SCHEME OF TEACHING AND EXAMINATION

B.E. ENVIRONMENTAL ENGINEERING

V SEMESTER

Sl. No.	Subject Code	Title of the Subject	Teaching Dept.	Teaching Hrs / Week		Examination			
				Theory	Practical	Duration (Hrs)	Marks		
							IA	Theory / Practical	Total
1	06 EV 51	Municipal Solid Waste Management	EV	04	--	03	25	100	125
2	06 EV 52	Origin and Characterization of Environmental Pollution	EV	04	--	03	25	100	125
3	06 EV 53	Water supply and Distribution System	EV	04	--	03	25	100	125
4	06 CV 54	Geotechnical Engineering – I	EV	04	--	03	25	100	125
5	06 CV 55	Hydrology and Water Resources Engineering	EV	04	--	03	25	100	125
6	06 EV 56	Water Treatment Engineering	EV	04	--	03	25	100	125
7	06 EVL57	Design and Drawing of Environmental Systems-I	EV	--	03	03	25	50	75
8	06 EVL 58	Environmental Process Laboratory I	EV		03	03	25	50	75
TOTAL				**24**	**06**	**24**	**200**	**700**	**900**

SCHEME OF TEACHING AND EXAMINATION

B.E. ENVIRONMENTAL ENGINEERING

VI SEMESTER

Sl. No.	Subject Code	Title of the Subject	Teaching Dept.	Teaching Hrs / Week		Examination			
				Theory	Practical	Duration (Hrs)	Marks		
							IA	Theory / Practical	Total
1	06 AL 61	Management & Entrepreneurship	Any dept.	04	--	03	25	100	125
2	06 EV 62	Environmental Transport Processes	EV	04	--	03	25	100	125
3	06 EV 63	Atmospheric Environmental Engineering	EV	04	--	03	25	100	125
4	06 EV 64	Wastewater Collection and Drainage Systems	EV	04	--	03	25	100	125
5	06 EV 65	Wastewater Treatment Engineering	EV	04	--	03	25	100	125
6	06 EV 66x	**Elective-I (Group A)**	EV	04	--	03	25	100	125
7	06 EVL 67	Atmospheric Environmental Lab	EV	--	03	03	25	50	75
8	06 EVL 68	Environmental Processes Lab-II	EV	--	03	03	25	50	75
TOTAL				**24**	**06**	**24**	**200**	**700**	**900**

Elective-I (Group A)

06EV661 - Environmental Biotechnology
06EV662 - Ecofriendly Energy Sources
06EV663 - Environmental Systems Optimization

SCHEME OF TEACHING AND EXAMINATION

B.E. ENVIRONMENTAL ENGINEERING

VII SEMESTER

Sl. No.	Subject Code	Title of the Subject	Teaching Dept.	Teaching Hrs / Week		Examination			
				Theory	Practical	Duration (Hrs)	Marks		
							IA	Theory / Practical	Total
1	06 EV71	Computer Applications in Environmental Engineering	EV	4	-	3	25	100	125
2	06 EV72	Ecology and Environmental Impact Assessment	EV	4	-	3	25	100	125
3	06 EV73	Advanced Wastewater Treatment	EV	4	-	3	25	100	125
4	06 EV74	Estimation, Specifications & Financial Aspects of Environmental Facilities	EV	4	-	3	25	100	125
5	06 EV75x	**Elective - II (Group B)**	EV	4	-	3	25	100	125
6	06 EV76x	**Elective - III (Group C)**	EV	4	-	3	25	100	125
7	06 EVR77	Design and Drawing of Environmental Systems – II	EV	-	3	3	25	50	75
8	06 EVL78	Computer Applications Lab	EV	-	3	3	25	50	75
TOTAL				**24**	**6**	**-**	**200**	**700**	**900**

Elective - II (Group B)

06EV751 - Nuclear, Radioactive & Biomedical Waste Technology
06EV752 - Occupational Safety and Health
06EV753 - Operation and Maintenance of Environmental Facilities

Elective - III (Group C)

06EV761 - Environmental Aspects of Developmental Projects
06EV762 - Environmental Applications of Remote Sensing & GIS
06EV763 - Geo Environmental Engineering

SCHEME OF TEACHING AND EXAMINATION

B.E. ENVIRONMENTAL ENGINEERING

VIII SEMESTER

Sl. No.	Subject Code	Title of the Subject	Teaching Dept.	Teaching Hrs / Week		Examination			
				Theory	Practical	Duration (Hrs)	Marks		
							IA	Theory / Practical	Total
1	06 EV81	Management for Environmental Engineers	EV	4	-	3	25	100	125
2	06 EV82	Water Quality Assessment in Natural Systems	EV	4	-	3	25	100	125
3	06 EV83x	**Elective - IV (Group D)**	EV	4	-	3	25	100	125
4	06 EV84x	**Elective - V (Group E)**	EV	4	-	3	25	100	125
5	06 EV85	Project Work	EV	-	6	3	50	100	150
6	06 EV86	Seminar	EV	-	3	-	--	50	50
TOTAL				**16**	**9**	**15**	**150**	**550**	**700**

Elective - IV (Group D)

06EV831 - Advanced Atmospheric Environmental Engineering
06EV832 - Environmental Management Systems
06EV833 - Hazardous Waste Technology

Elective - V (Group E)

06EV841 - Industrial Wastewater Treatment
06EV842 - Non-point Pollution Sources & Management
06EV843 - Recycle and Reuse Technology

V SEMESTER

MUNICIPAL SOLID WASTE MANAGEMENT

Subject Code	:	**06EV51**	IA Marks	:	25
No. of Lecture Hours/ Week	:	04	Exam Hours	:	03
Total No. of Lecture Hours	:	52	Exam Marks	:	100

PART - A

UNIT - 1

INTRODUCTION: Definition, Sources – household, street, demolition, construction. Composition and Properties of Municipal Solid Wastes.

4 Hours

UNIT - 2

ENGINEERING PRINCIPLES: Generation rates, Collection, waste handling and separation, storage and processing at the source.

6 Hours

UNIT - 3

COLLECTION, TRANSFER AND TRANSPORTATION: Types, equipment, personnel requirements, analysis & collection system, collection routes, types of transfer stations, transport means and methods, location oftransfer stations.

8 Hours

UNIT - 4

DISPOSAL: Dumping, Landfall - classifications, Siting Considerations, Generation, movement and control of gases and leachates, layout and preliminary design of landfills.

6 Hours

PART - B

UNIT - 5

SEPARATION, TRANSFORMATION AND RECYCLING: Unit operations for separation and processing, size reduction, separation, density separation, fundamentals of thermal processing – combustion, pyrolysis, gasification, energy recovery system.

8 Hours

UNIT - 6

BIOLOGICAL AND CHEMICAL CONVERSION TECHNOLOGIES: Principles, Aerobic &, anaerobic composting and energy recovery.

6 Hours

UNIT - 7

INCINERATION: Process, Types, Heat Recovery, Incineration Products, Design of Incinerators, Air Pollution Control.

6 Hours

UNIT - 8

PLANNING, SITING AND WASTES MANAGEMENT FACILITIES: Screening, Planning and developing a site for solid waste management. Separation of wastes – benefits, reuse and recycle material recovery.

8 Hours

REFERENCE BOOKS:

1. **Solid Waste Management in Developing Countries –** Bhide and Sundaresan (2000), Indian National Scientific Documentation Centre. New Delhi.
2. **Integrated Solid Waste Management** – George Tchobanaglous, Hilary Theisen and Samuel A. Vigil, (1993),
3. **Engineering Principles and Management Issues** – Mc Grawhill Inc.
4. **Environmental Engineering -** Peavy, H.S., Rowe, D.R., and Tchobanoglous, G., (1986),
5. **Environmental Engineering – A Design Approach** Sincero, A.P., and Sincero, G.A., (1999), Prentice Hall of India Pvt. Ltd., New Delhi.
6. **Solid Waste Engineering** – Vesiland, A, Thompson Books.
7. **Solid Waste Management** – CPHEEO Manual

ORIGIN AND CHARACTERIZATION OF ENVIRONMENTAL POLLUTION

Subject Code	:	**06EV52**	IA Marks	:	25
No. of Lecture Hours/ Week	:	04	Exam Hours	:	03
Total No. of Lecture Hours	:	52	Exam Marks	:	100

PART - A

UNIT - 1

INTRODUCTION: Sources of Pollution, Point and non-point, natural and man made sources. Methodology for Characterization of Pollutants: Concept of Flow Sheets, Grab and Composite Sampling, Flow Measurement and Concentration of Pollutants.

6 Hours

UNIT - 2

Mass balance approach, Pollutant load calculation, methods of estimating Unit loadings from point and Non- point sources. Statistical Analysis of data for Mean and Standard Deviation, significance tests – chi-squared,'t' & 'f' tests

6 Hours

UNIT - 3

CHARACTERIZATION OF AIR POLLUTANTS: Construction Activities, Automobile Emissions, Mining and Industries (Steel, Cement and Thermal Power Plant)

6 Hours

UNIT - 4

CHARACTERIZATION OF NOISE POLLUTION: Units of Measurement, Measuring Instruments, Characterization of Noise from Construction, Mining, Transportation and Industrial Activities, Airport Noise – General Control Measures.

6 Hours

PART - B

UNIT - 5

CHARACTERIZATION OF WATER POLLUTANTS: Domestic Wastewater, Thermal and Nuclear power plants, radioactive wastes, Mining and Industrial Units, (Pulp and paper, Pharmaceutical, Distillery, Food Processing, Fertilizer, Tannery, Chloralkali and small scale Industries).

8 Hours

UNIT - 6

CHARACTERIZATION OF SOLID WASTES: Domestic, Commercial and Industrial sources, Chemical Manufacturing, Food processing, Small Scale Industries and Biomedical Wastes.

6 Hours

UNIT - 7

SUBSURFACE SOURCES OF POLLUTION: Soak Pits, Septic Tanks, Low Cost Sanitation Units, Underground Oil Storage Tanks, Municipal Solid Waste Dumps. Nuclear and radioactive waste sources and characterization.

8 Hours

UNIT - 8

Characteristics of Pollutants from water and wastewater Treatment Plants, and Air Pollutants Recovered from Pollution Control Units. (eg. Bag Filters, Cyclones, Scrubbers, Precipitators etc.)

6 Hours

REFERENCE BOOKS:

1. **Wastewater Engineering, Treatment and Reuse** – Metcalf and Eddy, (2003), 4th Edition, Tata McGraw Hill Edition, Tata McGraw Hill Publishing Co. Ltd.
2. **Handbook of Non-point Pollution Sources and Management** – Novotny V., and Chester G., (1981), Van Nostrand Reinhold Co.
3. **Environmental Engineering** – Peavy, H.S., Rowe, D.R., and Tchobanoglous, G., (1986), Mc Graw Hill Book Co.
4. **Environmental Engineering – A Design Approach** – Sincero, A.P., and Sincero, G.A., (1999), Prentice Hall of India Pvt. Ltd., New Delhi.
5. **Air Pollution, Its Origin and Control** – Wark K., Warner C.F., and Davis. W.T., (1998), 3rd Edition, Harper and Row Publication.

WATER SUPPLY AND DISTRIBUTION SYSTEMS

Subject Code	:	**06EV53**	IA Marks	:	25
No. of Lecture Hours/ Week	:	04	Exam Hours	:	03
Total No. of Lecture Hours	:	52	Exam Marks	:	100

PART - A

UNIT - 1

INTRODUCTION: Necessity of Water Supply Schemes, Historical Development, Hydrologic Cycle, Surface and Groundwater Sources, Global Water Resources. Drinking and Industrial Water Quality Standards.

6 Hours

UNIT - 2

WATER DEMAND: Various uses and methods of estimation of demand, Forecasting of Population, Fluctuation in Demand, factors affecting fluctuation in demand, Total Demand of Water based on Population – rural and urban.

8 Hours

UNIT - 3

COLLECTION AND CONVEYANCE: Types of Intakes, Conveyance of Water, Pipes, Joints, etc., Selection of Materials. Basic design principles of conduits, types of reservoirs, Pump and Pumping Station, Classification, Selection, Centrifugal, Reciprocating and Submersible, Jet Pumps, Head-Discharge Characteristics, Pumps in Series and Parallel Operation.

9 Hours

UNIT - 4

HYDRAULICS OF FLOW THROUGH CONDUITS: Interconnection of Parallel Pipes, Raising Main Economics, Hydraulic Transients. Water hammer analysis and its preventive measures.

5 Hours

PART - B

UNIT - 5

PIPE LINES: Pipeline Friction, Hazen William Equation and Modified Form. Manning's Equation, Cole Brook - White equation, Cathodic Protection, Thawing of Frozen Pipes.

4 Hours

UNIT - 6

DESIGN ASPECTS OF PIPE NETWORKS: Hardy-Cross and Newton-Raphson methods, including Computer Programmes – LOOP, Branch and WADISO.

8 Hours

UNIT - 7

PLUMBING AND OPERATION: Laying of waterlines, Maintenance and testing of water supply schemes, Control of operation, leak detection, water conservation, Preventive Maintenance.

6 Hours

UNIT - 8

RURAL WATER SUPPLY SYSTEM: Necessity, Types of supply for individual, community and Regional Schemes. Rainwater harvesting, minor tanks, subsurface sources.

6 Hours

REFERENCE BOOKS

1. **Water and Wastewater Technology** – Hammer, M.J., (1986),SI Version, 2nd Edition, John Wiley and Sons.
2. **Environmental Engineering** – Peavy, H.S., Rowe, D.R., and Tchobanoglous, G., (1986), Mc Graw Hill Book Co.
3. **Water Supply and Wastewater Engineering** – Raju, B.S.N., (1995), Tata McGraw Hill Pvt. Ltd., New Delhi.
4. **Environmental Engineering – A Design Approach** – Sincero, A.P., and Sincero, G.A., (1996), Prentice Hall of India Pvt. Ltd., New Delhi.
5. **Water Supply and Sewerage** – Steel, E.W., and McGhee, T.J., (1979), 5th Edition, McGraw Hill Kogakusha Ltd.
6. **Hydraulics and Hydraulic Machinery** – Modi R. N. and Seth. H. N. (2003), Mc Graw Hill Book Co.

