waste Water Treatment		
	ENPE202	2. Statistical Methods and Design of Experiments		
	ENPE203	3. Rural Water Supply and Sanitation		
4		<b>Elective-IV (Any one)</b>	<b>3-0-0</b>	<b>3</b>
	ENPE204	1. Environmental Hydraulics		
	ENPE205	2. Environmental Policies & Legislation		
	ENPE206	3. Occupational Health and Safety		
5		<b>Elective-V (Any One)</b>	<b>3-0-0</b>	<b>3</b>
	ENPE207	1. Disaster Management		
	ENPE208	2. Application of Remote Sensing and GIS for Environmental Engineering		
	ENPE209	3. Design of Water and Waster Water Treatment Systems		
6	ENPR201	Environmental Engineering Laboratory-II	0-0-3	2
7	ENPR202	Environmental Engineering Process Design	0-0-3	2
8	ENPT201	Pre-thesis Work and Seminar	0-0-3	2
9	ENCV201	Comprehensive Viva-voce-I	0-0-0	2
		<b>Total</b>	<b>25</b>	<b>24</b>

### 3<sup>RD</sup> SEMESTER

SI No	Subject Code	Subject Name	L-T-P	Credits
1		Open Elective	3-0-0	3
2		Thesis Part-I	0-0-0	14
		<b>Total</b>	<b>3</b>	<b>17</b>

#### Open Electives (Any One)

1. Environmental Impact Assessment and Auditing  
(For Environmental Engg. and other Discipline)
2. Research Methodology
3. Project Management and Costing
4. Human Resources Management
5. Data Mining and Data Ware House
6. Enterprises Resource Planning
7. Foundation of E-commerce.
8. Soft Computing/ Soft Computing Applications.

### 4<sup>TH</sup> SEMESTER

SI No	Subject Code	Subject Name	L-T-P	Credits
1	ENPT401	Thesis Part-II	3-0-0	20
2	ENCV401	Seminar	0-0-0	2
3	ENCV402	Comprehensive Viva-voce-II	0-0-0	2
		<b>Total</b>	<b>3</b>	<b>24</b>

**Total Credits : 90**

## ENVIRONMENTAL CHEMISTRY (3-0-0)

### Module-I Environmental Chemistry of Water –

Water quality parameters – Physical, Chemical, Biological, Bacteriological, Xenobiotics, Water quality criteria and standards, Water quality monitoring and methodology, Chemical methods involved in treatment of water and waste water, Removal of dissolved organics and inorganic, Heavy metal pollution and abatement, Eutrofication, Removal of detergents, phosphates, nitrogen (Nitrate, Nitrite and Ammonia), Fluoridation of water and Fluorosis.

### Module-II

**Atmospheric Chemistry** - Particles, Ions and radicals and their formation, Criteria and non criteria pollutants, their sources – natural, combustion, biochemical reactions and sink, Thermodynamic and kinetics of air pollutants, Thermo chemical and photo chemical reactions in atmosphere, Atmospheric pollution due to automobiles emission and its control, Photochemical smog, PAN, PAH, VOCs, Acid rain, Depletion of Ozone, Control devices for pollutants – Adsorption, Absorption, Condensation, Scrubbers, ESP, Particulate removal, Removal of NO<sub>x</sub>, SO<sub>x</sub> and CO.

### Module-III

**Soil Chemistry** – Soil composition, Soil in natural and man-made environment, Soil Air and Water, Acid-Base and ion exchange reactions in soil, Macro and micro nutrients, Nitrogen pathways and NPK in soil, Wastes and pollutants in soil, Fertilizer and other soil amendments, Heavy metals and radionuclide in soil, Colloidal chemistry of inorganic constituents, Clays Organic matter and Soil humus, Remediation of metal contaminated soil.

### Books:-

1. Environmental Chemistry – Stanley E. Manahan 5<sup>th</sup> Ed., Lewis Publishers, 1995
2. Chemistry for Environmental Engineers and Science (5<sup>th</sup> Ed) - - CN Sawyer, PL Mc Carty and GFPerkin, Tata McGraw- Hill ed., New Delhi, 2003
3. Aquatic Chemistry – W. Stumm & Morgan, John Willy & Sons, Inc, 3<sup>rd</sup> Ed., NY-1995
4. Water Chemistry – V.L. Snoeyine and D.Jenkins, John Wiley and Sons, Inc, NY-1980
5. Principles and Application of Aquatic Chemistry – FMM Morel & JG Hering, John Wiley & Sons, Inc, NY, 1993
6. Environmental chemistry- A.K.Dey, Willy eastern.

