I SEMESTER

APPLIED ENVIRONMENTAL CHEMISTRY AND MICROBIOLOGY

Subject Code	**: 08 CEE-11**	IA Marks	: 50
No. of Lecture Hrs/ Week	: 04	Exam Hrs	: 03
Total no. of Lecture Hrs.	: 52	Exam Marks	: 100

Importance of Environmental Chemistry, types of reactions, redox reactions, reaction kinetics. Electrochemistry and its applications.

Physical and equilibrium chemistry – fundamentals and applications.
Trace Contaminants and their analyses.

pH – Principle, Measurement, Numerical Examples, Buffers and Buffer index.

Colloidal Chemistry – Properties of colloids, colloidal dispersions, stability of colloids and applications.
Applications of Organic Chemistry in Environmental Engineering.

Colourimetry – Principles and applications.
Applications of Analytical Chemistry – emission and absorption techniques.

Microbiology - Microorganisms of importance in air, water and soil environment Principles and applications of microscopy, microscopic flora and fauna of importance.
Metabolism and metabolic pathways, Bioconcentration, Biomagnification and Bioaccumulation.

Bacteria – Morphology, typical growth curve and generation time, Measurement Techniques – APC, MPN (Probability and Thomas methods), MFT. Monod's equation and its applications.

Algae - Morphology, classification and their importance.

Fungi - Protozoa - morphology, classification and their importance.
Enzymes - classification, kinetics - Michaelis-Menten equation, factors influencing enzyme reaction.

Virology - Types, characteristics and enumeration methodology.

REFERENCES:

1. McKinney R.E.(1962) "**Microbiology for Sanitary Engineers**", Newyork McGraw Hill.
2. Sawyer C.N. and McCarty, P.L ., (2003), **"Chemistry for Environmental Engineering and Science**", 5th Edition, Tata McGraw Hill Publishing Co. Ltd., New Delhi,
3. Pelczar M.J ,Chan ECS, Krieg, NR(1998) 5th edition Tata McGraw Hill Publishing Co. Ltd., New Delhi, **Textbook of Microbiology**.
4. Gaudy and Gaudy (1980), "**Microbiology for Environmental Scientists and Engineers**", McGraw Hill.
5. APHA, (2002), "**Standard Methods for Examination of Water and Wastewater**"; 21st Edition.
6. Stumn and Morgan(1970), "**Aquatic Chemistry", John Willey & Sons Newyork**
7. **Journals:**
   1. **Internationl Journal of systematic & Evolutionary Microbiology**
   2. **Journal of Applied Microbiology**
   3. **Journal of Microbiological Methods**

WATER TREATMENT TECHNOLOGY

Subject Code	**: 08 CEE-12**	IA Marks	50
No. of Lecture Hrs/ Week	: 04	Exam Hrs	03
Total no. of Lecture Hrs.	: 52	Exam Marks	: 100

Introduction – Sources of water, necessity of treatment, Critical Water quality parameters, water quality guidelines and standards for various water uses.

Intake structures – Different types, design criteria.

Unit operations – principles and design of aeration systems – two film theory, water in air system, air in water system.

Principles of sedimentation – types of settling and settling equations, design criteria and design of settling tanks.

Principle of Coagulation and Flocculation – types of coagulants, coagulant aids, coagulation theory, optimum dose of coagulant, design criteria and numerical examples.

Filtration – theory, types, hydraulics of filter bed, design criteria and design of filters, filter backwash, operational problems and trouble shooting.
Adsorption Process – types, factors affecting adsorption, kinetics and equilibrium – different isotherm equations and their applications.

Unit processes - disinfection – different types, disinfectants, factors affecting disinfection, methods of disinfection, chemistry of chlorination.

Water Softening – Ions causing hardness, Langelier index, various methods.

Fluoridation and defluoridation – Principles and design.

Special requirements of industrial water supply.
Trace organic contaminants in water supplies and their removal.
Bench Scale and Pilot Plant studies in water treatment.
Rural Water Supply Systems.

REFERENCES:

1. Fair, G.M., Geyer J.C and Okun, (1969) "**Water and Waste water Engineering**" Vol II, John Wiley Publications.
2. Weber W.J., (1975) "**Physico - Chemical Processes for Water Quality Control**".
3. AWWA, (1971), "**Water Quality and Treatment** "McGraw Hill.
4. CPHEEO Manual, (1991), "**Water Supply and Treatment",** GO Publications.
5. Peavy, H.S., Rowe and Tchobonoglous,G., (1985), **"Environmental Engineering**", McGraw Hill.

ADVANCED COMPUTATIONAL METHODS AND OPTIMIZATION

Subject Code	**: 08 CEE-13**	IA Marks	: 50
No. of Lecture Hrs/ Week	: 04	Exam Hrs	: 03
Total no. of Lecture Hrs.	: 52	Exam Marks	: 100

Numerical Methods - Partial differential equations, Newton-Raphson method, Finite difference, finite element, method of characteristics, different methods, Successive over relaxation methods.