GEOTECHNICAL ENGINEERING – I

Subject Code	:	**06CV54**	IA Marks	:	25
No of Lecture Hours/ Week	:	04	Exam Hours	:	03
Total No of Lecture Hours	:	52	Exam Marks	:	100

PART - A

UNIT -1

INTRODUCTION: History of soil mechanics, Definition, origin and formation of soil. Phase Diagram, Voids ratio, Porosity, Percentage Air Voids, Air content, Degree of saturation, Moisture content, Specific gravity , Bulk density, Dry density, Saturated density, Submerged density and their inter relationships.

6 Hours

UNIT - 2

INDEX PROPERTIES OF SOILS AND THEIR DETERMINATION: Index Properties of soils- Water content , Specific Gravity, Particle size distribution, Relative Density, Consistency limits and indices, insitu density, Activity of Clay, Laboratory methods of determination of index properties of soils: Moisture content, Specific gravity, Particle size distribution (Seive analysis and Hydrometer analysis only), Liquid Limit- Casagrande and cone penetration methods, Plastic limit and shrinkage limit determination.

7 Hours

UNIT - 3

CLASSIFICATION OF SOILS: Purpose of soil classification, basis for soil classification, Particle size classification – MIT classification and IS classification, Textural classification. Unified soil classification and IS classification - Plasticity chart and its importance, Field identification of soils.

CLAY MIERALOGY AND SOIL STUCTURE: Single grained, honey combed, flocculent and dispersed structures, Valence bonds Soil-Water system, Electrical diffuse double layer, adsorbed water, base-exchange capacity, Isomorphus substitution. Common clay minerals in soil and their structures- Kaolinite, Illite and Montmorillonite.

8 Hours

UNIT - 4

FLOW OF WATER THROUGH SOILS: Darcy's law- assumption and validity, coefficient of permeability and its determination (laboratory and field), factors affecting permeability, permeability of stratified soils, Seepage velocity, Superficial velocity and coefficient of percolation, effective stress concept-total pressure and effective stress, quick sand phenomenon, Capillary Phenomenon**.**

7 Hours

PART - B

UNIT - 5

COMPACTION OF SOILS: Definition, Principle of compaction, Standard and Modified Proctor's compaction tests, factors affecting compaction, effect of compaction on soil properties, Field compaction control, Proctor needle. Compacting equipment, Dynamic compaction, vibroflotation.

6 Hours

UNIT - 6

CONSOLIDATION OF SOILS: Definition, Mass-spring analogy, Terzaghi's one dimensional consolidation theory-assumption and limitations (no derivation), Normally consolidated, under - consolidated and over - consolidated soils, pre-consolidation pressure and its determination by Casagrande's method. Consolidation characteristics of soil (C_c, a_v, m_v and C_v), Time rate of consolidation.

6 Hours

UNIT - 7

SHEAR STRENGTH OF SOILS: Concept of shear strength, Mohr's strength theory, and Mohr-Coulomb theory, conventional and modified failure envelops, Total and effective shear strength parameters, Concept of pore pressure, factors affecting shear strength of soils, Sensitivity and Thixotropy of clay.

6 Hours

UNIT - 8

DETERMINATION OF CONSOLIDATION AND SHEAR PROPERTIES OF SOIL: Laboratory one dimensional consolidation test, Determination of consolidation characteristics of soils-compression index, and coefficient of consolidation, determination of coefficient of consolidation by square root of time fitting method, logarithmic time fitting method and rectangular hyperbola method.

Measurement of shear parameters- Direct shear test, unconfined compression test, Triaxial compression test and vane shear test, Test under different drainage conditions.

6 Hours

TEXT BOOKS:

1. **Principles of Geotechnical Engineering –** Braja, M. Das (2002), Fifth Edition, Thomson Business Information India (P) Ltd., India
2. **Soil Engineering in Theory and Practice –** Alam Singh and Chowdhary G.R. (1994),CBS Publishers and Distributors Ltd., New Delhi.
3. **Soil Mechanics and Foundation Engg –** Punmia B.C. (2005), 16th Edition Laxmi Publications Co. New Delhi.

REFERENCE BOOKS:

1. **Foundation Analysis and Design –** Bowles J.E. (1996), 5th Edition, McGraw Hill Pub. Co. New York.
2. **Soil Mechanics and Foundation Engineering –** Murthy V.N.S. (1996) 4th Edition, UBS Publishers and Distributors, New Delhi.
3. **Basic and Applied Soil Mechanics –** Gopal Ranjan and Rao A.S.R. (2000),New Age International (P) Ltd., New Delhi.
4. **Geotechnical Engineering –** Venkatrahmaiah C. (2006),3rd Edition New Age International (P) Ltd., New Delhi.
5. **Soil Mechanics –** Craig R.F. (1987), Van Nostrand Reinhold Co. Ltd.
6. **Text Book of Geotechnical Engineering –** Iqbal H. Khan (2005), 2nd Edition, PHI, India.

HYDROLOGY AND WATER RESOURCES

Subject Code	:	**06CV55**	IA Marks	:	25
No. of Lecture Hours/ Week	:	04	Exam Hours	:	03
Total No. of Lecture Hours	:	52	Exam Marks	:	100

PART - A

UNIT - 1

INTRODUCTION: Definition of hydrology. Importance of hydrology. Global water availability. India's water availability. Practical applications of hydrology. Hydrologic cycle (Horton's qualitative and engineering representations)

2 Hours

PRECIPITATION

Definition. Forms and types of precipitation. Measurement of rain fall using Symon's and Syphon type of rain gauges. Optimum number of rain gauge stations. Consistency of rainfall data (double mass curve method). Computation of mean rainfall (arithmetic average, Thiessen's polygon and Isohyetal methods). Estimation of missing rainfall data (Arithmetic average, normal ratio and regression methods). Presentation of precipitation data (moving average curve, mass curve, rainfall hyetographs, intensity – duration - frequency curves).

7 Hours

UNIT - 2

LOSSES FROM PRECIPITATION

INTRODUCTION. EVAPORATION: Definition, Process, factors affecting, measurement using IS Class A Pan. Estimation using empirical formulae.

Infiltration : Definition, factors affecting infiltration capacity, measurement (double ring infiltrometer). Harton's infiltration equation, infiltration indices.

7 Hours

UNIT - 3

RUNOFF

Definition. Concept of catchments. Water budget equation. Components. Factors affecting. Rainfall - runoff relationship using simple regression analysis.

3 Hours

HYDROGRAPHS

Definition. Components of Hydrograph. Unit hydrograph and its derivation from simple storm hydrographs. Base flow separation. S – curve and its uses.

4 Hours

UNIT - 4

GROUND WATER HYDROLOGY AND WELL HYDRAULICS

Scope and importance of ground water hydrology. Aquifer parameters. Steady radial flow into wells in unconfined and confined aquifers. Types of wells, Methods of construction.

6 Hours

PART - B

UNIT - 5

STREAM FLOW MEASUREMENT: Introduction. Measurement of stage. Measurement of discharge by Area – Velocity method and slope area method. Simple stage discharge relation.

6 Hours

UNIT - 6

RESERVOIR SEDIMENTATION: Introduction. Process of erosion. Factors affecting erosion. Sediment yield. Reservoir Sediment control. Determination of Sediment Yield at a reservoir site (Using sample recorder).

6 Hours

UNIT - 7

WATER RESOURCES: Introduction. Water wealth. River basins and their potential. Importance of water resources projects in India. Water resources development in Karnataka.

6 Hours

UNIT - 8

RAINWATER HARVESTING: Introduction. Small scale and small tank harvesting. Urban rainwater harvesting. Methods of ground water recharge.

5 Hours

TEXT BOOKS

1. **Engineering Hydrology** – Subramanya K, Tata McGraw Hill, New Delhi.
2. **A Text Book of Hydrology** – Jayarami Reddy,Lakshmi Publications, New Delhi.
3. **Hydrology** – H.M. Raghunath, Wiley Eastern Publication, New Delhi.

REFERENCE BOOKS:

1. **Hand Book of Hydrology** – Ven Te Chow.
2. **Hydrology and Water Resources Engineering** – R.K. Sharma and Sharma, Oxford and IBH, New Delhi.
3. **Hydrology and Water Resources Engineering** – Garg S.K., Khanna Publishers, New Delhi.
4. **Applied Hydrology** – Linsley, Kohler and Paulhus, Wiley Eastern Publication, New Delhi.
5. **Ground Water Hydrology** – Todd, Wiley Eastern Publication, New Delhi.

WATER TREATMENT ENGINEERING

Subject Code	:	**06EV56**	IA Marks	:	25
No of Lecture Hours/ Week	:	04	Exam Hours	:	03
Total No. of Lecture Hours	:	52	Exam Marks	:	100

PART - A

UNIT - 1

INTRODUCTION: Necessity of Water Treatment Units. Classification of Treatment Systems. Typical Flow sheets for Rural and Urban Water Treatment Systems and their distinguishing features.

6 Hours

UNIT - 2

PHYSICAL, CHEMICAL AND BACTERIOLOGICAL CHARACTERISTICS OF WATER: Surface and Ground Water Sources, Water Quality Standards for various uses.

4 Hours

UNIT - 3

AERATION: Gas Transfer theory, Factors Governing Aeration System. Types of Aerator Units, Design Criteria.

SEDIMENTATION: Types of Settling, Newton's and Stoke's equations, short circuiting and dispersion pattern, Design criteria for sedimentation tank, Tube and Plate Settlers.

08 Hours

UNIT - 4

COAGULATION AND FLOCCULATION: Stability and Destabilisation of Colloids, Coagulation Theory, Types of Flocculators and their Design Aspects.

8 Hours

PART - B

UNIT - 5

FILTRATION: Hydraulics of Flow through Porous Media, types of filters, theory of filtration, Rate Control Pattern, Slow and Rapid Sand Filtration, Pressure Filter, Design Aspects, backwashing of filters.

8 Hours

UNIT - 6

HARDNESS REMOVAL: Types, Ions causing hardness, Lime Soda Treatment, Ion Exchange Process and Zeolite process, problems associated with hardness.

4 Hours

UNIT - 7

DISINFECTION PROCESS: Mode of Disinfection, Rate of Disinfection, Factors affecting Processes, Chemical and Non-chemical Methods of Disinfection. Fluoridation and Defluoridation, Desalinization.

6 Hours

UNIT - 8

CORROSION AND CORROSION CONTROL PROCESS: Electro Chemical and Thermodynamic Methods of Corrosion Control. Langmuir Index, Wastes from Water Treatment Units - Treatment, Reuse and Recycle, Disposal, Operation and Maintenance of Water Treatment System.

08 Hours

REFERENCE BOOKS:

1. **Water and Wastewater Engineering** – Fair G.M., Geyer H.C., and Okun D.A., (1968), Vol. I & II, John Wiley and Sons.
2. **Water and Wastewater Technology** – Hammer, M.J., (1986), SI Version, 2nd Edition, John Wiley and Sons.
3. **Environmental Engineering** – Peavy, H.S., Rowe, D.R., and Tchobanoglous, G., (1986), Mc Graw Hill Book Co.
4. **Water Supply and Wastewater Engineering** – Raju, B.S.N., (1995), Tata McGraw Hill Pvt. Ltd., New Delhi.
5. **Environmental Engineering – A Design Approach** – Sincero, A.P., and Sincero, G.A., (1996), Prentice Hall of India Pvt. Ltd., New Delhi.
6. **Water Supply and Sewerage** – Steel, E.W., and Mc Ghee, T.J., (1979), 5th Edition, International Student Edition, Mc Graw Hill Kogakusha Ltd.
7. **Physico-Chemical Processes for Water Quality Control** – Weber W.J., Junior, (1972), John Wiley and Sons.

DESIGN AND DRAWING OF ENVIRONMENTAL SYSTEMS – I

Subject Code	:	**06EVL57**	IA Marks	:	25
No of Lecture Hours/ Week	:	03	Exam Hours	:	03
Total No. of Lecture Hours	:	42	Exam Marks	:	50

PART - A

Layout of Typical Water Supply System
Design and Drawing of Hydraulic Profile for Water Treatment Unit. Design and Drawing of Canal, River and Reservoir Intakes.
Drawing of Bore Well / Infiltration Well for Rural Areas.
Design and Drawing of Distribution Systems for simple network.
Design and Drawing of Ground Level Service Reservoir, Overhead Tank and Underground Clear Water Sump.

PART - B

Design and Drawing of Cascade Aeration Unit.
Design and Drawing of Flocculator and Sedimentation Units (Circular and Rectangular)
(Plan and Sectional Elevation, Clariflocculator).
Design and Drawing of Rapid Sand Filters (Plan and Section).
Design and Drawing of Defluoridation & Softening Units.
Layout showing hydrants, valves, bends and chlorination point in water treatment plant.

REFERENCE BOOKS:

1. **Water Treatment Plant Design** – ASCE, (1995).
2. **Water Supply and Pollution Control** – Clark, Viessman and Hammer, (1992), Harper Collins.
3. **Water & Wastewater Engineering** – Fair, Geyer, and Okun, (1968), Vol. I & II, John Wiley and Sons.
4. **Wastewater Treatment Plants – Planning, Design and Operation** –Quasim, S.R., (1985), Holt Rinehart and Winston, CBS College Publishing.
5. **Water Supply in Developing Countries** – Schlutz, (1984), Wiley Publications.
6. **Water Supply and Treatment** – **CPHEEO** Manual.

ENVIRONMENTAL PROCESS LABORATORY-I

Subject Code	:	**06EVL58**	IA Marks	:	25
No. of Practical Hours/Week	:	03	Exam Hours	:	03
Total No. of Practical Hours		42	Exam Marks	:	50

Introduction to Process Laboratory, equipment and their applications. Sampling (Grab, Composite and Integrated) and Flow Measurements. Aeration for Iron Removal.