# ENVIRONMENTAL ECOLOGY & MICROBIOLOGY

(3-0-0)

## Module –I

Concept of Ecosystem:-

Structure (component parts) and function (food chain, food web, energy flow, nutrient cycle & productivity) of ecosystem. Ecological succession, Concept of limiting factor, Eutrofication.

## Module- II

Concept of population & Population attributes, Factor affecting human population growth, Birth rate, death rate and population change, Carrying capacity and environmental resistance, Economic development and demographic transition, Population interaction. qualitative & quantitative characteristic of a plant community, Biodiversity & it's conservation.

## Module-III

Microbiology:-

Nutrition, Culture and growth of micro-organisms, Airborne microbes, Microbial diseases like Hepatitis, Polio, Typhoid and their control, MPN test, Application of microbes in agriculture Biofertilizer, Control of micro-organisms.

## Books:-

1. Fundamental of Ecology by E.P. Odum – W.B Foundation company
2. Fundamental of Ecology by Dash & Dash, TMH publication.
3. Concept of Toxicology by Omkar – Soban Lal Nagin chand & co
4. Microbiology – P.D. Sharama - Rastogi Publication.

# **WATER SUPPLY AND TREATMENT (3-1-0)**

## **Module-I**

Demand of water, Population forecasting method, Peak factor, Logistic method of forecasting population, Sources of water, Global water balance, Water quality (physical, chemical), Biological quality of water, MPN test, Intake structure.

## **Module-II**

Water distribution system, Network analysis, Reservoir capacity, Ground water and surface water unit treatment process, flow sheet, Sedimentation process- Type I, Type-II, Settling , Tube-settling, High rate settling, Coagulation theory, Zeta potential concept, Double layer ionic theory, Schulz-Hardy rule, Coagulation practices, Jar test, Optimization of coagulation doses, Velocity Gradient, Concept and derivation of 'G', Mixing unit, Flocculator design,

## **Module-III**

Filtration mechanism, Hydraulics, Head loss determination, Kinetics of filtration, Computation of sand bed preparation from river bank, Under drainage system, Disinfection mechanism, Chick's law, Kinetics of chlorination, Problem, Break point chlorination, Softening process, Design of ion exchange column, Reverse osmosis process, Design of Iron removal and reverse osmosis plant, Defluorination and Arsenic removal.

## **Books:-**

1. Water and Waster Water Engineering- Fair,Gayer Okun
2. A Text Book of Environmental Engineering – Sincero & Sincero
3. Unit Process in Sanitation Engineering – Rich
4. A Text Book of Water supply Engineering – Clarke and Viesmann
5. Environmental Engineering – Peavy,Rowe and Tchobanologous

# AIR AND NOISE POLLUTION (3-0-0)

## Module-I

Definition and Scope, Problems, General effects, Effects on plants and animals, Natural and anthropogenic sources, Classification of pollutants, Health effect, Acid rain, Ozone layer depletion, Global warming, Green House effect, SPM, PAN, CFC,  $\text{NO}_x$ ,  $\text{SO}_x$ , CO pollution and its chemistry.

## Module-II

Unit and measurement of air pollutants, Air pollution monitoring, High volume analyzer, Dust fall analysis, Atmospheric stability lapse rate, Meteorology, Air pollution dispersion, Gaussian dispersion model, Plume pattern, Atmospheric Cleansing process, Ambient air quality standards, Rudiments of air pollution control devices, Cyclone separator, Settling chamber, Bag house filter, Wet scrubbers, Stack height determination, ESP, (General description and function only).

## Module-III

Noise Pollution – Definition, Sources, Effects, Mechanisms, SPL, Decibel concepts, Level of pollution, Estimation of equivalent SPL,  $\text{LD}_{\text{eq}}$  Control of noise pollution, Source control, devices, High way and industrial noise estimation, Noise level monitoring techniques.