Optimization – classification and importance in Environmental Studies. Single and multivariable optimization without and with constraints.

Linear Programming – different methods, linear approximation of non-linear optimization.

Statistics and Probability - Frequency Distribution, Characteristics of Distributions , Binomial, Poisson and Normal distribution, Regression, Multiple regression, significance tests.

TEXT BOOKS:

1. Rao. S.S.(1979) **Optimization: Theory & Applications Techniques**, Wiley Eastern Ltd New Delhi.
2. Hamday A Taha(2007), "**Optimization Research":An introduction**, Pear son Prentice Hall, 8th Edition
3. Shanthakumar M.S., **Numerical Methods and Analysis**.

REFERENCES:

1. Ross S.M., "**Introduction to Probability and Statistics for Engineers and Scientists"**, John Wiley Publications.3rd Edition, Acedimic press
2. Stanton(1961) R.G –" **Numerical methods for science and engineers"**.Prentice Hall, Trade Edition
3. Kreyszig Erwin,9th Edition" **Advanced Engineering Mathematics"**, Wiley Eastern Publications.
4. Berthouex P M., Brown L. C., "**Statistics for Environmental Engineers"**, Lishers publication, 2nd Edition

WATER RESOURCES ENGINEERING AND APPLIED HYDRAULICS

Subject Code	**: 08 CEE-14**	IA Marks	50
No. of Lecture Hrs/ Week	: 04	Exam Hrs	03
Total no. of Lecture Hrs.	: 52	Exam Marks	100

Water resources of the world, India and Karnataka, National Water Policy.

Hydrology - Hydrologic cycle, estimation of missing precipitation and rain guage density.

Hydrograph theory - Unit hydrograph – derivation, flow routing, low flow analysis.

Urban Hydrology - Run-off estimation – IRRL Method, Design of Storm water Drains.

Basics and applications of Remote Sensing in water resources management.

Unsteady Flow through Conduits - Water hammer analysis, Water hammer protection methods - surge tanks.

Flow Measurements – A-V method, Weir method, flumes, end-depth method & chemical method

Groundwater - Basic equations of flow, confined and unconfined aquifers, sea water intrusion, artificial recharge, groundwater pollution, borewells - types & design principles.

REFERENCES:

1. Raghunath H.M.(1988), "**Advanced Hydrology**", Wiley Eastern Ltd New Delhi
2. Subramanya K.S(1994)., "**Advanced Hydrology".Tata Mc Graw Hill, New Delhi**
3. David Keith Todd(1980), "**Ground Water Hydrology**".2nd Edition John Wiley & Sons New Delhi
4. Sabins F.F(1997)., "**Remote Sensing – Principles and Interpretations**", W.H. Freeman & Co.
5. Anji Reddy, (2001), "**Remote Sensing and GIS**", B.S. Publications, Hyderabad.
6. Ven T. Chow (1988), "**Hand Book of Applied Hydrology**", 1st Edition Mc Graw Hill Publications
7. Hammer M.J, and Mackichan K.A., "**Hydrology and Quality of Water Resources**".
8. John Permankian, **"Water Hammer Analysis**".
9. Linsley, Franzini, Freyberg, Tchobanoglous G., "**Water Resources Engineering**", TATA McGraw Hill Series.
10. Linsley, Kohler and Paulhes, "**Hydrology for Engineers**", McGraw Hill.
11. Streeter and Wiley, "**Hydraulic Transients**", Ann Arbor Publications.

OCCUPATIONAL SAFETY AND HEALTH

Subject Code	**: 08 CEE-151**	IA Marks	50
No. of Lecture Hrs/ Week	: 04	Exam Hrs	03
Total no. of Lecture Hrs.	: 52	Exam Marks	100

Introduction, Occupational Safety and Health Act, Occupational Safety and Health Administration, Right to know Laws.

Accident – Causation, investigation methods and different models.

Ergonomics – need, Task Analysis, Preventing Ergonomic Hazards, Ergonomics Programme.

Occupational Hazard and Control - Hazard Analysis, Human Error and Fault Tree Analysis, Emergency Response.

Hazards and their control in different manufacturing and processing industries.

Fire Prevention and Protection - types of Fire, Fire Development and its Severity, Effect, Extinguishing Fire, Electrical Safety, Product Safety.

Occupational Health - Health and Safety Considerations, Personal Protective Equipment.

Health problems in different types of industries – construction, textile, steel and food processing, pharmaceutical, occuptupational Health and Safety considerations in Wastewater Treatment Plants.

REFERENCES:

1. Goetsch D.L., (1999), "**Occupational Safety and Health for Technologists**", Engineers and Managers", Prentice Hall.
2. Heinrich H.W., **"Industrial Accident Prevention",** McGraw Hill Publication , Newyork.
3. Colling D.A., "**Industrial Safety Management and Technology**", Prentice Hall, New Delhi.
4. Della D.E., and Giustina, (1996), "**Safety and Environmental Management**", Van Nostrand Reinhold International Thomson Publishing Inc.
5. CPHEEO **Manual on Sewage Treatment**.
6. National Safety Council and Associate (Data) Publishers Pvt. Ltd., (1991), "**Industrial Safety and Pollution Control Handbook**"

SOLID WASTE ENGINEERING AND MANAGEMENT

Subject Code	**: 08 CEE-152**	IA Marks	50
No. of Lecture Hrs/ Week	: 04	Exam Hrs	03
Total no. of Lecture Hrs.	: 52	Exam Marks	100

Land pollution and control - necessity and importance.