Batch Experimental Studies on Colour Removal.

Determination of Dissolved Oxygen.

Experimental Studies on Water Softening Process.
Experimental Studies on Coagulation.

Experimental Studies on Flocculation and Sedimentation Processes.
(Jar Test, Column Test, Pebble Bed Flocculator)

Experimental Studies on Disinfection Process.

a. Chlorine Demand in Water.
b. Available Chlorine in Bleaching Powder.
c. Residual Chlorine in Water.

Grain Size Analysis: Effective Size and Uniformity Co-efficient. Filtration – Single Media and Dual Media.
Experiments on Household Level Water Treatment Unit.

REFERENCE BOOKS:

1. **Standrd Methods for Examination of Water and Wastewater: 1998**, 20th edition Published by AWWA.
2. **Chemistry for Environmental Engineers –** Sawyer and McCarty, (2004), McGraw Hill, Publications.
3. **Lab Manual –** Published by NEERI, Nagapur.
4. **Water Supply, Treatment and Distribution –** Viessman, Clark, and Bisset.

VI SEMESTER

MANAGEMENT & ENTREPRENEURSHIP

Subject Code	:	**06AL61**	IA Marks	:	25
No. of Lecture Hours/ Week	:	04	Exam Hours	:	03
Total No. of Lecture Hours	:	52	Exam Marks	:	100

PART - A

UNIT - 1

MANAGEMENT: Introduction – Meaning – nature and characteristics of Management, Scope and functional areas of management – Management as a science, art or profession – Management & Administration – Roles of Management, Levels of Management, Development of Management Thought – early management approaches – Modern management approaches.

7 Hours

UNIT - 2

PLANNING: Nature, importance and purpose of planning process – objectives – Types of plans (Meaning only) – Decision making – Importance of planning – steps in planning & planning premises – Hierarchy of plans.

6 Hours

UNIT - 3

ORGANISING AND STAFFING : Nature and purpose of organization – principles of organization – Types of organization – Departmentation – Committees – Centralisation Vs Decentralisation of authority and responsibility – Span of control – MBO and MBE (Meaning only) Nature and importance of Staffing – Process of Selection & Recruitment (in brief).

6 Hours

UNIT - 4

DIRECTING & CONTROLLING: Meaning and nature of directing – Leadership styles, Motivation Theories, Communication – Meaning and importance – Coordination, meaning and importance and Techniques of Co-ordination.Meaning and steps in controlling – Essentials of a sound control system – Methods of establishing control (in brief).

7 Hours

PART - B

ENTREPRENEURSHIP

UNIT - 5

ENTREPRENEUR: Meaning of Entrepreneur, Evolution of Concept, Functions of Entrepreneur, Types of Entrepreneur, Intrapreneur – an emerging class. Concept of Entrepreneurship – Evolution of

Entrepreneurship, Development of Entrepreneurship, Stages in entrepreneurial process, Role of Entrepreneurs in Economic Development; Entrepreneurship in India; Entrepreneurship – its Barriers.

7 Hours

UNIT - 6

SMALL SCALE INDUSTRY: Definition; Characteristics; Need and rationale : Objectives, Scope, role of SSI in Economic Development. Advantages of SSI. Steps to start an SSI – Government policy towards SSI, Different Policies of SSI., Government Support on SSI., during 5 year plans. Impact of Liberalization, Privatisation, Globalization on SSI. Effect of WTO / GATT Supporting Agencies of Government for SSI Meaning. Nature of support; Objectives; Functions; Types of Help; Ancillary Industry and Tiny Industry (Definition only).

7 Hours

UNIT - 7

INSTITUTIONAL SUPPORT: Different Schemes, TECKSOK, KIADB; KSSIDC; KSIMC; DIC Single Window Agency; SISI, NSIC, SIDBI, KSFC.

6 Hours

UNIT - 8

PREPARATION OF PROJECT: Meaning of Project, Project Identification, Project Selection, Project Report, Need and significance of Project, Contents, formulation, Guidelines by Planning Commission for Project Report, Network Analysis, Errors of Project Report, Project Appraisal. Identification of Business Opportunities.

Market Feasibility Study: Technical Feasibility Study, Financial Feasibility Study & Social Feasibility Study.

6 Hours

TEXT BOOKS:

1. **Principles of Management** – P.C. Tripathi, P.N. Reddy, Tata McGraw Hill,
2. **Dynamics of Entrepreneurial Development & Management** – Vasant Desai – Himalaya Publishing House.
3. **Entrepreneurship Development** – Small Business Enterprises – Poornima M. Charantimath – Pearson Education – 2006 (2&4).

REFERENCE BOOKS:

1. **Management Fundamentals** – Concepts, Application, Skill Development – Robert Lusier – Thomson.
2. **Entrepreneurship Development** – SS Khanka – S Chand & Co.
3. **Managemen**t – Stephen Robbins – Pearson Education / PHI – 17th Edition, 2003.

ENVIRONMENTAL TRANSPORT PROCESSES

Subject Code	:	**06EV62**	IA Marks	:	25
No. of Lecture Hours/ Week	:	04	Exam Hours	:	03
Total No. of Lecture Hours	:	52	Exam Marks	:	100

PART - A

UNIT - 1

INTRODUCTION: Different transport mechanisms. Process Dynamics: Transport and Reaction Process, Material Balance Relationships, Kinetic Approach to Equilibrium. Factors Affecting Equilibrium Concentration and Temperature Effects.

8 Hours

UNIT - 2

MECHANICS OF MASS TRANSPORT: Diffusive Mass Transport & Convective Mass Transport in Molecular and Turbulent Flow Regimes (without proof). Combined Convective-Diffusion Equation for 1, 2 & 3 Dimensions. Analytical Solutions for 1-D & 2-D Cases & Simple Problems for Instantaneous Cases.

8 Hours

UNIT - 3

CHEMICAL THERMODYNAMICS: Free Energy Formation, Entropy Formation, Non-identity correction, Ionic Strength Considerations, Theoretical Equations for the Active Co- efficients, Effect of Ionic Strength on the Value of Equilibrium Constant, Simultaneous Reactions.

10 Hours

UNIT - 4

FUNDAMENTALS OF PROCESS KINETICS: Mass Law Relationships, Reaction Orders, Limitations of Mass Law Relationships, Application of First Order Reaction, Parallel, Reversible and Enzyme reactions.

8 Hours

PART - B

UNIT - 5

Gas Absorption and Adsorption – Two film theory, Particle Treatment, Ion Exchange, Electro dialysis.

4 Hours

UNIT - 6

Membrane Filters and Ultra filtration Process.

4 Hours

UNIT - 7

GROUNDWATER QUALITY: Basic differential equations with analytical solutions for 1-D and 2-D for instantaneous cases.

4 Hours

UNIT - 8

DESCRIPTION OF WATER QUALITY PROCESSES IN NATURAL WATER BODIES: Lake, River, Estuary and Oceans.

6 Hours

REFERENCE BOOKS:

1. **Process Chemistry for Water and Wastewater Treatment** – Benefield, L.D., Judkins (Jr) J.F., and Weand B.L.1985
2. **Groundwater** Freeze R.A. and Cherry, J.A., (1979), Prentice Hall, New Jersey,
3. **Environmental Systems Engineering** – Rich, L.G., (1973), Mc Graw Hill.
4. **Principles of Water Quality Modelling and Control** – Thomann & Mueller, (1987), Harper & Row.Publishers
5. **Mass Transfer Operation** – Treybul, R.E., (1960), McGraw Hill, Kogakusha.
6. **Physico - Chemical processes for Water Quality** Weber, W.J., (1972), John Wiley & Sons.

ATMOSPHERIC ENVIRONMENTAL ENGINEERING

Subject Code	:	**06EV63**	IA Marks	:	25
No. of Lecture Hours/ Week	:	04	Exam Hours	:	03
Total No. of Lecture Hours	:	52	Exam Marks	:	100

PART - A

UNIT - 1

INTRODUCTION: Definitions and terminologies, atmospheric structure and composition, scales of air pollution problem - local, urban, regional, continental and global. Air pollution episodes- Bhopal Gas Tragedy, Los Angeles and London smog.

6 Hours

UNIT - 2

SOURCES AND CLASSIFICATION OF AIR POLLUTANTS: Natural and anthropogenic, emission inventory source classification, primary and secondary pollutants, properties of major air pollutants along with sources and sinks- particulates and gases. Units of measurements of air pollutant. Simple problems on Unit conversion. Photochemical air pollutants, Air pollution due to automobiles. Smoke and its measurement.

6 Hours

UNIT - 3

EFFECTS OF AIR POLLUTION: Effects on human health and welfare, vegetation, animals, materials and structure/monuments, visibility and related atmospheric characteristics, Acid rain, Green house effect, Ozone depletion and Heat island effect.

4 Hours

UNIT - 4

AIR POLLUTION METEOROLOGY: Scales of meteorology, meteorological factors- heat, solar radiation, temperature, lapse rate, wind, humidity, precipitation, mixing height, pressure, atmospheric stability conditions, wind velocity profile, windrose diagram. Inversion –types, plume behaviour under different atmospheric stability, effect of topography on pollutant dispersion, Effect of air pollutants on meteorology. Land/sea breeze effects, Industrial plant location and city planning.

10 Hours

PART - B

UNIT - 5

MEASUREMENT OF AIR POLLUTANTS AND AIR POLLUTION LAWS: Measurement of gaseous (CO, HC, NOx, SO_2) and particulate pollutants, sampling devices, sampling train, sampling methods/techniques, stack sampling techniques. Air pollution laws and standards: air pollution laws/acts, air quality and emission standards, air pollution indices-determination of air pollution index by different methods.

8 Hours

UNIT - 6

ATMOSPHERIC DISPERSION OF STACK EFFLUENTS: Plume rise, effective stack height, plume rise formulations, guide lines for fixing stack height, problems on plume rise calculations. Gaussian plume model- for point source. Gaussian dispersion coefficients, Pasquil –Gifford atmospheric stability classification. Downwind ground-level concentration computation, maximum ground level concentration. Infinite line source Gaussian model. Instantaneous puff dispersion model. Estimate for various sampling times and decay of pollutant.

8 Hours

UNIT - 7

AIR POLLUTION CONTROL EQUIPMENTS General methods, control by process changes, Design of particulate control devices-settling chambers, inertial separators, cyclones, fabric filters, scrubbers (wet collectors), electrostatic precipitators. Control of gaseous pollutants- adsorption, absorption, combustion and condensation.

6 Hours

UNIT - 8

NOISE POLLUTION: Sources of noise, effects of noise pollution, units & measurement of noise, control of noise pollution, standards. Equations & Applications.

4 Hours

REFERENCE BOOKS:

1. **Fundamentals of Air Pollution** – Boubel, R.W., Donald, L.F., Turner, D.B., and Stern, A.C., (1994), Academic Press.
2. **Air Pollution Control Theory** – Crawford, M., (1980), TMH Edition, Tata Mc Graw Hill Publishing Co. Ltd., New Delhi.
3. **Air Pollution** – Henry. C. Perkins, (1980), McGraw Hill.
4. **Environmental Engineering** – Peavy, H.S., Rowe, D.R., and Tchobanoglous, G., (1986), Mc Graw Hill Book Co.
5. **Environmental Engineering - A Design Approach** – Sincero, A.P and Sincero, G.A., (1999), Prentice Hall of India.
6. **Air Pollution- Its Origin and Control** – Wark, K., Warner, C.F. and Davies, W.T., (1998), Harper & Row Publishers, New York.

WASTEWATER COLLECTION AND DRAINAGE SYSTEM

Subject Code	:	**06EV64**	IA Marks	:	25
No. of Lecture Hours/ Week	:	04	Exam Hours	:	03
Total No. of Lecture Hours	:	52	Exam Marks	:	100

PART - A

UNIT - 1

Types of Surface and Underground Drainage Systems and their Merits and Demerits. Types of Sewers – Lateral, Sub-main, Main, Intercepting and Outfall Sewers.

6 Hours

UNIT - 2

QUANTITY OF DOMESTIC WASTEWATER: Sources - Rate of Domestic Sullage and Wastewater Flow, Infiltration and Exfiltration, Design Flow.

5 Hours

UNIT - 3

STORM WATER RUN -OFF: Estimation of Run- off, Design Principles of Drains and Sewers.

4 Hours

UNIT - 4

DESIGN OF SEWERS AND DRAINS: Self Cleansing and Non-scouring Velocities. Formulae, Design of different types (L, U and V Drains) suitable for Rural and Urban Areas, Pressure Sewers.

8 Hours

PART - B

UNIT - 5

APPURTENANCES: Manholes, Lamp Holes, Street Inlets, Inverted Syphon, House Drainage Connection, Sewer Junction and Transitions. Wastewater Pumping: Necessity, Types of Pumps, Location of Pumping Station, Operation and Maintenance.

10 Hours

UNIT - 6

DISPOSAL OF SULLAGE WATER OF RURAL COMMUNITIES: Disposal Methods – Septic Tank and Soak Pits, Disposal in Natural Valley, Agricultural Land , Low Lying Area, etc., Development of Disposal Sites.

8 Hours

UNIT - 7

Measuring and Sampling of Flow in Sewers, Laying, Jointing and Testing of Sewer Lines, Loads on buried pipes.

6 Hours

UNIT - 8

MAINTENANCE OF DRAINAGE AND SEWERAGE SYSTEMS: Inspection, Cleaning, Repair and Rehabilitation. Preventive Maintenance.

5 Hours

REFERENCE BOOKS:

1. **Water and Wastewater Technology** – Hammer, M.J., (1986), SI Version, 2nd Edition, John Wiley and Sons.
2. **Water and Wastewater Engineering** – Fair G.M., Geyer H.C., and Okun D.A., (1968), Vol. I & II, John Wiley and Sons.
3. **Wastewater Engineering, Treatment and Reuse** – Metcalf and Eddy, (2003), 4th Edition, Tata McGraw Hill Edition, Tata McGraw Hill Publishing Co. Ltd.
4. **Environmental Engineering** – Peavy, H.S., Rowe, D.R., and Tchobanoglous, G., (1986), Mc Graw Hill Book Co.
5. **National Building Codes** (NBC) and Bureau of Indian Standards (BIS) Codes.