### Books:-

1. Rao, M.N and Rao, HVN – Air Pollution TMH
2. Waek and Waner – Air Pollution
3. Stern – Air Pollution vol-I to IV
4. Parkins – Air Pollution
5. Masters – Environmental Engineering and Science
6. Sinerio & Sinerio – Environmental Engineering
7. Crawford – Air Pollution Control
8. Pandey V – Noise Pollution
9. N.D. Nevers – Air Pollution

## **Elective - I** (any one)

### **DESIGN OF AIR POLLUTION CONTROL DEVICES**

(3-0-0)

#### **Module-I**

General mechanism and aspects – Efficiencies of Control system, control strategies, Air pollution control standards, Atmospheric cleansing process, Automobile pollution – Legislation for motor vehicle emission control, IC Engine, Air-fuel ratio, Modified version of IC Engine for reduction vehicular emission, Catalytic Converter.

#### **Module-II**

Particulate Control – Settling Chamber, Laminar and turbulent flow, Stokes law application, Horizontal and vertical flow settling chamber, Multiple battle plate settler, Filtration, Bag house filter, Design interceptor, Impaction, convective diffusion, Air-Cloth ratio, Unit filtration rate, Cyclones, Cutsizes determination, Efficiency calculation, Wet scrubbers, Ventury mounted scrubbers, Electro Static collection and Precipitator design (ESP)

#### **Module-III**

Gaseous Pollutant Control:- Basic philosophy, Tray and peaked tower, Gas adsorption system, Adsorption tower design, Break through curve, Flue gas desulphurization Plant, NO<sub>x</sub> control reactor, Wet scrubber, Biological removal of air pollutant

#### **Books:-**

1. De Nevers. H – Air Pollution Control Engineering
2. Sincero & Sincero – Environmental Engineering
3. Stern – Air Pollution Control
4. Crawford – Air Pollution Control
5. C.S Rao – Environmental Pollution Control and Engineering
6. Air Pollution Part-II – Prof T.K. Roy

# **INSTRUMENTAL METHODS FOR ENVIRONMENTAL ANALYSIS (3-0-0)**

## **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.

## **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

# ADVANCE MATHEMATICS (3-0-0)

## **Module I:**

Calculus of variation, Complex variables, application of set theory, Review of complex variables. Open and closed set, mapping and transformation, function of complex variables, Integration of with respect to complex argument, Lagrange's equation, Galerkin Ritz method.

## **Module II:**

Probability and statistics.

Random variables, discrete variables, probability distribution function, density function, Normal distribution, Correlation, regression analysis, Analysis of Variance (ANOVA), Chi-square test, hypothesis analysis, Multivariate analysis.

## **Module III:**

Numerical analysis.

Introduction, interpolation, differences, Solution of linear and non linear equation, solution technique of differential equation, Matrix, Gauss-Seidal, Grout's method, Newton Rap son method, Eigen values and eigen vector problem, Design of experiments, random design, Fuzzy logic, Training model, Concept of Artificial Neural Network (ANN), factor method, optimization with linear and non linear programming

## **Books and References:**

1. Potter and Goldberg- Mathematical methods
2. Spiegel- A text book of complex variable
3. Spiegel-Text book of statistics
4. Miller and Freud – probability and statistics for engineers
5. Krysgic- advanced mathematics
6. Chapra –Numerical methods

**ENVIRONMENTAL SYSTEM MODELLING AND  
OPTIMIZATION (3-0-0)**

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

**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 – Scrensen 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), (2<sup>nd</sup> 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 HYDROLOGY (3-0-0)

## 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, Muskingum's equation, salt water intrusion and modeling, Ground water pollution, Transport of contaminants, advection, diffusion, Adsorption, model, Numerical modeling and solution, Artificial recharge and rainwater harvesting.

## 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

# ENVIRONMENTAL ECONOMICS (3-0-0)

## Module-I

Introduction to Environmental Economics: Scope of the problem, Interaction between economy and environment, Economist's perspectives on environmental problems. Brief idea about Quality of natural Environment and Environmental problems (Air Pollution, Water Pollution, Toxic Emission, ecosystem health). Introduction to Environmental Policy Instruments: Choice of policy instrument, command and control instruments, taxation, tradable permits, Environmental performance bonds

Public and environmental goods, negative externality and market failure, Internalization Environmental Valuation: Contingent valuation methods, travel cost method, hedonic price method

## Module-II

Economics of natural resources: Natural Resources (renewable and non-renewable), Population dynamics, extraction of non-renewable resources, depletion, resource modeling,

Green and Natural resource accounting: GDP, NDP and sustainable development, Environmental accounting