Solid waste – sources and engineering classification, characterization, generation and quantification.

Transport - collection systems, collection equipment, transfer stations, collection route optimization.

Treatment methods - various methods of refuse processing, recovery, recycle and reuse, composting, incineration, pyrolysis and energy recovery-design examples.

Disposal methods – Impacts of open dumping, site selection, sanitary land filling – design criteria and design example, leachate and gas collection systems, leachate treatment.

Recent Developments in Solid Wastes Reuse and Disposal – Power Generation, Blending with construction materials and Best Management Practices (BMP).

Role of various organizations in Solid Waste Management – Governmental, Non-Governmental, Citizen Forums.

Biomedical Waste management – sources, treatment and disposal

REFERENCES:

1. Tchobanoglous G., Theissen H., and EIiassen R.(1991), **"Solid Waste Engineering - Principles and Management Issues**", McGraw Hill, New York.
2. Pavoni J.L(1973)., "**Handbook of Solid Waste Disposal**".
3. Peavy, Rowe and Tchobanoglous (1985), "**Environmental Engineering**", McGraw Hill Co. 4th Edition
4. Mantell C.L., (1975), "**Solid Waste Management**", John Wiley.
5. CPHEEO Manual on Solid Waste Management.
6. WHO Manual on Solid Waste Management.
7. Vesiland A., "**Solid Waste Engineering**", Thompson Books.
8. Hazardous waste (management and handling) rules, 2001

REMOTE SENSING AND GIS IN ENVIRONMENTAL ENGINEERING

Subject Code	**: 08 CEE-153**	IA Marks	50
No. of Lecture Hrs/ Week	: 04	Exam Hrs	03
Total no. of Lecture Hrs.	: 52	Exam Marks	100

Remote Sensing: Definition – Ideal Remote Sensing System – Sensors and Types – Remote Sensing Satellite – IRS and INSAT specifications – Applications of remote sensing – DIP Techniques.

GIS: Definition – Data and Types – Sources of data - Global Positioning System (GPS) – Data Structure – Types of Analysis – Errors – Applications of GIS.

Environmental Applications of RS and GIS:

- Optimal Routing of Solidwastes using GIS – Case Study.
- Environmental Siting of Industries and Zoning Atlas Development using Remote Sensing Data and GIS - Case Study.
- Re-modelling of Water Distribution System using GIS – Case Study.
- Sustainable Urban Development Planning using GIS.
- Environmental Degradation Assessment using RS and GIS.

REFERENCES:

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

II SEMESTER

ATMOSPHERIC ENVIRONMENTAL POLLUTION AND CONTROL

Subject Code	**: 08 CEE-21**	IA Marks	: 50
No. of Lecture Hrs/ Week	: 04	Exam Hrs	: 03
Total no. of Lecture Hrs.	: 52	Exam Marks	: 100

Introduction: sources, effects on – ecosystems, characterization of atmospheric pollutants, air pollution episodes of environmental importance.

Meteorology - composition and structure of the atmosphere, wind circulation, solar radiation, lapse rates, atmospheric stability conditions, wind velocity profile, Maximum Mixing Depth (MMD), Temperature Inversions, Windrose diagram.

Monitoring of particulate matter – respirable, non-respirable and nano - particulate matter.

Monitoring of gaseous pollutants – CO, CO_2, Hydrocarbons (HC), SO_X and NO_X, photochemical oxidants.

General characteristics of stack emissions, plume behaviour, heat island effect.

Pollutants dispersion models – description and application of point, line and areal sources.

Air Pollution Control equipment for particulate matter – gravity settling chambers, centrifugal collectors, wet collectors, fabric filters, electrostatic precipitator (ESP).

Air Pollution Control Equipment for gaseous pollutants – adsorption, absorption, scrubbers, condensation and combustion.

Indoor Air Pollution – sources, effects and control.

Noise - sources, measurements, effects and occupational hazards. Standards, Noise mapping, Noise attenuation equations and methods, prediction equations, control measures, Legal aspects of noise.

REFERENCES:

1. Wark K ., Warner C.F., and Davis W.T., (1998), "**Air Pollution - Its Origin and Control**", Harper & Row Publishers, New York.

2. Lee C.C., and Lin S.D., (1999), **"Handbook of Environmental Engineering Calculations**", McGraw Hill, New York.
3. Perkins H.C.(1974), "**Air Pollution**", McGraw Hill.
4. Crawford M.,(1976) "**Air Pollution Control Theory**", TATA McGraw Hill.
5. Stern A.C., "**Air Pollution**", Vol I, II, III.
6. Seinfeld N.J., (1975), "**Air Pollution",** McGraw Hill.
7. Stern A.C.(1968), (ed) Vol. V, "**Air Quality Management**".