WASTEWATER TREATMENT ENGINEERING

Subject Code	:	**06EV65**	IA Marks	:	25
No. of Lecture Hours/ Week	:	04	Exam Hours	:	03
Total No. of Lecture Hours	:	52	Exam Marks	:	100

PART - A

UNIT - 1

INTRODUCTION: Objectives of Wastewater Treatment, Unit Operations and Processes. Process, Flow Sheets for Wastewater Treatment Systems.

5 Hours

UNIT - 2

UNIT OPERATIONS: Screening, Comminutor, Grit Chamber, Primary Sedimentation, Design Criteria and Examples.

8 Hours

UNIT - 3

UNIT PROCESSES: Suspended & attached Growth Systems, Aerobic & Anaerobic Systems, Activated Sludge Process and its Modifications, Trickling Filters, Rotating Biological Contactor, Biofilters, Secondary Sedimentation Tank, Design criteria and examples.

10 Hours

UNIT - 4

Stabilization Ponds – Aerobic, Facultative & Anaerobic Lagoons, Septic Tanks and their Design Aspects.

5 Hours

PART - B

UNIT - 5

SLUDGE TREATMENT: Sludge Pumping, Sludge Thickening, Stabilization, Conditioning, De-watering.

8 Hours

UNIT - 6

SLUDGE DIGESTION: Aerobic and Anaerobic Digesters, Design Criteria with examples.

6 Hours

UNIT - 7

ENERGY RECOVERY FROM DIGESTERS: Methane quantification. Sludge drying beds – Principles and Design Criteria.

04 Hours

UNIT - 8

OPERATION AND MAINTENANCE OF TREATMENT UNITS: In-plant Monitoring, Operational Problems and Solutions, Preventive Maintenance, Disposal of Wastes from various Units.

6 Hours

REFERENCE BOOKS:

1. **Water and Wastewater Technology** – Hammer, M.J., (1986), SI Version, 2nd Edition, John Wiley and Sons.
2. **Wastewater Treatment – Concepts and Design Approach** Karia, G.L., and Christian, R.A., (2006), Prentice Hall of India Pvt. Ltd., New Delhi.
3. **Wastewater Engineering, Treatment and Reuse** – Metcalf and Eddy, (2003), 4th Edition, Tata McGraw Hill Edition, Tata McGraw Hill Publishing Co. Ltd.
4. **Environmental Engineering**– Peavy, H.S., Rowe, D.R., and Tchobanoglous, G., (1986), Mc Graw Hill Book Co.
5. **Water Supply and Wastewater Engineering** –Raju, B.S.N., (1995), Tata McGraw Hill Pvt. Ltd., New Delhi.
6. **Environmental Engineering – A Design Approach**– Sincero, A.P., and Sincero, G.A., (1999), Prentice Hall of India Pvt. Ltd., New Delhi.

ENVIRONMENTAL BIOTECHNOLOGY

Subject Code	:	**06EV661**	IA Marks	:	25
No. of Lecture Hours/ Week	:	04	Exam Hours	:	03
Total No. of Lecture Hours	:	52	Exam Marks	:	100

PART - A

UNIT - 1

BIOCHEMISTRY: Introduction, Lipids, sugars, polysaccharides, nucleotides, RNA, DNA, amino acids, proteins, hybrid biochemicals, hierarchy of cellular organisms.

5 Hours

UNIT - 2

METABOLIC PATHWAYS, KINETICS OF ENZYME CATALYZED REACTIONS: Applied Enzyme Catalysis – Hydrolysis of starch cellulose. Enzyme mixtures – pectic enzymes. Immobilized enzyme technology. Immobilization methods, industrial process, analytical applications, kinetics.

10 Hours

UNIT - 3

MULTIPLE INTERACTING MICROBIAL POPULATIONS: Neutralism, mutualism, commensualism and amensalism. Classification of interaction between two species. Competition – Volterra's analysis for growth of two species and simple problems.

4 Hours

UNIT - 4

KINETICS OF SUBSTRATE UTILIZATION: Product utilization and biomass production in cell cultures, ideal reactors for kinetics management, kinetics for balanced growth, transient growth kinetics, structured kinetic models.

7 Hours

PART - B

UNIT - 5

BIOTECHNOLOGY: Introduction to microbial biotechnology, uses of enzymes and biomass production, isolation and purification of enzyme engineering, protein engineering, immunotoxins, metabolic engineering for over production of metabolites.

8 Hours

UNIT - 6

USES OF MICROBES: Isolating and culturing of microorganisms, production of organic compounds like, ethanol and acetone by microbial fermentation, production of enzymes by microorganism.

5 Hours

UNIT - 7

Sewage treatment using microbial systems, nitrogen fixing and pollutant degrading genes, biocontrol agents.

5 Hours

UNIT - 8

SPECIFIC BIOTECHNOLOGICAL APPLICATIONS TO: Pollution control, restoration of degraded lands, free-cells and immobilized cell technology for wastewater treatment [Batch and Continuous Stirred Tank Reactor (CSTR)], aerobic and anaerobic digestion, biogas from wastes.

8 Hours

REFERENCES:

1. **Biochemical Engineering and Fundamentals**– Bailey and Ollis, (1990), McGraw Hill International Edition.
2. **A Textbook of Biotechnology**– Dubey, R.C., S. Chand and Co., New Delhi.

3. **Elements of Biotechnology** – Gupta, P.K., (2000), Rastogi Publications, Meerut.
4. **Chemistry for Environmental Engineering and Science**– Sawyer, C.N., Mc Carty, P.L., and Parkin, G.F., (2003),5th Edition, TMH Edition, Tata Mc Graw Hill Co. Ltd., New Delhi.

ECOFRIENDLY ENERGY SOURCES

Subject Code	:	**06EV662**	IA Marks	:	25
No. of Lecture Hours/ Week	:	04	Exam Hours	:	03
Total No. of Lecture Hours	:	52	Exam Marks	:	100

PART - A

UNIT - 1

INTRODUCTION TO ENERGY SOURCES: Global Energy, Environmental Resources, Energy necessity and energy crisis. Indian Energy Scenario: Energy Consumption, needs and crisis, energy sources and availability.

6 Hours

UNIT - 2

RENEWABLE SOURCES OF ENERGY AND ENVIRONMENT: Biomass – introduction, energy plantation, bio-mass conversion technologies (wet and dry process), photosynthesis, agricultural waste derived energy, urban waste derived energy.

6 Hours

UNIT - 3

Bio-Gas: Generation, factors affecting bio-digestion, advantages of anaerobic digestion, classification of bio-gas plants.

5 Hours

UNIT - 4

HYDROPOWER: Site selection for hydroelectric power plants, classification of hydroelectric power plants, submergence, ecological imbalance, catchment area treatment, advantages and disadvantages of hydroelectric power plants. Submergence, Ecological Imbalance, Catchment Area Treatment.

10 Hours

PART - B

UNIT - 5

TIDAL ENERGY: OTEC (Ocean Thermal Electric Conversion), methods of ocean thermal electric power generation, site selection. Energy from tides – basic principles of tidal power, components of tidal power plant.

SOLAR ENERGY: Solar constants, solar radiation at earth surface, physical principles of conversion of solar radiation into heat. Concentrating collectors (focusing and non-focusing).

10 Hours

UNIT - 6

WIND ENERGY: Introduction, basic principles of wind energy conversion. Site selection considerations. Basic components of wind energy conversion system. Wind energy collectors. Natural gas – classification and comparison of different gas turbine power plants, Associated Environmental Effects.

6 Hours

UNIT - 7

NUCLEAR ENERGY: necessity, general components of nuclear reactors, different types of reactors, breeding reactors, location of nuclear power plants, disposal of nuclear wastes, Associated Environmental Effects.

5 Hours

UNIT - 8

GEO-THERMAL ENERGY: introduction, nature of geothermal fields, geo-thermal sources, binary fluid geo-thermal power system and arrangement for hybrid plants.

4 Hours

REFERENCE BOOKS:

1. **Renewable Energy and Environment** –Mathur, A.N., and Rathore, N.S., Proceedings of the National Solar Energy, Himanshu Publications, Udaipur.
2. **Energy Technology–Non-conventional, Renewable and Conventional** –Rao and Parulekar B.B., (1977), 2nd Edition, Khanna Publishers.
3. **Non-conventional Energy Sources**– Rai, G.D.Khanna Publications.
4. **Integrated Renewable Energy for Rural Development** –Saha, H., Saha, S.K., and Mukherjee, M.K., (1990),Proceedings of the National Solar Energy Convention, Calcutta, India,
5. **Handbook of Energy Systems Engineering** – Wilber, L.C., (1989), Wiley and Sons. The Energy Research Institute (TERI), New Delhi, Publications. Ministry of Environment and Forests, Government of India, Annual Reports.

ENVIRONMENTAL SYSTEMS OPTIMIZATION

Subject Code	:	**06EV663**	IA Marks	:	25
No. of Lecture Hours/ Week	:	04	Exam Hours	:	03
Total No. of Lecture Hours	:	52	Exam Marks	:	100

PART - A

UNIT - 1

INTRODUCTION: Definition and Engineering Applications of Optimization. Statement of an Optimization Problem, Classification of Optimization Problems.

6 Hours

UNIT - 2

CLASSICAL OPTIMIZATION TECHNIQUES: Single Variable Optimization, Multivariable Optimization with No Constraints, with Equality Constraints and Inequality Constraints. (Statement of Theorem without Proof).

8 Hours

UNIT - 3

LINEAR PROGRAMMING: Graphical Method, Simplex and Two-phase Method, Big-M Technique

4 Hours

UNIT - 4

Duality in Linear programming, Sensitivity Analysis and Parametric analysis.

6 Hours

PART - B

UNIT - 5

TRANSPORTATION PROBLEM: Definition & Applications of Transportation Model. Solution of the Transportation Problem, North West Corner Rule and Vogels Approximation Methods, Application to Wastewater Reuse and Solid Waste Management.

8 Hours

UNIT - 6

APPLICATION OF LINEAR PROGRAMMING TO: Problems on Air Pollutant Transport, Air Pollution Control, Wastewater Treatment Problem, Formulation for Non-point Source Pollution from Dairy Farms and Combined Sources from Urban Areas.

10 Hours

UNIT - 7

NUMERICAL SEARCH METHODS: Elimination Methods, Dichotomous Search and Fibonacci Methods.

4 Hours

UNIT - 8

SIMULATION: Basic Concepts, Development & Implementation of Simulation Process, Pre-simulation Activities, Developmental & Operational Activities and Random Number Generation Techniques.

6 Hours

REFERENCE BOOKS:

1. **Operations Research**– Fredrick S. Hiller, and Lieberman, (1990),
2. **Water Supply and Treatment**– CPHEEO. Manual.
3. **A Systems Approach to Civil Engineering Planning and Design**– Jewell, T.K., (1986), Harper & Row.
4. **Handbook of Non-point Pollution (Sources and Management**– Novotny V., and Chester G., (1981), Van Nostrand Reinhold Co.
5. **Optimization Techniques** – Rao, S.S., (1984), Wiley Publications.
6. **Operations Research - Principles & Practice**– Ravindram, Phillips & Solberg, (1987), Wiley Publications.
7. **Environmental Systems Engineering**– Rich, L.G., (1973), McGraw Hill.

ATMOSHPHERIC ENVIRONMENTAL LABORATORY

Subject Code	:	**06EVL67**	IA Marks	:	25
No. of Practical Hours/ Week	:	03	Exam Hours	:	03
Total No. Practical Hours	:	42	Exam Marks	:	50

1. Introduction to Atmoshpheric Monitring: Particulate Sampling – Dust Fall, Pollution Suspended Particulates and Total Particulate Matters using H.A.S.
2. Experimental on Respirable Dust.
3. Estimating Sulphur Dioxide in Ambient Air Using High Volume Air Sampler.
4. Stack Sampling Techniques and Demonstration of Stack Monitoring.
5. Exercises on Ambient Gas Monitoring using GASTEC Device.
6. Demonstration / Exercises on Air Pollution Control Devices – Bag Filter, Scrubber, Cyclone and ESP.
7. Exercises on Auto Exhaust Analyser for Petrol Vehicle.
8. Exercises on Noise Measuring Instruments.
9. Exercises on Luxmeter (Light Intensity measuring Instrument)

10. Demonstration on Wind Monitoring and Analysis of Data for Windrose Diagrams.
11. Demonstration of Rain Gauges.

REFERENCE BOOKS:

1. **Air Pollution and Control**– Perkins H. C.
2. **Air Pollution Theory and Control Relevant IS Codes** Stern.

ENVIRONMENTAL PROCESS LABORATORY-II

Subject Code	:	**06EVL68**	IA Marks	:	25
No. of Practical Hours/ Week	:	03	Exam Hours	:	03
Total No. Practical Hours	:	42	Exam Marks	:	50

BOD and COD Analysis for Muncipal, Industrial Wastewater and Leachates.

Bench Scale Experiment – Aeration, Trickling Filter and Rotating Biological Contactor.

Oxidation Ditch, Upflow Filter Bed and Reverse Osmosis Experiments.

Experments for Organic Contaminant and Heavy metal removal using adsorption columns.
Teritary Treatment by Physico-Chemical Methods – Flocculation, Filtration.

Water Hyacinth and Duckweeds for Wastewater treatment and polishing.

Experiments of Sludge Analysis – VSS, VFA, N & Phosphate, pH-Buchner Funnel Tests, Capillary Suction Time Test.

Experiments on Muncipal Solid Waste – Moisture Content, Density, Calorific Value.

REFERENCE BOOKS:

1. **Standard Methods for Examination of Water and Wastewater** 20^{th} edition, 1998 APHA.
2. **Environmental, Process Design Techniques for Industrial Waste Treatment**– Adams and Eckenfelder Jr. W. W., Nashville (USA), 1974.
3. **Wastewater Engineering** –Metcalf and Eddy, , Tata McGraw Hill, 1995.
4. **Relevant IS Codes**.