Social efficiency and benefit-cost analysis: Efficiency and competitive markets, supply, demand and efficiency, benefit and cost analysis

Sustainable development and irreversibility in environmental policy: definition, economical efficiency, economic growth and environment

## Module-III

**Global Environmental Issues and policies:** Climate Change: Causes; possible effects; costs of mitigating green house gas emissions; Carbon Trading, adaptation measures, Design of international agreements, Environmental conflict, bargaining and cooperation, Environmental issues and policies in India

## Text Books:

1. Kolstad, C.D., 2000, Environmental Economics, Oxford University Press.
2. Conrad, J. M. (1999). Resource Economics. Cambridge University Press
3. Hanley, N., Shogren, J. F., and White, B. (1997). Environmental economics in theory and practice. Oxford university press, New York.
4. M. Common and S. Stagi, (2005). Ecological Economics an introduction, Cambridge University Press
- 5 R. Quentin Grafton, Wiktor Adamowicz (2004). The economics of the environment and natural resources, Wiley Blackwell Publication.
- 6 Baumol, W.J., and E.E. Oates, 1988, The Theory of Environmental Policy, Cambridge University Press
7. Tietenberg, T., 1998, Environmental Economics and Policy, Addison-Wesley

### WASTE WATER ENGINEERING (3-1-0)

#### Module-I

Sewage characteristics, Quality and Quantity, Flow rate, Sewage treatment process, Reactor type, Hydraulic characteristics, C-diagram, Preliminary treatment – design and operation of Screening and grit chamber, Sedimentation, Chemical precipitation.

Waste water treatment of small communities: - Oxidation ditch, extended aeration system, SBR, Process design and operation of mechanically aerated lagoon and waste stabilization pond system.

#### Module-II

Principle of biological treatment – derivation of bacterial growth kinetics used in designing of waste water treatment plant. Operation of Activated Sludge Process, bulking and rising sludge, Sludge characteristics and disposal methods, design of secondary settling tank, Design and operation of Biological nitrification – denitrification system, Phosphorus uptake, Aerobic attached growth process- Process design and operation of trickling filter, RBC, Bio-filter,

#### Module-III

. Anaerobic treatment process: - Process microbiology and biochemistry, application for treatment of sewage, advantages and disadvantages. advanced wastewater treatment process

#### Books :-

1. Waste water engineering, by Metcalf &. Eddy - McGraw Hill.
2. Text book of Water Supply & Waste Water Engineering – Hammer Etal.
3. Environmental Engineering By Howard S. Peavy, Donald R. Rowe & George Tehobanoglous.
4. Sewage Disposal and Air Pollution Engineering S.K. Gorg.
5. Environmental Engineering – Gerard kiely
6. Design of waste water treatment systems - Quasim.

# **SOLID AND HAZARDOUS WASTE MANAGEMENT**

(3-0-0)

## **Module-I**

Sources, Composition and Characteristics, Qualitative and quantitative characteristics, Solid waste problems, Industrial mining, Agricultural and domestic wastes, Generation, collection rates and handling at the sources, Regulatory aspects of solid waste management.

Solid waste disposal :- Sanitary landfill planning, Site selection, Design and operation, Equipments, landfill stabilization, Composting and optimum conditions for composting.

## **Module – II**

Biomedical waste categorization, generation, collection, transport, treatment and disposal.

Incineration :- Process, types, fleet recovery, incineration products.

Pyrolysis :- Combustion, pyrolysis, gasification, energy recovery system.

## **Module-III**

Hazardous waste management:- Classification, Generation, Guidelines for HWM. Chemical, Physical and Biological treatment, Thermal Processes, Transportation, Storage, Ground water contamination, disposal techniques, Regulatory to framework

## **Books & References:-**

1. Renewable energy Environment & Development – Maheswar Dayal Konark Pub. Pvt Ltd 1998
2. George Tchobanglous, Hilary theisen and Samuel A. Vigil integrated Solid Waste Management. Engineering Principle and management issues (1993). Mc Graw Hill Inc.
3. WHO manual on solid waste management.
4. A Versiland, Solid Waste Engineering Thanson Books.
5. Hazardous Waste Management – C.A. Wentz – Mc Graw Hill
6. Hazardous Waste Management Engineering – E.J Martin and J.H. Johnson- Van Nostrand
7. Biomediation Principle – Eweis, JB, Ergas SJ, Chang DYP and Schroeder ED, Mc Graw Hill, Singapore, 1998

## **Elective-III** (any one)

### **INDUSTRIAL WASTE WATER TREATMENT** (3-0-0)

#### **Module- I**

Water usage by different industries, Environmental impact of effect of liquid discharge in water bodies, Characteristics of wastewater Sampling, Composite and grab sampling, industrial wastewater survey, water balance diagram, Waste minimization technique, Volume reduction, Strength reduction.