ECOLOGY AND ENVIRONMENTAL IMPACT ASSESSMENT

Subject Code	**: 08 CEE-22**	IA Marks	50
No. of Lecture Hrs/ Week	: 04	Exam Hrs	03
Total no. of Lecture Hrs.	: 52	Exam Marks	100

Ecology - Classification of Ecosystems, Structure and Function of Ecosystems, Energy flow in Ecosystems, Ecological Niche and succession, Biogeochemical cycles, Ecological Pyramids.

Aquatic and Terrestrial Ecosystems - Diversity and dominance Indices, Ecosystem Models.

Lake Ecosystem – trophic levels, nutrient loading, nutrient enrichment, Leibig's Law, control of eutrophication.

Environmental Impact Assessment – Definition, Objectives, Types - Rapid and Comprehensive EIA, EIS, FONSI. Step-by-step procedure for conducting EIA and Limitations of EIA, Prevention of Significant Deterioration (PSD) Programme.

Frame work of Impact assessment, scope and contents of EIA, methodologies and techniques of EIA.

Attributes, Standards and Value functions.

Public participation in EIA.

Environmental Management Plan (EMP) and Disaster Management Plan (DMP).

EIA Case Studies –Thermal Power Plant, Mining, Fertilizer, Construction Projects, Air port, Water and Wastewater Treatment Plants.

REFERENCES:

1. Kormondy, (1960), "**Concepts of Ecology**", Prentice Hall Publication.
2. Odum, (1961), "**Fundamentals of Ecology",** Adisson Co.
3. Krebs J., "**Ecology - The Experimental Analysis of Distribution and Abundance**", I Edition, Harper International.
4. Mall C.A.S., and Day J.W., "**Ecosystem Modeling in Theory and Practice: An Introduction with Case Histories**", John Willey.
5. Canter L., (1995), "**Environmental Impact Assessment**", McGraw Hill.
6. Jain R.K., Urban L.V., Stacey G.S., (1977), "**Environmental Impact Analysis – A New Dimension in Decision Making**", Van Nostrand Reinhold Co.
7. Clark B.C. Bisett and Tomlinson P , (1985), "**Perspective on Environmental Impact Assessment**", Allied Publishers.
8. Rau and Wooten, (1981), "**Environmental Impact Assessment**" Handbook.
9. **Journals** :
    1. International Journal of Sustainable Development & World Ecology
    2. Impact Assessment (Quaterly Journal)
    3. Assessment of Jl of Environmental Management
    4. Jl of Ecology, Impact assessment & Environmental Planning

WASTEWATER TREATMENT ENGINEERING

Subject Code	**: 08 CEE-23**	IA Marks	: 50
No. of Lecture Hrs/ Week	: 04	Exam Hrs	: 03
Total no. of Lecture Hrs.	: 52	Exam Marks	: 100

Objectives of wastewater treatment, characteristics, flow variations, types of reactors and reactors analysis.

Wastewater Treatment Flow Diagrams and Hydraulic Profile.

Theoretical principles and design - screens, equalization basin, grit chamber, primary and secondary settling tanks.

Wastewater treatment – aerobic, anaerobic, suspended and attached growth systems.

Kinetics of biological treatment systems – biokinetic constants and their determination, batch and continuous systems.

Theoretical principles and design – suspended growth system - conventional activated sludge process and its modifications.

Theoretical principles and design – attached growth system - trickling filter, bio-towers and rotating biological contactors.

Principles and design of stabilization ponds

Sludge Processing – separation - sludge thickeners, volume reduction, conditioning and digestion – aerobic and anaerobic.

Nitrification and Denitrification Processes, Phosphorous removal.

Wastewater disinfection.

Rural wastewater systems – septic tanks, two-pit latrines, eco-toilet, soak pits.

Advanced Wastewater Treatment – Need and technologies used.

REFERENCES:

1. Benefield R.D., and Randal C.W., (1980), **"Biological Process Design for Wastewater Treatment"**, Prentice Hall, Englewood Chiffs, New Jersey.
2. Metcalf and Eddy Inc., (2003), **"Wastewater Engineering - Treatment and Reuse",** 4th Edition, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
3. Karia G.L., and Christian R.A., (2001**), "Wastewater Treatment Concepts and Design Approach",** Prentice Hall of India Pvt. Ltd., New Delhi.]
4. **Ronand L., and Droste, (1997),"Theory** and Practice of Water and Wastewater Treatment", John Wiley and Sons Inc.
5. Fair G.M., Geyer J.G and Okun, "**Water-wastewater Engineering**".
6. Lee C.C., and Lin S.D., (1999), **"Handbook of Environmental Engineering Calculations",** McGraw Hill, New York.
7. Gaudy,(1972) "**Advanced Wastewater Treatment".**

8. National Safety Council and Associate (Data) Publishers Pvt. Ltd., (1991), **"Industrial Safety and Pollution Control Handbook"**

TRANSPORT PROCESSES AND MODELLING - AQUATIC SYSTEMS

Subject Code	**: 08 CEE24**	IA Marks	: 50
No. of Lecture Hrs/ Week	: 04	Exam Hrs	: 03
Total no. of Lecture Hrs.	: 52	Exam Marks	: 100

Modelling – Introduction, applications in environmental management.