VII SEMESTER

COMPUTER APPLICATIONS IN ENVIRONMENTAL ENGINEERING

Subject Code	:	**06EV71**	IA Marks	:	25
No. of Lecture Hours/ Week	:	04	Exam Hours	:	03
Total No. of Lecture Hours	:	52	Exam Marks	:	100

PART - A

UNIT - 1

INTRODUCTION: Computer Programming and Computer Aided Design, software and analytical tools, requirements and benefits of CAD, requirements of CAD languages.

4 Hours

UNIT - 2

POPULATION FORECAST PROGRAMS: Arithmetic increase method, geometric increase method, incremental increase method and logistic curve method.

4 Hours

UNIT - 3

WATER SUPPLY AND TREATMENT PROGRAMS: Rising main design, pumping unit, service reservoir capacity calculation, Distribution network analysis & design – (One to three loops only). Water treatment units design – plain sedimentation tank, clariflocculator tank, filters (rapid and slow) – Mechanical rapid mix Unit – cascade aerator & spray aerator.

10 Hours

UNIT - 4

WASTEWATER COLLECTION AND TREATMENT UNITS PROGRAMS: Sewer design, wastewater treatment units – Screen, Grit chamber, Secondary settling tank, ASP, Trickling filter, waste stabilization pond, Oxidation ditch, Sludge digester, Sludge drying beds and septic tank.

10 Hours

PART - B

UNIT - 5

AQUATIC SYSTEMS PROGRAMS: Water quality in rivers due to discharge of conservative and non-conservative waste, DO models for rivers (Streeter- Phelphs) and lakes, Water quality in mixing zone – critical point method.

6 Hours

UNIT - 6

AIR QUALITY PROGRAMS: Programs on stack effective height calculation, Gaussian Plume Model for gaseous and particulate dispersion from point sources. Line source Gaussian model, Instantaneous puff dispersion model. Estimate for various sampling times and decay of pollutant. Design of particulate control devices – Settling chamber, cyclones.

10 Hours

UNIT - 7

INTRODUCTION TO GIS: Components of GIS, Application and benefits of GIS. GIS Operations – Spatial Data Input, Data Management Display, Exploration Analysis & GIS Modeling.

4 Hours

UNIT - 8

Introduction to Computer graphics – Applications.
Introduction to DBMS – Components of DBMS

4 Hours

REFERENCE BOOKS:

1. **Principles of Surface Water Quality Modeling and Control** – Thomann, R.V., and Mueller, J.A., (1987), Harper Int. Edition.
2. **Computer Aided Design software and Analytical Tools**– Krishna Murthy, C.S., and Rajeev, S., (1998), Norosa Publishing House.
3. **Air Pollution its Origin and Control** – Wark, K., Warner, G.F., and Davis, W.T., (1998), Addison- Wesley.
4. **Air Pollution Control Theory**– Martin Crawford, (1990), TMH Edition.
5. **Pollution Control in Process Industries**– Mahajan, (1989), Tata Mc. Graw Hill.
6. **Pollution Control in Process Industries**– Sincero & Sincero, (1989). Tata Mc. Graw Hill.
7. **Water Supply and Treatment** – CPHEEO Manual (1993), New Delhi.
8. **Wastewater collection, treatment & disposal** – CPHEEO Manual (1993), New Delhi.

ECOLOGY AND ENVIRONMENTAL IMPACT ASSESSMENT

Subject Code	:	**06EV72**	IA Marks	:	25
No. of Lecture Hours/ Week	:	04	Exam Hours	:	03
Total No. of Lecture Hours	:	52	Exam Marks	:	100

PART - A

UNIT - 1

INTRODUCTION: Scope of Ecology**;** Sub – Divisions in Ecology, Ecosystem Concepts: Nature, Interactions, Structure and Functions. Ecological Pyramids, Food Chain and Food Webs, Measurement of Productivity.

6 Hours

UNIT - 2

ENERGY FLOW IN ECOSYSTEM: Perfect and Imperfect Biogeochemical Cycles, Diversity, Dominance and Evenness Indices – Problems. Aquatic Ecosystems: Lotic & Lentic Systems – Structure and Zonation. Eutrophication of Lakes: Causes, Limiting Nutrients and Control Methods.

6 Hours

UNIT - 3

POPULATION GROWTH FORMS: Carrying Capacity and Environmental Resistance, Maximum Sustainable Yield, Quantitative Ecology, Concept of Model and Ecosystem Modelling.

5 Hours

UNIT - 4

INTRODUCTION TO EIA: Definition Evaluation of EIA in India, Rapid and Comprehensive. EIA, EIS, FONSI and NDS. Need for EIA Studies, Baselinedata. Step – by – step Procedure for conducting EIA, Advantages and Limitations of EIA. Hierarchy in EIA, Statutory Requirements in EIA, MoEF Guidelines in Siting Developmental Projects.

9 Hours

PART - B

UNIT - 5

OBJECTIVES AND SCOPE OF EIA: Contents of EIA. Methodologies and Evaluation Techniques of EIA, their selection for Specific Projects.

5 Hours

UNIT - 6

ENVIRONMENTAL ATTRIBUTES: Value Functions, Prediction Equations and Mitigation of Impact on Air, Water, Land, Ecology and Socioeconomic Environment. Input requirements for Computer Models.

5 Hours

UNIT - 7

PUBLIC PARTICIPATION IN EIA: Elements of Effective Public Participation and Benefits and Procedures. Environmental and Disaster Management Plans.

PROJECT ACTIVITY: Attribute Activity Relationship, Matrices & BEES.

9 Hours

UNIT - 8

IMPACT QUANTIFICATIONS FOR : Water Resource Developmental Projects, Mass Transit Routes, Hazardous Waste disposal Sites, Sanitary Landfilling, Mining Project (Coal, Aluminium, Iron Ore, Bauxite) Thermal Power Plant (Coal- based) Project, Pharmaceutical Industries.

7 Hours

REFERENCE BOOKS:

1. **Environmental Impact Assessment** –L.W.Canter (1996), McGraw Hill Inc.
2. **Fundamentals of Ecology** –Odum (1964), Addison Co.
3. **Environmental Impact Analysis** – Jain R. K., Urban & Stacey,.
4. **Environmental Impact Assessment Methodologies** – Anjaneyulu Y., (2002),., B.S. Publications, Hyderabad.
5. **Concepts of Ecology** –Kormondy (1989), Prentice Hall, 1989.
6. **Guidelines for EIA of Developmental Projects**. Ministry of Environment and Forests, Government of India.

ADVANCED WASTEWATER TREATMENT

Subject Code	:	**06EV73**	IA Marks	:	25
No. of Lecture Hours/ Week	:	04	Exam Hours	:	03
Total No. of Lecture Hours	:	52	Exam Marks	:	100

PART - A

UNIT - 1

INTRODUCTION TO ADVANCED TREATMENT OF WASTEWATER: Need, Different Technologies Used. Combination of Unit Operations and Processes with Treatment Flow sheets.

6 Hours

UNIT - 2

REMOVAL OF REFRACTORY ORGANICS:- Adsorption, Adsorption Isotherms, Design factors & Design of Adsorption process.

6 Hours

UNIT - 3

REMOVAL OF DISSOLVED INORGANIC SUBSTANCES: Chemical Precipitation, Ion Exchange, Reverse Osmosis.

6 Hours

UNIT - 4

Electro dialysis, Membrane Filtration Processes, Gas stripping, Advanced oxidation processes & Distillation, Disinfection.

8 Hours

PART - B

UNIT - 5

NUTRIENTS REMOVAL: Nitrogen – sources, forms, Nitrification & denitrification processes Phosphorous –Sources, Forms, Chemical and Biological Methods of Treatment.

6 Hours

UNIT - 6

Upflow Anaerobic Sludge Blanket (UASB) reactor & its applications, Immobililised cell technology, Comparison of different techniques, Enzymes & Microbial cell Immobilisation, Effect of Immobilisation on growth Kinetics. Immobilisied cell reactors – types, design criteria & applications.

10 Hours

UNIT - 7

Water reuse – need for reuse, wastewater reclamation, wastewater reuse & recycle applications.

5 Hours

UNIT - 8

Risk assessment – Introduction, Ecological risk assessment & risk management.

5 Hours

REFERENCE BOOKS:

1. **Wastewater Engineering, Treatment and Reuse**– Metcalf and Eddy, (2003), 4th Edition, Tata McGraw Hill Edition, Tata McGraw Hill Publishing Co. Ltd.
2. **Introduction to Wastewater Treatment Process** – Ramelho, R.S. (1980), Academic Press.

3. **Immobilized Living Cells and their Applications** –Kennedy J.F., and Cabral J.M.S. (1983), Academic Press.
4. **Immobile Microbial Cells**– Wingard Jr. L.B., and Katzir E.K. (1983), Vol. 4, Academic Press.
5. **Process Chemistry for Water and Wastewater Treatment** – Benefield, L.D., Judkins (Jr) J.F., and Weand B.L.1985, Prentice Hall, Eagle Wood Cliffs, New Jersy

ESTIMATION, SPECIFICATIONS & FINANCIAL ASPECTS OF ENVIRONMENTAL FACILITIES

Subject Code	:	**06EV74**	IA Marks	:	25
No. of Lecture Hours/ Week	:	04	Exam Hours	:	03
Total No. of Lecture Hours	:	52	Exam Marks	:	100

PART - A

UNIT - 1

EARTHWORK: Volume by cross-section (including prismoidal and curvature corrections), spot levels and contour – construction of mass diagram, calculation of haul, over haul and economic haul lead and lift.

7 Hours

UNIT - 2

WORKING OUT DATA : Procedure for working out quantities and rates for the following items – lime and cement mortars, lime and cement concrete, brick and stone masonry, flooring, plastering, RCC works, centering and form works for different RCC items, doors, windows and ventilators

7 Hours

UNIT - 3

SPECIFICATIONS: Drawing up specifications for several construction materials such as coarse aggregate lime, cement, mortars, plain and reinforce concrete, brick masonry, stone masonry, flooring, roofing, plastering, wood work, earthwork and surfing, water supply distribution lines. Surface and sub-surface drainage line (including stone-ware pipes).

8 Hours

UNIT - 4

ESTIMATION: Methods of taking out quantities, preparation of detailed and abstract estimates for the following environmental engineering works - Septic tank, manhole, pump house, store room. Calculation for procuring steel for reinforcement for various basic components such as small slabs, chejja and lintels.

12 Hours

PART - B

UNIT - 5

VALUE ENGINEERING: Necessity, method and objections to its study.

4 Hours

UNIT - 6

FINANCIAL ASPECTS: Definition, purpose. Cost price – value – different forms of value – gross income – net income – outgoings – types of out goings – obsolescence, annuity, year's purchase.

5 Hours

UNIT - 7

Capital cost, operating cost, capitalized value, time value of money, sinking fund – depreciation – methods of calculation of depreciation, cost fixation on the produced commodity.

5 Hours

UNIT - 8

FISCAL INCENTIVES FOR ENVIRONMENTAL PROTECTION: Exemption from IT, Investment and Depreciation Allowance, Exemption from Tax to Capital Gains, Rebate in Cess Levied on Consumption of Water.

4 Hours

REFERENCE BOOKS:

1. **Estimation and Costing** – Dutta.
2. **Estimationand Costing** – Mahajan.
3. **Economics for Engineers** – Amin.
4. **Engineering Economics – Vol. I** –Tarachand.
5. **water supply and wastewater treatment** – CPHEEO manuals.
6. **Current Schedule of Rates** (SR) of PWD, KUWS&DB.

NUCLEAR, RADIOACTIVE AND BIOMEDICAL WASTE TECHNOLOGY

Subject Code	:	**06EV751**	IA Marks	:	25
No. of Lecture Hours/ Week	:	04	Exam Hours	:	03
Total No. of Lecture Hours	:	52	Exam Marks	:	100

PART - A

UNIT - 1

INTRODUCTION: Nuclear fission and fusion. Nature and sources of radiation, interactions of radiation with matter, types of radiation on the basis of ionization.

6 Hours

UNIT - 2

MEASUREMENT METHODS: Units of radiation and radiation standards.

6 Hours

UNIT - 3

EFFECTS: General biological effects of ionizing radiation, radiation effect on aqueous environment and moist air system, effect of radiation at molecular levels, external radiation hazards.

8 Hours

UNIT - 4

RADIATION PROTECTION: Control of radiation hazards, survey, contamination monitoring, radiation hazards from reactors, radiological emergencies and control, protection against x-rays, quantitative risk assessment.

8 Hours

PART - B

UNIT - 5

CASE STUDIES: Salient details of Chernobyl reactor accident. Hiroshima and Nagasaki Episodes. Short and long term effects of groundwater chemistry around a nuclear waste deposits.

8 Hours

UNIT - 6

Biohazard – sources, effects & control. Biohazard standards.

4 Hours

UNIT - 7

Biomedical wastes – sources, generation rate, characterization, Biomedical wastes (Management & Handling) rules.

6 Hours

UNIT - 8

Biomedical waste management – Principles & ethics, collection, transportation, treatment & safe disposal.

6 Hours

REFERENCE BOOKS:

1. **Environmental Radiation and Thermal Pollution and their Control** – Chatwal G.R., et.al. (1994),Anmol Publications, New Delhi.
2. **Aspects of Radiation Biophysics** – Mookerjee A., and Bhattacharjee S.B. (1994).,Interprint publishers.
3. **Hazardous Waste Management**– Lagrega M.D., et.al.(1995), McGraw Hill Inc. NEERI, Nagpur Publications on Biomedical waste management.

OCCUPATIONAL SAFETY AND HEALTH

Subject Code	:	**06EV752**	IA Marks	:	25
No. of Lecture Hours/ Week	:	04	Exam Hours	:	03
Total No. of Lecture Hours	:	52	Exam Marks	:	100

PART - A

UNIT - 1

INTRODUCTION: History and Development, Occupational Safety and Health Act, Occupational Safety and Health Administration, Right to know Laws.