#### **Module-II**

General principle of industrial wastewater treatment, Equalization, neutralization, oil separation, flotation, Precipitation, heavy metal removal, API separator design, Chemical Oxidation, Wet air oxidation, Membrane Separation, Nutrient removal, Biological treatment, Aerobic and Anaerobic, Sequencing batch reactor, High rate bioreactor, Plastic Biform, hybrid bioreactor.

#### **Module-III**

Case studies for few industries, Manufacturing process, Waste flow sheet, Water balance diagram, Characteristics and treatment flow sheet for- Tannery, Power plant, Pulp and paper mills, steel plant, metal finishing, Distilleries, petroleum refineries, fertilizer, sugar, pharmaceutical and antibiotics, Concept of joint treatment of industrial wastewater- Common effluent treatment plant.

#### **Books and References:-**

1. w.Eckenfelder- Industrial water pollution control
2. Metcalf and Eddy:- waste water treatment
3. Nelson Nemerrow:- Liquid waste from industry, Narosa / Addison Wiely publication

# STATISTICAL METHODS AND DESIGN OF EXPERIMENTS (3-0-0)

## Module – I

Review of binomial, Negative binomial, Poisson, Normal and Lognormal distribution. Tests of significance for means, variance, co-relation and regression coefficients,  $\chi^2$  –tests for good ness of fit, Attributes and contingency table, Tests of proportions, Tests of significance under large sample approximation.

## Module –II

Stochastic process in environment, Probability concepts, Conditional probability and Baye's theorem, Environmental data analysis and QA / QC. Descriptive statistics, Average times, Sample size determination, Sampling frequency and duration. Measurement uncertainty, Accuracy and precision, Sample and dynamic blanks, Error propagation, Linear test square regression, Trend analysis, Non parametric statistics.

## Module-III

Non parametric tests, Test of randomness, Median test, Sign test, Mann- Whitney Wilcoxon U – test. Experiment design and hypothesis, Testing :- factorial design of experiments, Confidence intervals, Equality of means, T- test, Analysis of variance (ANOVA), F-test, Significance of factor effects and their interactions.

### Books :-

1. Statistical method by Gupta Kapoor.
2. Scum Series – Statistical method Tata McGraw Hill Publication
3. Mathematical Statistics by A.P.K. Swain

# RURAL WATER SUPPLY AND SANITATION (3-0-0)

## Module-I

Water uses drinking water, potable water for live stock, agricultural water, water quality, lake water, surface water, Ground water, Hilly area, Sources of water, collection of water, Tube well, Hand tube well, dug well, Design of deep tube well.

## Module-II

Small scale water treatment, slow sand filter, pressure filter, package water treatment, Chlorination, water reservoir, capacity of reservoir, design of reservoir, distribution system.

## Module-III

Sewage disposal, cess pool, septic tank principle and design, Biogas plant, Solid waste management, storage collection, composting, vermicomposting, Block level incinerator, Epidemiology, vector transmission, diseases control, Eutrophication of pond and lakes, control.

### Books:-

1. Ehler and Steel- A text book of rural water supply and sanitation.
2. Manual of water supply and treatment- CPHEERO.
3. Manual of sewerage and sewage treatment - CPHEERO.
4. Salvato- Environmental Sanitation.

## **Elective-IV (any one)**

### **ENVIRONMENTAL HYDRAULICS (3-0-0)**

#### **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, plumbing hydraulics.

#### **Books:-**

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

# **ENVIRONMENTAL POLICIES & LEGISLATION (3-0-0)**

## **Value Education, Human Rights and Legislative Procedure**

Social Values and Individual Attitudes, Work Ethic, Indians Vision of Humanism, Moral and Nonmoral Valuation, Standards and Principles, Value Judgments. Rural Development in India, Co-operative Movement and Rural Development. Human Rights, UN declaration, Role of various agencies in protection and promotion of Rights. Indian Constitution, Philosophy of Constitution, Fundamental Rights and Fundamental Duties, Legislature, Executive, and Judiciary: Their Composition, Scope and Activities.