Physical phenomena – advection, diffusion, dispersion, Fick's laws of diffusion and convective - diffusion equations for turbulent & shear flow regimes.

Steady-state water quality modelling - models for conservative and non-conservative substances.

Data collection and analysis - specialized water quality surveys, estimation of decay and reareation rates.

1-D Oxygen balance models - Streeter-Phelps equation, critical point method.
Calibration and verification of 1-D oxygen model. Error measures.

Mixing zones in rivers – types of outfalls and mixing regimes. Steady-state 2-D analysis. Field study methodology. Parameter estimation - lateral mixing co-efficient - critical point method – simple numerical problems.

Dissolved oxygen models for lakes under completely mixed and stratified conditions.

Eutrophication models - simplified nutrient loading models for rivers and lakes.

Ocean disposal of wastewater - Siting and design of outfalls.

REFERENCES:

1. Rich L.G., **"Environmental Systems Engineering",** McGraw Hill.
2. Thomann R.V., and Mueller J.A., (1987), **"Principles of Water Quality Management and Control"**, Harper & Row Publications.

3. Schnoor J.L., **"Environmental Modelling – Fate and Transport of Pollutants in Water, Air and Soil**", John Wiley and Sons.
4. Thomann R.V., (1980), **"Systems Approach to Water Quality Management"**, McGraw Hill.
5. Lee C.C., and Lin S.D., (1999), **"Handbook of Environmental Engineering Calculations"**, McGraw Hill, New York.

ENVIRONMENTAL PLANNING AND MANAGEMENT

Subject Code	**: 08 CEE-251**	IA Marks	50
No. of Lecture Hrs/ Week	: 04	Exam Hrs	03
Total no. of Lecture Hrs.	: 52	Exam Marks	100

Environment and Sustainable Development - carrying capacity, relationship with quality of life, carrying capacity and resource utilization.

Engineering Methodology in Planning and its Limitations - carrying capacity based short and long term regional planning.

Environmental Protection - Economic development and social welfare consideration in socio economic developmental policies and planning.

Total cost of development and environmental protection cost. Case studies on Regional carrying capacity.

Engineering Economics – Value Engineering, Time Value of Money, Cash Flows, Budgeting and Accounting.

Environmental Economics: Introduction, economic tools for evaluation, Green GDP

Cleaner development mechanisms and their applications.

Environmental Audit – methods, procedure, reporting and case studies.

Total Quality Management in environmental management and protection – ISO 9000, 14000 and 18000 series of standards.

REFERENCES:

1. Lohani B.N (1984)., "**Environmental Quality Management**",South Asian Publishers, New Delhi
2. Chanlett, (1973)"**Environmental Protection**", McGraw Hill Publication, Newyork.

3. Danoy G.E., and Warner R.F., (1969), "**Planning and Design of Engineering Systems**",Unwin Hyman Publications.
4. MOEF, Government of India, "**Carrying Capacity Based Developmental Planning Studies for the National Capital Region"**, 1995-96.
5. NEERI, Nagpur, Annual Reports 1995 & 1996.
6. UNEP / UNDP – "**Environmental Sustainable Development**".

HAZARDOUS WASTES MANAGEMENT

Subject Code	**: 08 CEE252**	IA Marks	: 50
No. of Lecture Hrs/ Week	: 04	Exam Hrs	: 03
Total no. of Lecture Hrs.	: 52	Exam Marks	: 100

Introduction, Sources, Classification, Regulations for Hazardous Waste Management.

Hazardous Waste Characterization, Designated Hazardous Wastes.

Waste Minimization and Resource Recovery – Approaches, Development of a Waste Tracking System, Selection of waste Minimization Process, Case Studies.

Transportation of Hazardous Waste – requirements, regulations, containers, bulk and non-bulk transport, Emergency Response.

Physico-chemical, Chemical and Biological Treatment of hazardous waste.

Thermal treatment - Incineration and pyrolysis.

Sanitary landfill – design approach, leachate and gaseous collection system.

Facility Siting and Process Selection for treatment, storage, disposal facility (TSDF).

Soil contamination and site remediation – bioremediation processes, monitoring of disposal sites.

REFERENCES:

1. Lehman, (1983), **"Hazardous Waste Disposal"**, Plenum Press.
2. Lagrega M.D., Buckingham P.L., and Evans J.C., (1994), **"Hazardous Waste Management**", McGraw Hill International Edition.