6 Hours

UNIT - 2

ACCIDENT CAUSATION: Cause of Accidents, Deaths in Work Accidents, work injuries, type of accidents, chemical and heat burn injuries.

5 Hours

UNIT - 3

Theories of Accident Causation: Domino, Human Factor, Petersew's Accident Incident, Epidemiological, Human Error Model.

5 Hours

UNIT - 4

ERGONOMICS: Definition, factors associated with physical stress, worksite analysis programme, hazard prevention and control. Specific ergonomic problems and problem solving strategies, economics of ergonomics.

6 Hours

PART - B

UNIT - 5

OCCUPATIONAL HAZARD AND CONTROL: Hazard Analysis, Human Error Analysis in Causation with Hazard Analysis, Fault Tree Analysis, Emergency Response, Decision for Action, Purpose and Considerations, Right Decision, Wrong Remedy

6 Hours

UNIT - 6

Engineering Versus Management Control, Hazard Control Measures, Hazards and their Control in Pharmaceutical, Construction, Textiles, Petroleum Refineries and LPG Bottling, Iron & Steel Industries

6 Hours

UNIT - 7

FIRE PREVENTION AND PROTECTION: Fire Development and its Severity, Effect of Enclosure, need for early Detection of Fire, Extinguishing Fire, Electrical Safety, Product Safety, Technical Requirements of Product Safety Programme.

8 Hours

UNIT - 8

OCCUPATIONAL HEALTH: Health and Safety Considerations, Personal Protective Equipment, Effects of Exposure and Treatment for Metal Working Trades, Municipal Solid Waste, Epoxy Resins, and Foundries. Occupational Health and Safety Considerations in Wastewater Treatment Plants.

10 Hours

REFERENCE BOOKS:

1. **Industrial Safety Management and Technology–**Colling D.A., 1990, Prentice Hall, New Delhi.
2. **Safety and Environmental Management–** Della D.E. and Giustina (1996), Van Nostrand Reinhold International Thomson Publishing Inc,
3. **Environmental Pollution and Health Hazards–** Anand Gopal Mukherjee, Causes and Control, Galgotia Publications Pvt. Ltd.
4. **Environmental and Industrial Health Hazards–**Trevethick R.A. (1973). William Heinemann Medical Books Ltd., London
5. **Occupational Safety and Health For Technologist, Engineers & Managers –**Goetsch D.L., (1999), 3rd Edition, Prentice Hall,

OPERATION AND MAINTENANCE OF ENVIRONMENTAL FACILITIES

Subject Code	:	**06EV753**	IA Marks	:	25
No. of Lecture Hours/ Week	:	04	Exam Hours	:	03
Total No. of Lecture Hours	:	52	Exam Marks	:	100

PART - A

UNIT - 1

INTRODUCTION: Importance of Operation & Maintenance, Basic Principles of Operation & Maintenance – Corrective and Preventive Maintenance. Data Base of Facilities for O&M – Detailed Plans, Drawings, Operation Manuals, Computer Applications in O&M.

6 Hours

UNIT - 2

O&M OF WATER SUPPLY FACILITIES: Intakes, Pumps, Rising Mains, Water Treatment Process Control, Water Quantity and Water Quality Monitoring.

6 Hours

UNIT - 3

Loss of carrying capacity of pipes, Causes, Leak Detection, Projection of Pipe Break Rates, Record Keeping, Appurtenances – Valves, Hydrants and Fittings. Use of Network Models in O&M.

8 Hours

UNIT - 4

O&M OF WASTEWATER FACILITIES: Sewer Network: Inspection Methods for Sewers and Appurtenances – Manual and Television, Cleaning. Rehabilitation – Sealing, Repair and Replacement.

6 Hours

PART - B

UNIT - 5

O&M OF WASTEWATER TREATMENT PLANT: Safety in Sewer Inspection**:** Monitoring, Operational Problems and Corrective Measures in Different Units of Treatment.

8 Hours

UNIT - 6

O&M OF AIR POLLUTION CONTROL FACILITIES: Regular Inspection of Devices, SPM Control Equipment, Gravity Settlers, Cyclone Separators, Bag Filters, Scrubbers, Electrostatic Precipitators.

6 Hours

UNIT - 7

GASEOUS EMISSION CONTROL DEVICES – Absorption Beds and Adsorption Columns, Thermal Oxidisers, Incinerators and their Trouble Shooting.

6 Hours

UNIT - 8

OPERATION & MAINTENANCE PLANNING: Organisational Structure, Work Planning, Preparation and Scheduling, Cost Estimates, training – needs & planning.

6 Hours

REFERENCE BOOKS:

1. **Water and Wastewater Technology**– Hammer, M.J., (1986), SI Version, 2nd Edition, John Wiley and Sons.
2. **Wastewater Treatment Plants – Planning, Design and Operation**– Quasim, S.R., (1985), Holt Rinehart and Winston, CBS College Publishing Neumann W.L.,

3. **Industrial Air Pollution Control Systems** – 1997, McGraw Hill.
4. **Water Supply & Treatment** – CPHEEO Manual 1(991), GOI Publication.
5. **Wastewater Treatment** – CPHEEO Manual (1995), GOI Publication.
6. **Training Manual** on O&M for Municipal Staff, Asian Development Bank, Government of Karnataka.
7. **Analysis of Water Distribution Systems** – Walski T.M. (1987), CBS Publications, New Delhi.
8. **Wastewater Enigineering, Treatnent Under Use**- Metcalf & Eddy Inc, 2003, 4th Edition, Tata McGraw Hill Publishers Co. Ltd, New Delhi

ENVIRONMENTAL ASPECTS OF DEVELOPMENTAL PROJECTS

Subject Code	:	**06EV761**	IA Marks	:	25
No. of Lecture Hours/ Week	:	04	Exam Hours	:	03
Total No. of Lecture Hours	:	52	Exam Marks	:	100

PART - A

UNIT - 1

INTRODUCTION: Environment, Sustainable Development, Quality of Life (GDP, GNP), Need for Development and Environmental Protection, Ambient and Effluent Emission Standards, Regulation for Environmental Pollution Control, Environmental Ethics. Carrying capacity concept – applications for regional planning development.

8 Hours

UNIT - 2

INFRASTRUCTURAL PROJECTS: Highways, Airports, Water Supply and Sanitation, Wastewater Treatment – Salient Details and Environmental Aspects.

8 Hours

UNIT - 3

CONSTRUCTION PROJECTS: Construction activities and their environmental effects, Mitigation Measures.

6 Hours

UNIT - 4

WATERSHED DEVELOPMENT - RESERVOIRS & DAMS: Micro-climatic changes, Submergence of land, forest & habitation – social effects. Effects on Flora & Fauna, Pollution accumulation on Sediments, Reservoir Sedimentation.

6 Hours

PART - B

UNIT - 5

IRRIGATION & AGRICULTURAL ACTIVITIES: Water logging, Malaria Cause and Salinity Problems - Mitigative measures for Environmental Protection.

Natural – Earthquake, Tsunami, Cyclone & Land slides, Threats & their Management.

8 Hours

UNIT - 6

POWER PROJECTS: Hydro thermal and Nuclear projects, Power Transmission lines and Influence on Environment and Mitigation Methods.

4 Hours

UNIT - 7

INDUSTRIAL DEVELOPMENTAL PROJECTS: Process Flow Diagrams and Waste Generation Points for Pig Iron Plant, Coke oven, fertilizer, Textile and Food Industry.

6 Hours

UNIT - 8

Plastics and Polymer Industry, Electroplating Industry, Mining Activity. Pollution Control Measures, Recycle & Reuse, Cleaner development mechanisms

6 Hours

REFERENCE BOOKS:

1. **Environmental Quality Management** – Lohani B. N., (1984), South Asian Publishers Pvt. Ltd.
2. **Environmental Science and Engineering**– Henry J.G. and Heinke G.W. (1996), Prentice Hall of India.
3. **Environment and Sustainable Development Journals**– UNEP/UNDP.
4. **Geo-environment – An Introduction** Ashwathanarayana U., (1995), Capital Books Pvt. Ltd., New Delhi.
5. **Handbook of Energy Systems Engineering**– Wilber L.C. (1989), Wiley and Sons.
6. **Hydrology & Water resources Engineering**– R. K. Sharma & Sharma.

ENVIRONMENTAL APPLICATIONS OF REMOTE SENSING AND GIS

Subject Code	:	**06EV762**	IA Marks	:	25
No. of Lecture Hours/ Week	:	04	Exam Hours	:	03
Total No. of Lecture Hours	:	52	Exam Marks	:	100

PART - A

UNIT - 1

REMOTE SENSING: Definition – Ideal Remote Sensing System–Sensors and Types.

4 Hours

UNIT - 2

Remote Sensing Satellite – IRS and INSAT specifications – Applications of remote sensing – DIP Techniques.

6 Hours

UNIT - 3

GIS: Definition, Components of GIS, Data and Types, Sources of data - Global Positioning System (GPS).

4 Hours

UNIT - 4

DATA STRUCTURE: Types of Analysis, Errors, Errors analysis & correction, general Applications of GIS.

6 Hours

PART - B

UNIT - 5

Environmental Applications of RS and GIS in Optimal Routing of Solidwastes collection system of an urban area. Environmental Siting of Industries and Zoning Atlas Development using Remote Sensing Data and GIS.

8 Hours

UNIT - 6

Re-modelling of Water Distribution & Sewer Network Systems using GIS.

8 Hours

UNIT - 7

GIS for Sustainable Urban Development Planning. Storm water system management using GIS

8 Hours

UNIT - 8

Groundwater Vulnerability Modelling using GIS. Environmental Degradation Assessment using RS and GIS (Forest covers Reservoir capacity, Catchments area).

8 Hours

REFERENCE BOOKS:

1. **GIS for Land Resource Assessment** – Burrough P.A., (1986), Oxford University Press, U.K.
2. **Geographic Information Systems; An Introduction** – Star J.L., and Estes J.E., (1990), Prentice Hall Publications.
3. **Fundamentals of Spatial Information Systems** – Laurini R. and Thompson D., (1992), Academic Press.
4. **GIS Handbook GIS India** – Mishra H.C., (1997), Shanthi Nivas, Hyderabad.
5. **Remote Sensing and GIS** – Anji Reddy, (2001), B.S. Publications, Hyderabad.
6. **Remote Sensing – Principles and Interpretations** – F. F. Sabins, W.H. Freeman & Co.
7. **Fundamentals of GISM –**N. Demas, (2000), John Wiley & Sons, Inc Case Studies Reports.

GEOENVIRONMENTAL ENGINEERING

Subject Code	:	**06EV763**	IA Marks	:	25
No. of Lecture Hours/ Week	:	04	Exam Hours	:	03
Total No. of Lecture Hours	:	52	Exam Marks	:	100

PART - A

UNIT - 1

INTRODUCTION: Definition of Geo-environment and its Components. Global Degradation of Environment, Ecologically Sustainable Industrial Development.

5 Hours

UNIT - 2

DYNAMICS OF GEO-ENVIRONMENT: Residence Time, Chemical Composition, Pools and Fluxes, Dynamics of the Processes of Geo-environment, Speciation, Anthropogenic Impact, Biogeochemical Cycles.

6 Hours

UNIT - 3

SOIL FACTOR OF ECOLOGY: Residual and Transported Soils, Weathering, Soil Texture, Soil Classification, Soil Moisture, Water Vapour, Organic Matter, Soil Microbes and Soil Erosion, Soil Conservation in India.

5 Hours

UNIT - 4

ENVIRONMENT OF SOILS: Soil Properties in Relation to Plant Growth, Soil Types in Relation to their Agricultural Potential, Soil Management for Sustainable Agriculture, Soil Management Scenarios for Developing Countries, Contamination of the Soils, Heavy Metal Pollution of the Soil.

6 Hours

PART - B

UNIT - 5

ENVIRONMENT OF SEDIMENTS: Introduction, Water Mixing Processes, Deposition of Sediments, Heavy Metals in Coastal Sediments, Heavy Metals in the Hydrocycle, Trace Metals in the Aquatic System, Quantification of Environmental Impact in Sediments.

8 Hours

UNIT - 6

MINING AND GEO-ENVIRONMENT: Introduction, Geological Characteristics in Relation to Mining, Acid Mine Drainage (AMD), Mercury Pollution due to Artisanal Gold Mining, Environmental Effects of Coal Mining Industry, Beneficial Use of Mining Wastes, Restoration of Mined Land.

10 Hours

UNIT - 7

POLLUTION OF GEO-ENVIRONMENT: Introduction, Underground Sources of Contamination, Septic Tank, Chemical Storage, Manure Pits, Landfills, Contaminated Ground and its Treatment, Methods of Waste Disposal, Planning of Waste Disposal Facility

6 Hours

UNIT - 8

GEO-ENVIRONMENT AND HEALTH: Geo-medicine. Essential Elements, Etiology of Diseases Related to Trace Elements, Trace Element Deficiency Disorders, Cardiovascular Diseases, Mining Environment and Health, Dusts and Health Risks.

6 Hours

REFERENCES:

1. **Geo-environment - An Introduction–** Aswathnarayana V. (1995) Capital Books Private Limited, New Delhi.
2. **Soil Pollution and Soil Organisms –** Mishra P.C. (1989), Ashish Publishing House, New Delhi.
3. **Soils in our Environment –** Miller R.W., Donahu R.L., (1997), Prentice Hall of India Private Limited, New Delhi.
4. **Environmental Geo-technology with Geo-synthetics –**Rao & Banerjee (1996), Proceedings of International Seminar and Techno Meet .
5. **Ecology** N.S. Subramanian, AUVS Sanbamurthy (2000), Narosa Publishing House, New Delhi.

DESIGN AND DRAWING OF ENVIRONMENTAL SYSTEMS – II

Subject Code	:	**06EVL77**	IA Marks	:	25
No. of Practical Hours/ Week	:	04	Exam Hours	:	03
Total No. Practical Hours	:	42	Exam Marks	:	50

PART - A

UNIT - 1

DESIGN & DRAWING OF STORM DRAINS: Street Inlet and L, V and Box Drains, Manhole. Design & Drawing of Septic Tank, Dispersion Trench and Soak Pit.