The Legislature: Function of Parliament, Constitution of Parliament, Composition of the Council of the States, Composition of the House of the People, Speaker, Legislative Procedure: Ordinary Bills, Money Bills, Private Members Bills; Drafting Bills; Moving the Bills, Debate, Voting, Approval of the President/Governor.

Vigilance: Lokpal and Functionaries.

## **Environmental Policy and Legislation**

Environmental Policies - National and International trends, Changes in global perspective, International treaties.

National Policies: National Environmental Policy, National Forest Policy, National Water Policy, Rehabilitation and Resettlement Policy; Evolution of environmental Legislation in India, Legal provisions for environmental protection; various Acts, Rules and Regulations. Notifications issued under various Acts and Rules. Environmental standards, Criteria for Standards setting. Public Liability Insurance Act and legal aspects relating to hazardous and toxic substances. Framework for environmental impact assessment. Screening, Scoping and baseline studies, Techniques for assessment of impacts on physical resources, ecological resources, human use values and quality of life values.

Impact assessment methodologies -various methods, their applicability. Strategic Environmental Assessment. Cumulative impact assessment. Risk and uncertainty in EIA. Environmental Management Planning. Disaster management planning.

### **Text Books:-**

1. Environmental Law by S.K.Nanda – Central Law publications.
2. Lal's Law Book, Vol- I & II

### **Reference Book:-**

1. Universal's Environmental Laws – Universal Law Publishing Co.Pvt.Ltd.

# **OCCUPATIONAL HEALTH AND SAFETY (3-0-0)**

## **Module -I**

Occupational Health and Safety concern and problems. National and international protocols and concerns, policies and legislation. Ergonomics; Stress-strain concept; Assessment of human capabilities and limitations; Human Physiological Work Capacity and its evaluation.

## **Module -II**

Sources of work stress (a) intrinsic to the jobs, (b) work environmental stressors like heat & Humidity , noise & vibration, dust, illumination, etc.; Methodologies for evaluating different types of stresses. Human Error and Accidents: Different Classification of Human Error, Theories of Accident Causation, Human Error Audit. Accident analysis.

## **Module -III**

Education and Training in Occupational Hygiene. Need to evolve an integrated Occupational Health and Safety Programme for specific industries. Occupational Health & Safety Management Systems (OHSAS - 18001): Legal and other Requirements ; Overview; Planning, hazard identification and risk assessment; Occupation Health and Safety Policy; OH & SMS Documentation; Emergency Preparedness and Response.

## **Books and Reference**

1. Dan Petersen, "Techniques of Safety Management", McGraw-Hill Company, Tokyo, 1981.
2. Relevant India Acts and Rules, Government of India.
3. Relevant Indian Standards and Specifications, BIS, New Delhi.
4. Blake R.B., "Industrial Safety" Prentice Hall, Inc., New Jersey, 1973.
5. Safety and Good House Keeping", N.P.C., New Delhi, 1985.
6. Accident Prevention Manual for Industrial Operations", N.S.C.Chicago, 1982.

## **Elective –V** (any one)

### **DISASTER MANAGEMENT** (3-0-0)

#### **Module-I**

**Introduction:** Overview of disaster, major natural disasters – flood, tropical cyclone, droughts, landslides, heat waves, earthquakes, fire hazards, tsunami, etc. Basic understanding of fragile ecosystems, hydrological factors, inclement climatic conditions like thunder storm, cyclone, tsunami and flooding. Factors for disaster – climatic change and global sea rise, coastal erosion, environmental degradation, large dams and earthquakes, road building and landslides

#### **Module-II**

**Disaster management, mitigation, and preparedness:** Techniques of monitoring and design against the disasters. Management issues related to disaster; Mitigation through capacity building, legislative responsibilities of disaster management; disaster mapping, assessment, pre-disaster risk and vulnerability reduction, post disaster recovery and rehabilitation; disaster related infrastructure development. Disaster management plan, national crisis management committee, state crisis management group.

**Design guidelines:** Disaster proofing construction at appropriate situation. Engineering, architectural, landscaping and planning solution for different types of calamities. Vulnerability atlas, norms, standards and practice procedures for shelter and settlement. Organizational and management aspects.