3. Wentz C.A., (1989), "**Hazardous Waste Management**", McGraw Hill.
4. Dawson and Mercer, (1981), **"Hazardous Waste Management**", John Wiley.
5. Fawcett, (1984), "**Hazardous and Toxic Materials: Safe Handling and Disposal"**, John Wiley.
6. National Safety Council and Associate (Data) Publishers Pvt. Ltd., (1991), "**Industrial Safety and Pollution Control Handbook"**

HYDRAULICS OF WATER AND WASTEWATER SYSTEMS

Subject Code	**: 08 CEE-253**	IA Marks	: 50
No. of Lecture Hrs/ Week	: 04	Exam Hrs	: 03
Total no. of Lecture Hrs.	: 52	Exam Marks	: 100

Water Supply System – Introduction – types of systems, population forecasting methods, water demand, pressure, design period, pipe materials and roughness coefficient.

Storage Reservoirs – Need, different types, capacity determination and evaluation of pumping systems.

Pipe Networks – Peak factors for intermittent and continuous distribution system. Branch and Grid Iron systems. Nodal demand, Design Layouts of distribution systems, Evaluation of distribution system - Computer Analysis of Pipe Networks for different options, Economic Analysis of Pipelines and Networks.

Leak Detection – Prediction, Prevention and Control.

Water Quality in Distribution System – factors affecting water quality, predictive tools and intermediate disinfection.

Wastewater Collection System – Separate and Combined Sewer Systems, relevant equations for flow conditions, pipe materials and roughness coefficient, design guidelines and examples. Sewer Appurtenances,

Sewer Network – Estimation of Nodal Flows, Pumping Stations, Evaluation of Different Network Options.

Storm Sewers – flooding and water quality problems, run-off calculations, storm water inlets, open drains and sewer pipes and design for different layouts.

REFERENCES:

1. Sincero A.P., and Sincero G.A., (1999), "**Environmental Engineering – A Design Approach",** Prentice Hall of India Pvt. Ltd., New Delhi.Hammer M.J., and Hammer Jr. M.J., (2008),
2. **"Water and Wastewater Technology**", Prentice Hall of India Pvt. Ltd., New Delhi.
3. Walski T.M., (1987), "**Analysis of Water Distribution Systems**", CBS Publications, New Delhi.
4. CPHEEO **Manual on Water Supply and Treatment**, (1991), GOI Publications.CPHEEO Manual on Sewerage and Sewage Treatment, (1995), GOI Publications.

III SEMESTER

COMPUTER AIDED DESIGN OF ENVIRONMENTAL SYSTEMS

Subject Code	**: 08 CEE-31**	IA Marks	: 50
No. of Lecture Hrs/ Week	: 04	Exam Hrs	: 03
Total no. of Lecture Hrs.	: 52	Exam Marks	: 100

Importance and necessity of Computer Aided Design (CAD) in environmental studies.

Design of - rising main, pumps, service reservoir, water distribution network and water treatment units.

Design of sewer network and wastewater treatment units.

Prediction of surface water quality – DO, conservative and non-conservative pollutants.

Design of stack height, ground level concentration profiles using Plume Models.

Geographical Information System (GIS) - Components, Applications, Benefits, Operations and Modelling.

Introduction to Computer graphics and Data Base Management System (DBMS).

REFERENCES:

1. Krishna Murthy C.S. and S. Rajeev "**Computer Aided Design software and analytical tools**"- Norosa Publishing House, 1998.

2. **"CPHEEO Manual in water supply and treatment**" -New Delhi 1993.
3. **"CPHEEO Manual on sewerage and sewage treatment**, New Delhi 1993.
4. Thomann R.V. and Mueller J.A. **"Principles of surface water quality modeling and control",** Harper Int. Edition.

NON – POINT SOURCES OF POLLUTION AND MANAGEMENT

Subject Code	**: 08 CEE-321**	IA Marks	: 50
No. of Lecture Hrs/ Week	: 04	Exam Hrs	: 03
Total no. of Lecture Hrs.	: 52	Exam Marks	: 100

Introduction – Nonpoint Pollution, Problem, definitions, magnitude of Nonpoint Pollution, Nonpoint Pollution Control Laws

Surface Water Problems - Introduction Waste Assimilative Capacity and Stream Standards

Pollution From the Atmosphere – Atmospheric Inputs

Groundwater Pollution – Groundwater (Base Flow) and Nonpoint Pollution Groundwater Movement, Origin of Groundwater Quality
Sources of Groundwater Contamination

Pollution from impervious urban areas – Introduction Deposition and Accumulation of Pollutants on Impervious Surfaces
Removal of Solids from street Surfaces, Porous Pavement.

Non point Pollution Simulation Models- Basic Concepts Brief Description of available Nonpoint Pollution Simulation Models

Land use and nonpoint pollution - use Effects on Nonpoint Pollution Comparative Assessment of Pollution Impact from land uses
Effect of hydrologic Modifications

Management Practices of Nonpoint pollution control- Introduction Source Control Measures Collection Control and Reduction of Dilvery

Planning for Nonpoint Pullution Control – Introduction, Water Quality Planning Process, Selection of Best Management Practices for Non Point Source Pollution Control

REFERENCES:

1. Hand Book of "**Water Quality Management Planning"**, Edited by Pavoni J L, Van Nostrand Reinhold Environmental Engineering Series.
2. Pluarg, Pollution from Land Use Activities Reference Group Novotny V and Chesters G, (1981), "**Hand Book of Non-point Pollution, Sources and Management"**, Van Nostrand Reinhold Company.