UNIT - 2

Design & Drawing of Grit Chamber and Screens. Hydraulic Profile of Wastewater Treatment Systems.

UNIT - 3

Layout drawing of typical wastewater plant
Design & Drawing of Secondary Treatment systems. ASP.

UNIT - 4

Design & Drawing of Trickling Filters, RBC, Bio Towers.

PART - B

UNIT - 5

Design Principles & drawing of Aerated Lagoon, Stabilization Ponds – Oxidation pond.

UNIT - 6

Design & Drawing of Anaerobic Digester & Sludge Drying Beds.

UNIT - 7

Design & Drawing of Sanitary Landfill for Municipal Solid Waste Disposalwith leachate & gas collection systems.

UNIT - 8

Design & Drawing of Air Pollution Control Systems – Settling Chambers, Cyclone separator, Bag Filter and Wet Scrubber.

REFERENCES:

1. **Wastewater Treatment Plants – Planning, Design and Operation –**Quasim, S.R., (1985), Holt Rinehart and Winston, CBS College Publishing.
2. **Sewerage & Sewage Treatment -** CPHEEO Manual, Government of India. Park D.,.
3. **Environmental Engineering – A Design Approach–** Sincero A.P., and Sincero G.A. (1999), Prentice Hall of Indial.
4. **Air Pollution Control Methods –** Park D

COMPUTER APPLICATIONS LABORATORY

Subject Code	:	**06EVL78**	IA Marks	:	25
No. of Practical Hours/ Week	:	03	Exam Hours	:	03
Total Practical Hours	:	42	Exam Marks	:	50

I. Introduction to DOS & UNIX operating system environment along with file handling commands (like- open, copy, rename, delete etc.)

II. Writing programmes in C-language & Running for the following.

1) Exercises on data sorting and searching, matrix operation, numerical Integration and curve fitting.
2) Exercises on statistical analysis of data – mean, median, std. Deviation & variance for grouped and ungrouped data.
3) Population forecast: AM, GM, incremental and logitic curve method.
4) Rising main design, pumping UNIT design and water distribution system (two to three loops).
5) Design of water and wastewater treatment units, sewer design and septic tank design.
6) DO model for river (streeter – phelps) and lake, river mixing zone water quality – critical point method.
7) Air quality system: Gaussian Plume model for gaseous and particulate dispersion, effective stack height determination and particulate control devices design.

II. Running following application software packages:

a. WAT PLANT and DOWATTS for treatment units.
b. WADISO, BRANCH, LOOP, QUALOOP and EPANET for water Distribution system.
c. RMAIN - water rising main design.
d. SEWER – sewer network design.
e. WRPLOT (USEPA) – Wind rose plot
f. ISCST / ISCLT (USEPA) versions air quality predictions from industrial sources.
g. CALINE (USEPA) versions model for air quality near Highways.

REFERENCES:

1. **Water Supply and Treatment –**(1993), CPHEEO Manual , New Delhi,
2. **Sewerage and Sewage Treatment –** (1993), CPHEEO Manual, New Delhi, **Software Package Manual on BRANCH, LOOP, SEWER –** UNDP/UNEP.

3. **WATPLANT and QUALOOP Softwares**. – CPHEEO – Manual.
4. **Relevant Software Manuals**– USEPA
5. **Air Pollution its origin and control** (1998)–Wark.K, Warner G.F. and Davis W.T , Addison- Wesley,
6. **Principles of surface water quality modeling and control** (1987.)– Thomann R.V. and Mueller J.A, Harper & Row Publishers,
7. **Environmental Engineering – A Design Approach** (1999.)– Sincerio A.P.& Sincerio G.A., PHI,

VIII SEMESTER

MANAGEMENT FOR ENVIRONMENTAL ENGINEERS

Subject Code	:	**06EV81**	IA Marks	:	25
No. of Lecture Hours/ Week	:	04	Exam Hours	:	03
Total No. of Lecture Hours	:	52	Exam Marks	:	100

PART - A

UNIT - 1

INTRODUCTION: Historical Perspective, Contribution of HL Gantt and others to the evolution of management as scientific discipline, recent trends, relevance of management science in the Indian context.

2 Hours

MANAGEMENT AND ITS FUNCTIONS: Definition of Management, Purpose, Types of Management, Project Manager and Key Roles, Time Management, Management Style – Autocratic and Group, SWOT, Motivation of Staff and key factors of effective Management. Institutional Development.

4 Hours

UNIT - 2

ENVIRONMENTAL LEGISLATION- Acts and rules related to Environmental Protection, Air, Hazardous Waste and Biomedical waste, Environmental protection Act. Command and Control Agencies Central, State, Individual Industry, NGO's.

6 Hours

UNIT - 3

TOTAL QUALITY MANAGEMENT IN ENVIRONMENTAL PROTECTION: ISO 14000 and 18000 series of standards, Preventive Environmental Policy. Environmental Audit: General Procedure, Types of Audit, Features, Effective Auditing.

8 Hours

UNIT - 4

Program Planning, Commitment by Management, Confidentiality, Audit Report of Action Plan, Water & Energy Audit, Case Studies.

6 Hours

PART - B

UNIT - 5

PROJECT FORMULATION & MANAGEMENT CONCEPTS: Levels of Projects, Characteristics, Classification and Implementation, Network analysis – Critical Path Method (CPM), Program Evaluation and Review Techniques (PERT).

8 Hours

UNIT - 6

ENGINEERING ECONOMICS AND CONTRACTS: Basic Concepts of Economics, Engineer – Contractor relationships, Types of Contracts, Contract procedures – Tenders and Various Deposits.

6 Hours

UNIT - 7

FINANCIAL MANAGEMENT: Basic Concepts in Accounting, Balance sheet, Profit – Loss Account, Water Traiff Fixation by various methods.
Purchasing and Stores: Purchasing Policies, Centralized and Decentralized Purchasing, budget and Payment Procedures, Function of Stores.

6 Hours

UNIT - 8

ENVIRONMENTAL ECONOMICS: Externalities, Internalization, Valuation Techniques, Social Cost, Analysis, Benefits & Costs of Pollution Control, Contingent Valuation of Economics. Personnel Management: Recruitment and Selection and Training Personnel, Employer – Employee Relationship, Authority and Delegation of Powers, Career Development, performance Appraisal, Leadership Qualities and Communication Skill.

6 Hours

REFERENCE BOOKS:

1. **Construction Planning Equipment and Methods** (1979)**–** Peurifoy R. L., , Mcgraw Hill.
2. **Environmental Quality Management** (1984)**–** Lohani B. N., , South Asian Publishers, New Delhi.,
3. **Management** 1989. Koontz and Weibrich, H McGraw Hill,
4. **Industrial Organisation and Engineering Economics –** Banga & Sharma.
5. **Environmental Economics** 2001- Ulaganathan Shankar, Oxford University Press.
6. **Environmental Management –**Richard Welford Corporate

WATER QUALITY ASSESSMENT IN NATURAL SYSTEMS

Subject Code	:	**06EV82**	IA Marks	:	25
No. of Lecture Hours/ Week	:	04	Exam Hours	:	03
Total No. of Lecture Hours	:	52	Exam Marks	:	100

PART - A

UNIT - 1

INTRODUCTION: Ultimate Disposal of Wastewater in Water Bodies and on Land. Merits and Demerits. Criteria and Standards for Disposal in Water Bodies and Land. Classification of Pollution – Point Source and Non-point source

5 Hours

UNIT - 2

WASTEWATER DISPOSAL IN RIVERS: Effects of Oxygen Demanding Waste, Bacteria and Nutrients. One and Two Dimensional Equations. Streeter - Phelph's Equation and Expressions for Critical Point.

6 Hours

UNIT - 3

Mixing Zone Concept, Steady state Stream Tube Model Equation for Bank Outfall, and Expression for Critical Point for Conservative and Exponentially Decaying Toxic Pollutants. Pipe and Diffuser Outfalls - Mixing Patterns, Merits and Demerits. Applications to Evaluate Impacts under different Treatment Options and Stream Flow Regimes, Impacts of Combined Toxic Pollutants.

6 Hours

UNIT - 4

WASTEWATER DISPOSAL IN LAKES: Steady state Dissolved Oxygen Analysis for completely Mixed and Stratified Lakes, Mass Balance Diagrams, Nutrient Loading Relationships.

8 Hours

PART - B

UNIT - 5

Wastewater Disposal in Estuaries: Characteristics of Estuarial Flow Regimes. 1-D Steady State Equation for fully mixed estuary. Impact of wastewater discharge on dissolved oxygen regime for different treatment options.

6 Hours

UNIT - 6

WASTEWATER DISPOSAL IN COASTAL ZONES OF OCEANS: One and Two Dimensional Equations. Outfall Design - Hydraulics of Diffusers and Design Example.

6 Hours

UNIT - 7

SUBSURFACE WATER QUALITY ASSESSMENT: Basic one and Two Dimensional Mass Balance Equations and their Analytical Solutions. Impacts of Point Source Discharges and Leachate from Land Fill Sites. Simple Problems.

7 Hours

UNIT - 8

IMPACT OF WASTEWATER APPLICATION ON LAND: Effects of Application Rates – Leaching Factor, Mode etc., on different types of Soils. Sodium Absorption Ratio (SAR). Microbiological Effects in different Soils with and without Treatment of Wastewater. Seasonal Effects. Design Problems.

8 Hours

REFERENCE BOOKS:

1. **Principles of water quality modelling and control** 1987 – Thomann and Mueller.
2. **Applied stream Sanitation –** Velz C.J.Freez A. and Cherry, Ground Water, Prentice Hall, (1979).
3. **Wastewater Engineering, Treatment and Disposal** (1995)– Metcalf and Eddy, , Tata McGraw Hill,.
4. **Surface Water Quality Modeling** –Steven C. Chopra (1997), McGraw Hill Inc.

ADVANCED ATMOSPHERIC ENVIRONMENTAL ENGINEERING

Subject Code	:	**06EV831**	IA Marks	:	25
No. of Lecture Hours/ Week	:	04	Exam Hours	:	03
Total No. of Lecture Hours	:	52	Exam Marks	:	100

PART - A

UNIT - 1

ATMOSPHERIC PROCESSES AND CHEMICAL REACTIONS: Definition of terms-aerosols, particle, photolysis, gas to particle conversion, condensation, evaporation, dissolution, sublimation, specific heat, conduction, radiation. Mechanical turbulence, forced convection, advection, equation of state, first law of thermodynamics. Reaction Rates (Gas Phase Species) Atmospheric gases and their molecular structures, chemical reactions and photo processes, reaction rates, reaction rate coefficients, sets of reactions, stiff systems.

6 Hours

UNIT - 2

ATMOSPHERIC BOUNDARY LAYER: Characteristics of atmospheric boundary layer-boundary layer depth, mean velocity power-law profile, Log-Law velocity profile, spectral description of turbulence, turbulence intensity, Reynolds stress parameter, spectral density function, integral length scale, inertial subrange and small scales. Turbulent fluxes of momentum, turbulent fluxes of energy and water vapor, friction velocity, surface roughness lengths, bulk aerodynamic equations for eddy diffusion, monin-obukhov similarity theory, eddy diffusion above the surface layer, ground surface temperature and moisture.

6 Hours

UNIT - 3

PHYSICAL MODELING - WIND TUNNEL SIMULATION: Similarity considerations for wind tunnel experiments-Reynolds number, Richardson number, Rossby number, Prandtl number. Atmospheric boundary layer simulation techniques in wind tunnel, passive devices, active devices. Case study – point and line source dispersion simulation in wind tunnel.

5 Hours

UNIT - 4

URBAN AIR QUALITY SIMULATION MODELING: General need, alternative approaches, basic model applications, general composition of models, Numerical modeling approaches-Gaussian diffusion models, physical basis of the mass conservation approach, mathematical foundation of the mass conservation approach. Inherent problem in air quality simulation modeling-boundary conditions, spatial resolution and compatibility with available data. Transportation related modeling-street canyon models, highway models, airport models. Air quality simulation models for Quasi-Inert pollutants-sulfur dioxide and particulate models, carbon monoxide models. Air quality simulation models for photochemical pollutants-background, features of photochemical air quality simulation models, model evaluation, model validation.

10 Hours

PART - B

UNIT - 5

DISPERSION OF HEAVY GASES: Introduction, characteristics of heavy gas flow, introduction to numerical modeling of heavy gas dispersion, requirements for physical models (non-dimensional parameters, choice of scaling variables).

6 Hours

UNIT - 6

MOBILE SOURCES OF POLLUTION: Introduction, emission standards for automobiles, Gasoline, origin exhaust emissions from gasoline engines,

crankcase and evaporative emissions, emission reduction by fuel changes, emission reduction by engine design changes, external reactors, Diesel engine emissions, Turbo jet engine and gas turbine engines, alternative fuels and their utilization.

6 Hours

UNIT - 7

INDOOR AIR POLLUTION: Introduction, the IAQ problem, diagnosis and remediation of IAQ problems, the interdisciplinary approaches. Industrial hygiene and its application to IAQ, industrial hygiene methodology. Indoor air quality and industrial hygiene, sampling, analysis and interpretation. Industrial hygiene methodology, architectural and construction aspects.

8 Hours

UNIT - 8

DESIGN OF INDUSTRIAL VENTILATION SYSTEMS: Introduction, ventilation by dilution, hood specifications, hoods of simple geometry, experimental velocity contours, complex hood design, duct design, fan selection and performance.