#### **Module-III**

**Emergency water supply and sanitation:** Water supply preparedness and protection, emergency water supply strategy, rural and urban emergencies. Assessment of damage. Emergency water supply schemes – sources, quality, treatment, storage and distribution, operation and maintenance. Sanitation – human waste and health, strategy for excreta disposal in emergencies, techniques for excreta disposal, disposal of wastewater, management of refuse.

#### **Text book:**

1. Ghosh.G.K. Disaster Management, Saujanay Books, Delhi, 2007
2. Schneid, T. D., and Collins, L. Disaster management and preparedness. Boca Raton, Florida, 2001.

#### **Reference Books**

1. Alexander D, Principles of emergency planning and management, Oxford University Press, 2002.
2. Damon Coppola, Introduction to International Disaster Management, Butterworth-Heinemann
3. Hallow, G. and Bullock, J. Introduction to Emergency Management : Elsevier, 2002.
4. Disaster Management By G.K. Ghosh, A.P.H. Publishing Corporation
5. Disaster Management By R.B. Singh, Rawat Publications
6. Disaster Management: Through the New Millennium By Ayaz Ahmad, Anmol Publications
7. Disaster Management By B Narayan, A.P.H. Publishing Corporation
8. Disaster Management - Recent Approaches By Arvind Kumar, Anmol Publications

# APPLICATION OF REMOTE SENSING & GIS FOR ENVIRONMENTAL ENGINEERING (3-0-0)

## 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 Co ordinate system , GIS components: Hardware, software and infrastructures, GIS data types, Data acquisition ,Data Input and Data Processing, and management including topology DEM/ DTM generation.

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.

# DESIGN OF WATER AND WASTE WATER TREATMENT SYSTEMS (3-0-0)

## **Module-I**

Design of water supply systems: Selection of site for the source of water supply, Population Estimate, design of units for sedimentation, coagulation, flocculation, Granular media filtration, disinfection,

## **Module-II**

Design of aerators, spray, Cascade, Iron elimination filter. Water softening, advanced treatments, design of city water supply pumping and distribution system.

## **Module –III**

**Buried sewer design**, sewer design , aeration tank, aerator, compressor, primary and secondary settling tank, mechanical scrapper, trickling filter inlet pipe, rotary distributor design, biotower , sludge digester.

## **Books & References:-**

1. Manual of sewerage and sewage treatment :-CPHEERO
2. Quasim:-Design of wastewater treatment plant

## OPEN ELECTIVE

### **ENVIRONMENTAL IMPACT ASSESSMENT AND AUDITING (3-0-0)**

#### **Module-I**

Sustainable Development Framework for Environmental Impact Assessment. Screening, Scoping and Baseline Studies, Significance and Importance of Impacts, Mitigation aspects, Assessment of alternatives, Public Hearing, Decision Making. Assessment of impacts on physical resources, ecological resources, human use values and quality of life values.

#### **Module-II**

Impact assessment methodologies -various methods, their applicability. Strategic Environmental Assessment. Environmental Management Planning. Disaster management planning.

#### **Module-III**

Environmental Audit: 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.

#### **Books and References**

1. Renewable Energy Environment and Development-Maheswar Dayal Konark Pub. Pvt.Ltd. 1998
2. Planning and Implementation of ISO14001, Environmental Management System-Girdhar Gyani & Amit Lunia Raj Publishiong House, Jaipur, 2000.
3. "The ISO: 14000 Handbook" - Joseph Caseio (Ed), Published - CEEM Information Services. 2000
4. INSIDE ISO: 14000 – The Competitive Advantage of Environmental Management - Don Sayre, Vinity Books International, New Delhi, 2001.
5. A Guide to the Implementation of the ISO: 14000 Series on Environmental Management – Ritchie, I and Hayes W, Prentice Hall, New Jersey, 1998.

#### **Books and References**

1. Environmental Impact Assessment -Larry, W. Canter (2nd ed), McGraw Hill Inc. Singapore, 1996.
2. Strategic Environmental Assessment - Riki Therirvel, E.Wilson, S.Thompson, D.Heaney, D. Pritchard. Earthscan, London, 1992.
3. 3.Environmental Impact Assessment-Cutting edge for the 21st century - Alan Gilpin, CUP, London, 1994.
4. Environmental Impact Assessment-Theory & Practice - Peter Wathern, Unwin Hynman, Sydeny, 1988.
5. A Practical Guide to Environmental Impact Assessment - Paul, A Erickson, Academic Press, 1994.