INDUSTRIAL WASTEWATER TREATMENT

Subject Code	**: 08 CEE-322**	IA Marks	: 50
No. of Lecture Hrs/ Week	: 04	Exam Hrs	: 03
Total no. of Lecture Hrs.	: 52	Exam Marks	: 100

Effects of Industrial Wastes on sewerage system and sewage treatment plants and receiving water bodies. Effluent standards and receiving water quality standards. Different aspects and choices of various alternatives
Treating different effluent streams separately, Treating diffeent streams jointly after mixing them partly or fully, Treating industrial Wastewater along with Municipal Wastes.

Industrial Waste survey-Process flow charts, condition of waste stream. Material balance, Sampling – Grab, Composite and integrated samples. Continuous monitoring – pH, Conductivity, Biomonitoring.

Pretreatment of Industrial Wastewater – Volume reduction, Strength reduction, Neutralization, Equalization and Proportion, Removal of Organic and inorganic dissolved solids.

Wastewater Treatment in specific industries: Distrillery, Sugar, Pulp and paper, Cement, Textile, Dairy, Fertilizer, Pesticides, Pharmaceutical, Radio Active Wastes treatment- Low activity and high activity waste waters Ultimate disposal of Industrial Wastewater, effects of waste additions on physical and chemical properties of soil, Bio-Remediation of Distillery, Sugar, Refinery and Diary Industries.

Design of complete treatment system & disposal for industries: Distillery, Diary, Textile, paper and pulp mill to meet P.C.B. norms.

Environmental Auditing: Introduction, Cost of Pollution, Environmental audit solutions, Financial and Managerial opportunities. Criminal and Regulatory liabilities.

REFRENCES:

1. Nelson N Nemerow – "**Liquid Waste of industry theories,** "Practices and Treatment. Addison Willey New York.
2. Nardam S Azad – "**Industrial Wastewater Management Hand Book"** McGraw Hill book Co., Newyork.
3. Ross R.D. – "**Industrial Waste Disposal"**, Reinhold Environmental Series – New York.
4. **"Dickinson"**- Practical Waste Treatment and Disposal Applied Science publication, London.
5. Mahajan (1984) –" **Pollution control in Process industries"**. TMH, New Delhi.
6. Self N.J – "**Industrial pollution Control."**
7. Eckenfelder- "**Industrial Water pollution Control"-** McGraw hill Company, New Delhi American Chemical Society, Washington D.C. USA/Gaynor W Dawson,
8. let al – "**Hazardous Waste Management"-** A Wiley-IInterscience Publication, New York.
9. James F parr et al – "**Land Treatment of Hazardous Wastes"-** Noyes Data Corporation, Parkridge, New Jersey, USA.

ADVANCED ATMOSPHERIC ENVIRONMENTAL ENGINEERING

Subject Code	**: 08 CEE-323**	IA Marks	: 50
No. of Lecture Hrs/ Week	: 04	Exam Hrs	: 03
Total no. of Lecture Hrs.	: 52	Exam Marks	: 100

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.

Atmospheric Boundary Layer: Characteristics of atmospheric boundary layer-boundary layer depth, mean velocity power-law profile, Log-Log 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 vapour, 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.

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.

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).

Mobile Sources of Pollution: Introduction, emission standards for automobiles, Gasoline, origin exhaust emissions from gasoline engines, crankcase and evaporative emissions, alternative fuels and their utilization.

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.

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.

REFERENCES:

1. Jacobson. Z. A., **Fundamental of Atmospheric modeling,** Cambridge University press, Cambridge, 1999.
2. Warren B. Johnson et. al. , **Air Pollution**, Arthur C. Stern, third edition, Volume I, Academic Press, New York, 1976.
3. Krogstad and Jacobsen, **Dispersion of heavy gases, in encyclopedia of environmental control technologies**, edited by Cheremioinoff, Volume-2, Rulf publishing company, Houston,

4. Crawford Martin**, "Air pollution control theory"**, Tata McGraw-Hill publishing company Ltd. New Delhi, 1980.
5. Stull B. Roland, **Boundary Layer Meteorology**, Kluwer Academic Publishers, 1988.
6. Snyder H. William, "**Guideline for fluid modeling of atmospheric diffusion",** U.S. Environmental Protection Agency research Triangle Park, NC 27711.
7. Wark K., Warner C.F., and Davis. W.T., Air Pollution, "**its origin and control**" third edition, Harper and Row Publication, 1998.
8. Steve M. Hays, Ronald V. Gobbell & Nicholas R. Ganick, "**Indoor Air Quality"-** Tata McGraw-Hill, 1995.