5 Hours

REFERENCE BOOKS:

1. **Fundamental of Atmospheric Modeling** (1999) – Jacobson. Z. A., Cambridge university press, Cambridge,
2. **Air Pollution** (1976) –Warren B. Johnson et. al. edited by Arthur C. Stern, third edition, Volume I, Academic Press, New York,
3. **Dispersion of Heavy Gases** – Krogstad and Jacobsen, Encyclopedia of Environmental Control Technologies, edited by Cheremioinoff, Volume-2, Rulf publishing company, Houston.
4. **Air Pollution Control Theory** (1980)– Crawford Martin, , Tata McGraw-Hill Publishing Company Ltd. New Delhi,
5. **Boundary Layer Meteorology** 1988 – Stull B. Roland, , Kluwer Academic Publishers,
6. **Guideline for Fluid Modeling of Atmospheric Diffusion** – Snyder H. William, , U.S. Environmental Protection Agency research Triangle Park, NC 27711.
7. **Air Pollution** (1998) – Wark K. –Warner C.F., and Davis. –W.T. Its origin and Control, Third Edition, Harper and Row Publication,
8. **Indoor Air Quality** (1995) – Steve M. Hays– Ronald V. Gobbell & Nicholas R. Ganick– Tata McGraw-Hill.

ENVIRONMENTAL MANAGEMENT SYSTEMS

Subject Code	:	**06EV832**	IA Marks	:	25
No. of Lecture Hours/ Week	:	04	Exam Hours	:	03
Total No. of Lecture Hours	:	52	Exam Marks	:	100

PART - A

UNIT - 1

ENVIRONMENT AND SUSTAINABLE DEVELOPMENT: Importance of Planning – local, regional, state and national planning concepts, site and location with reference to environmental pollution. Zoning – physical planning.

6 Hours

UNIT - 2

ECONOMICS OF POLLUTION CONTROL: Cost benefit ratios, total cost of development and environmental protection cost. Reliability and risk anlaysis, case studies on regional carrying capacity, National capital region – Delhi area.

8 Hours

UNIT - 3

ENVIRONMENTAL EDUCATION: Introduction, objectives, formal and non-formal education. Organizational structure for Environmental Management at central and state levels.

4 Hours

UNIT - 4

ACTS AND RULES RELATED TO ENVIRONMENTAL MANAGEMENT: Water, Air, Environmental protection, Wild life protection, Forest conservation, Motor vehicle act, Hazardous waste, Biomedical waste and Noise pollution.

10 Hours

PART - B

UNIT - 5

ENVIRONMENTAL PROTECTION: Economic development and social welfare consideration in socio-economic development policies and planning.

4 Hours

UNIT - 6

CLEANER TECHNOLOGIES AND THEIR ROLE IN ENVIRONMENTAL MANAGEMENT: Total Quality Management (TQM) in environmental management and protection, ISO – 14000 Series of standards.

6 Hours

UNIT - 7

INTERNATIONAL EFFORTS FOR ENVIRONMENTAL PROTECTION: Stockholm Conference – 1972, UNEP – 1982, control of transboundary movements and disposal of hazardous wastes, Earth Summit – 1992, Montreal Protocol, climate or green house control convention, Manila declaration.

8 Hours

UNIT - 8

ENVIRONMENTAL AUDIT: Air, water, soil and its importance in environmental management.

6 Hours

REFERENCE BOOKS:

1. **Planning and Design of Engineering Systems** – Danoy G.E., and Warner R.F. (1969), Unwin Hyman Publications.
2. **Environmental Protection** 1973 **–** Chanlet, Mc Graw Hill Publication.
3. **Environmental Quality Management** 1984**–** Lohani B.N,.South Asian Publishers New Delhi
4. **Environmental Sustainable Development –** UNEP / UNDP.
5. **A Text Book of Environmental Engineering –** Heinke et.al.
6. **Journal of Indian Association for Environmental Management, 1995-1997.**
7. **Carrying Capacity Based Developmental Planning Studies for the National Capital Region –** MOEF, Government of India (1995-1996). NEERI (1995 and 1996)., Nagpur, Annual Reports
8. **Environmental Engineering and Management –** Suresh K., and Dhameja (2000), S.K. Kataria & Sons.

HAZARDOUS WASTE TECHNOLOGY

Subject Code	:	**06EV833**	IA Marks	:	25
No. of Lecture Hours/ Week	:	04	Exam Hours	:	03
Total No. of Lecture Hours	:	52	Exam Marks	:	100

PART - A

UNIT - 1

INTRODUCTION: Definition, sources and classification, regulations for Hazardous Waste Management (Both India and USA).

6 Hours

UNIT - 2

CHARACTERISATION OF HAZARDOUS WASTE: Ignitability, corrosivity, reactivity, toxicity, quantification, designated hazardous waste, assessment of hazardous sites.

6 Hours

UNIT - 3

TOXICOLOGY AND RISK ASSESSMENT: Toxic effects, dose-response relationships, carcinogens, ecotoxicology, risk, exposure and toxicity assessment, risk characterization, ecological risk assessment.

8 Hours

UNIT - 4

WASTE MINIMIZATION AND RESOURCE RECOVERY: Approaches to waste reduction, development of a waste tracking system, selection of waste minimization process – case studies on by-product recovery – plating and solvent. Waste to waste compatibility for storage, treatment and disposal.

10 Hours

PART - B

UNIT - 5

PHYSICO-CHEMICAL AND BIOLOGICAL TREATMENT: Air stripping, soil vapour extraction, carbon absorption, steam stripping, stabilization and solidification – mechanisms, testing, field implementation, thermal methods – combustion, liquid injection incinerators, biological methods – conventional treatment, in-situ bio-remediation, slurry-phase treatment and solid phase treatment.

7 Hours

UNIT - 6

TRANSPORTATION OF HAZARDOUS WASTE: Regulations, containers for hazardous materials, bulk and non-bulk transport, hazardous substances emergency response.

4 Hours

UNIT - 7

LAND DISPOSAL: Landfill operations, site selection, liner and leachate collection systems, cover systems, contaminant transport through landfill barriers, landfill stability, closure and post-closure care, other types of land disposal facilities.

7 Hours

UNIT - 8

SITE REMEDIATION: Site assessment and inspection, remedial action, monitoring of disposal sites.

04 Hours

REFERENCE BOOKS:

1. **Hazardous Waste Management –** Lagrega M.D., Buckingham P.L., and Evans J.C. (1994), McGraw Hill International Edition.
2. **Hazardous Waste Management –** Wentz C.A. (1995), McGraw Hill International Edition.
3. **Hazardous Waste Management –** Dawson and Mercer (1981), John Wiley.

4. **Management of Hazardous Waste –** Cashman J.R. (1986), Technomic Publishing.
5. **Hazardous Waste Disposal –** Lehman (1983), Plenum Press.
6. **Hazardous and Toxic Materials: Safe Handling and Disposal** – Fawcett (1984), John, Wiley.

INDUSTRIAL WASTEWATER TREATMENT

Subject Code	:	**06EV841**	IA Marks	:	25
No. of Lecture Hours/ Week	:	04	Exam Hours	:	03
Total No. of Lecture Hours	:	52	Exam Marks	:	100

PART - A

UNIT - 1

INTRODUCTION: Sources of Industrial Wastewaters. Industrial Wastewater Survey. Use of Flow Diagrams for waste stream identification

4 Hours

UNIT - 2

VARIATION IN QUANTITY AND QUALITY OF INDUSTRIAL WASTEWATER: Monitoring, Estimation of average characteristics and mass load calculations.

6 Hours

UNIT - 3

TOXICITY OF INDUSTRIAL WASTEWATERS TO AQUATIC BIOTA: Testing Methods and Units, Biomonitoring of Effluents.

5 Hours

UNIT - 4

INDUSTRIAL WASTEWATER: Effects on receiving water bodies & land. Guidelines for discharge of effluents on land into municipal sewers and natural water.

6 Hours

PART - B

UNIT - 5

COMBINED TREATMENT: Raw Industrial Wastes and Domestic Wastewater after Mixing Partly or fully. Selection of Treatment Methods.

5 Hours

UNIT - 6

APPROACHES TO WASTE MINIMIZATION - Volume Reduction, Strength Reduction, Equalization, Neutralization and Proportioning and floatation Design Examples.

6 Hours

UNIT - 7

TREATABILITY STUDIES FOR INDUSTRIAL WASTEWATERS: Bench-scale & pilot scale studies. Estimation of Bio Kinetic Coefficients.

8 Hours

UNIT - 8

INDUSTRIAL WASTE - PROCESS LINE DIAGRAMS: Characteristics, Effects and Treatment of Industrial Wastes from - Sugar & Distilleries, Pulp & Paper, Pharmaceuticals, Tanneries and Food processing, Textile, Fertilizer, Steel & Dairy Industries. Wastewater Reuse and Waste Recovery from Different Industries.

12 Hours

REFERENCE BOOKS:

1. **Liquid Waste of Industry- Theories, Practice and Treatment** – Nemerow N.L. (1982), Addison Wesley.
2. **Wastewater Treatment –** Rao M.N., and Datta A.K. (1987), Oxford and IBM Publishers.
3. **Pollution Control in Process industry –** Mahajan S.P. (1987), TMH Co.
4. **Wastewater Engineering, Treatment and Reuse –** Metcalf and Eddy, (2003), 4th Edition, Tata McGraw Hill Edition, Tata McGraw Hill Publishing Co. Ltd.

NON-POINT POLLUTION SOURCES & MANAGEMENT

Subject Code	:	**06EV842**	IA Marks	:	25
No. of Lecture Hours/ Week	:	04	Exam Hours	:	03
Total No. of Lecture Hours	:	52	Exam Marks	:	100

PART - A

UNIT - 1

INTRODUCTION: Non-Point Sources of Pollution - Definition, Magnitude and Control laws, urban storm runoff, agricultural runoff, mining residues, leachate.

5 Hours

UNIT - 2

HYDRAULIC AND CONSIDERATIONS: Precipitation runoff, overland routing, interflow, groundwater flow, and surface water problems – waste assimilative capacity.

6 Hours

UNIT - 3

POLLUTION FROM ATMOSPHERE – Atmospheric inputs. Erosion and Sediment Yield – Definition, Sediment yield estimation, sediment delivery. Transport of pollutants and loading effects on soils, soil nitrogen and micro organisms.

7 Hours

UNIT - 4

GROUNDWATER POLLUTION – Sources, Ground Water movement, Factors influencing fate & transport of contaminants, groundwater quality, groundwater quality models (1, 2 & 3D models).

6 Hours

PART - B

UNIT - 5

POLLUTION FROM IMPERVIOUS URBAN AREAS – deposition and accumulation of pollutants from impervious surfaces, removal of solids from street surfaces, pervious pavements.

10 Hours

UNIT - 6

LANDUSE AND NON-POINT POLLUTION: Landuse effects on non-point sources of pollution, comparative assessment of pollutants from landuses, effect of hydraulic modifications.

8 Hours

UNIT - 7

BEST MANAGEMENT PRACTICES AND EFFECTIVE MANAGEMENT PRACTICES OF STORMWATER QUALITY – Introduction – Source control measures - ex-filtration trench, detention pond, swales.

6 Hours

UNIT - 8

PLANNING FOR CONTROL – Water quality planning process, selection of best alternatives, and strategy for non-point pollution control.

4 Hours

REFERENCE BOOKS:

1. **Hand Book on Nonpoint sources & Management** .(1995)**–** Novotney & Chesters,.
2. **Hazardous Waste Management–** Lagrega M.D., et.al, McGraw Hill Inc.
3. **Engineering Hydrology** (1985) **–** Subramanya K., Tata McGraw Hill, New Delhi
4. Linsley, Kohler & Palhus,
5. **Water & Wastewater Engineering –** Fair, Geyer & Okun (1968), Vol-I & II, John Wiley & Sons
6. **Water Quality & Treatment –** AWWA, Tata McGraw Hill.

RECYCLE AND REUSE TECHNOLOGY

Subject Code	:	**06EV843**	IA Marks	:	25
No. of Lecture Hours/ Week	:	04	Exam Hours	:	03
Total No. of Lecture Hours	:	52	Exam Marks	:	100

PART - A

UNIT - 1

WASTE AS A RESOURCE: Resource Economics, Disposable Materials, Recycling, Collection, Processing, Governmental Role in Waste Management, Potential for Reuse.

6 Hours

UNIT - 2

WASTE ANALYSIS: Sampling, Composition, Categorization, Determination of Waste Properties, Ash and Fines Analysis, Energy Content.

5 Hours

UNIT - 3

SYSTEM DESIGN: Design of Recycling Systems, Collection System, Process Train Design and Complexity, Product Design of Recycling, Conveyance, Transport Safety, Efficiency of Operation Systems.

8 Hours

UNIT - 4

WATER REUSE: Direct and Indirect Reuse, Intentional Reuse, Groundwater Recharge, Case studies of Water Reuse, Close Cycle and Open Cycle Reuse, Recreational Reuse.

8 Hours

UNIT - 5

ENERGY RECOVERY: Combustion, Energy Losses, Energy Recovery Analysis, Emission Control, Residue Control, In-plant Operations, Refuse Derived Fuel-cogeneration and tri generation concepts.

8 Hours

PART - B

UNIT - 6

METALS RECOVERY: Ferrous Metals, Properties, Principles of Magnetic Field-ferrous Material Interactions, Magnetic Separation Equipment, Non-ferrous Metal Separation, Eddy-Current Separation - Theory and Types, Extraction of Material from a Bed.

8 Hours

UNIT - 7

REUSE OF INDUSTRIAL EFFLUENT: Urban Effluent Reuse for Agriculture in Arid and Semiarid Zones, Uses of in Pisciculture, Groundwater Recharge using treated Domestic wastewater.

5 Hours

UNIT - 8

HEALTH ASPECTS OF WATER REUSE: Guidelines for Evaluating Recreational Water Reuse, Resource Conservation and Recovery Act.

4 Hours

REFERENCE BOOKS:

1. **Recycling and Resource Recovery Engineering –** Springer (1996), Springer – Verlag Berlin Heidelberg.
2. **Proceedings of the International Symposium ICE:** Reuse of Sewage Effluent (1985), Thomas Felford London.
3. **Water Reuse Problems and Solutions –** Dean R.B., and Lund E. (1981), Academic Press.
4. **Waste Recycling for Energy Conservation** – Kut D., and Hase G., John Wiley & Sons Inc.

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