OPERATION AND MAINTENANCE OF ENVIRONMENTAL FACILITIES

Subject Code	**: 08 CEE-331**	IA Marks	50
No. of Lecture Hrs/ Week	: 04	Exam Hrs	03
Total no. of Lecture Hrs.	: 52	Exam Marks	100

Importance of Operation & Maintenance: Basic Principles, Objectives, Requirements, Corrective and Preventive Maintenance.

Data Base of Facilities for O&M – Detailed Plans, Drawings, Operation Manuals, Record keeping, standard operating procedure and Computer Applications in O&M.

Operation & Maintenance Planning - Organisational Structure, Work Planning, Preparation and Scheduling, Cost Estimates.

O&M of Water Supply Facilities: Operational Problems and Corrective Measures in Different Units of Treatment. Use of Network Models – CPM and PERT.

O&M of Wastewater Facilities: Operational Problems and Corrective Measures in Different Units of Treatment.

O&M of Air Pollution Control Facilities: Operational Problems and Corrective Measures in Different Units of Treatment.

REFERENCES:

1. Metcalf and Eddy Inc., (2003), "**Wastewater Engineering-Treatment and Reuse**", 4th Edition, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
2. Hammer M.J., and Hammer Jr. M.J., (2008), "**Water and Wastewater Technology**"- Prentice Hall of India Pvt. Ltd., New Delhi.
3. CPHEEO Manual., (1991) "**Water Supply & Treatment**", GOI Publication.
4. CPHEEO Manual., (1995) on **Sewerage & Sewerage Treatment,** GOI Publication,.
5. Training Manual on O&M for Municipal Staff, **Asian Development Bank Project**, Government of Karnataka.
6. National Safety Council and Associate (Data) Publishers Pvt. Ltd., (1991), "**Industrial Safety and Pollution Control Handbook"**

TOXICOLOGY & ENVIRONMENTAL RISK ASSESSMENT

Subject Code	**: 08 CEE-332**	IA Marks	: 50
No. of Lecture Hrs/ Week	: 04	Exam Hrs	: 03
Total no. of Lecture Hrs.	: 52	Exam Marks	: 100

Introduction to toxicology – Significance, Applications, & Importance

Introduction to risk assessment, toxicology – exposure, toxic effects, dose response relationships, carcinogens and non-carcinogens.

Toxicology & Epidemiology, public health & Risk assessment,toxicology & risk assessment, Epidemiology & risk assessment. Human exposure assessment, characterization of health risks.

Hazard identification, exposure and toxicity assessment, Risk caracterization, risk communication, ecological risk assessment – Monte Carlo methods, case studies.

REFERENCES:

1. LaGrega M.D., Buckingham P.L. and Evans J.C.(1994), "**Hazardous Waste Management"-** McGraw Hill, New York
2. David G.M, and Haner N.B., "**An Applied Approach to Epidemiology and Toxicology for Engineers"** – Instructor's Resource Guide, US Department of Health Education and Welfare.

3. World Health Organization Report," **Recommended Health Based Limits in Occupational Exposure to Heavy Metals"**
4. Kamrin S. E., "**A text book on Primer on Toxicology Principles & Applications"** Lewis Publishers.
5. Kalos M.H., and Whitloc P.A., Monte Carlo Methods, Vol. 1, Basics, Wiley Publications.
6. Fan A.M & Chang L.W, (1996), "**Toxilogy & Risk Assessment-Principles , Methods & Applications",** Informa Health Care pubs.
7. Price F.T, Nancy Lane, Briq K.V, (2000), "**Environmental Toxiology & Risks Assessment – Recent Advancement in Environmental Fate & Transport ", ASTM International**
8. Landis W.G., Ming-Ho Yu, (2004), "**Introduction to Environmental Toxicology - Impacts of Chemicals upon Ecological Systems", CRC Press**

RECYLE AND REUSE TECHNOLOGY

Subject Code	**: 08 CEE-333**	IA Marks	: 50
No. of Lecture Hrs/ Week	: 04	Exam Hrs	: 03
Total no. of Lecture Hrs.	: 52	Exam Marks	: 100

Waste as a Resource: Resource Economics, Disposable Materials, Recycling Collection, Processing, Governmental Role in Waste Management, Potential for Reuse.

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

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

Water reuse: Direct and indirect Reuse, intentional Reuse, groundwater Recharge, Examples of Water reuse, Close Cycle and Open Cycle Reuse Recreational Reuse.

Energy Recovery: Combustion, energy losses, Energy recovery Analysis, Emission Control, In-Plant Operations, Refuse Derived Fuel.

Metals Recovery: Ferrous Metals, Prosperities, 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.

Reuse of Industrial Effluent: Urban Effluent Reuse for Agriculture in Arid and Semiarid Zones. Uses of Sewage in Pisciculture, Groundwater recharge of Sewage Effluents, Reuse for Amenity.

Health Aspects of Water Reuse: guidelines for Evaluating recreational Water Reuse, Resource Conservation and Recovery Act.

REFERENCES:

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