

**SCHOOL OF ENGINEERING**

**SYLLABUS AND COURSE STRUCTURE**

**M. TECH (ENVIRONMENT ENGINEERING)**

**ACADEMIC YEAR 2020-21**

**M.Tech. (Environment Engineering)**

**Code & Subject Scheme**

**Semester I**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Code** | **Subject** | **Contact Hours/Week** | | | **Total Credits** |  |
| **L** | **T** | **P** |
| MCI061A | Applied Environmental Chemistry and Microbiology | 4 | 0 | 0 | 4 | C |
| MCI062A | Water Treatment Technology | 4 | 0 | 0 | 4 | C |
| MCI063A | Water Resources Engineering  And Applied Hydraulics | 4 | 0 | 0 | 4 | C |
| MCI064A | Remote Sensing and GIS in Environmental Engineering | 4 | 0 | 0 | 4 | C |
| MCI065A | Environmental Lab-I | 0 | 0 | 2 | 2 | C |
| MCI066A | Remote Sensing and GIS Lab | 0 | 0 | 2 | 2 | C |
| MCI007A | Seminar | 0 | 0 | 2 | 2 | C |
|  | **Total** | **16** | **0** | **6** | **22** |  |
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**Semester II**

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| **Code** | **Subject** | **Contact Hours/Week** | | | **Total Credits** |  |
| **L** | **T** | **P** |
| MCI067A | Atmospheric Environmental  Pollution and Control | 4 | 0 | 0 | 4 | F |
| MCI068A | Ecology and Environmental  Impact Assessment | 4 | 0 | 0 | 4 | C |
| MCI069A | Wastewater Treatment  Engineering | 4 | 0 | 0 | 4 | C |
| MCI070A | Solid Waste Management | 4 | 0 | 0 | 4 | C |
| MCI071A | Environmental Lab-II | 0 | 0 | 2 | 2 | C |
| MCI072A | Computer Applications Laboratory | 0 | 0 | 2 | 2 | C |
| MCI0013A | Seminar | 0 | 0 | 2 | 2 | C |
|  | **Total** | **15** | **0** | **7** | **22** |  |

**Semester III**

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| **Code** | | **Subject** | | | **Contact Hours/Week** | | | | **Total Credits** |  |
| **L** | **T** | | **P** |
| MCI073A | | Transport Processes And  Modelling of Aquatic System | | | 4 | 0 | | 0 | 4 | C |
| MCI074A | | Industrial Wastewater Treatment | | | 4 | 0 | | 0 | 4 | C |
|  | | Elective-I | | | 4 | 0 | | 0 | 4 | S |
|  | | Elective-II | | | 4 | 0 | | 0 | 4 | S |
| MCI016A | | Dissertation Part – I | | | 0 | 0 | | 12 | 12 | C |
|  | | **Total** | | | **16** | **0** | | **12** | **28** |  |
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| **Elective Subjects (One from Each Group)** | | | | | | | | | | |
| **Elective I** | | | **Elective II** | | | | | | | |
| MCI075A | | Non – Point Sources of Pollution and Management | MCI078A | | | Global Warming and Climate Change | | | | |
| MCI076A | | Occupational Safety and Health | MCI079A | | | Hazardous Waste Management | | | | |
| MCI077A | | Environmental Planning and Management | MCI080A | | | Advanced Atmospheric Environmental Engineering | | | | |

**Semester IV**

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| **Code** | **Subject** | **Contact Hours/Week** | | | **Total Credits** |  |
| **L** | **T** | **P** |
| MCI023A | Dissertation Part – II | 0 | 0 | 28 | 28 | C |
|  | **Total** | **0** | **0** | **28** | **28** |  |

**SEMESTER-I**

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| **L-T-P** | **MCI061A-Applied Environmental Chemistry and Microbiology** | **Credits: 4** |
| **4-0-0** |

**Objective:** To train the engineers and researchers to know the basic composition of materials, technology formeasurement of its concentration and technology for environmental conservation, and aspire to improve welfare andsustainability of our society by applying their chemical knowledge. Microbiology provides a general introduction to thediverse roles of microorganisms in natural and artificial environments.

**Unit-1**

**Introduction:**Importance of Environmental Chemistry, types of reactions, redox reactions, reaction kinetics.Electrochemistry and its applications. Physical and equilibrium chemistry–fundamentals and applications. TraceContaminants and their analyses. pH – Principle, Measurement, Numerical Examples, Buffers and Buffer index.

**Unit-2**

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

**Unit-3**

**Colorimetry:**Principles and applications. Applications of Analytical Chemistry – emission and absorption techniques.

**Unit-4**

**Water & wastewater analysis:**Fluoridation, deflouridation, chlorination, BOD, DO, types and measurement of BOD,rate of BOD & theoretical oxygen removal, COD- determination & its application in wastewater treatment.

**Unit-5**

**Microbiology** - Microorganisms of importance in air, water and soil environment Principles and applications ofmicroscopy, microscopic flora and fauna of importance.Metabolism and metabolic pathways, Bio concentration, Bio magnification and Bioaccumulation.Bacteria – Morphology, typical growth curve and generation time, Measurement Techniques – APC, MPN (Probabilityand Thomas methods), MFT. Monod’s equation and its applications. Algae - orphology, classification and theirimportance. Fungi - Protozoa - morphology, classification and their importance. Enzymes - classification, kinetics -Michaelis-Menten equation, factors influencing enzyme reaction. Virology - Types, characteristics and enumeration methodology.

**Outcome:**

On completion of this course, students are able to

* Master a broad set of chemical knowledge concerning the fundamentals in the basic areas of the discipline (organic,inorganic, analytical, physical and biological chemistry).
* Demonstrate that microorganisms have an indispensable role in the environment, including elemental cycles,biodegradation, etc.

***Text Book:***

1. McKinney R.E. *Microbiology for Sanitary Engineers.*New York USA: McGraw Hill.

2. Sawyer C.N., McCarty P.L.*Chemistry for Environmental Engineering and Science.*New Delhi India: Tata McGraw Hill Publishing Co. Ltd., 2010.

***Reference Book:***

1. Pelczar M.J, Chan E. C.S.*Textbook of Microbiology.*New Delhi India:Tata McGraw HillPublishing Co. Ltd., 2014

2. Gaudy. *Microbiology for Environmental Scientists and Engineers.*  McGrawHill.

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| **L-T-P** | **MCI062A-Water Treatment Technology** | **Credits: 4** |
| **4-0-0** |

**OBJECTIVES:** The course is designed to train students in the practical aspects of operating andmaintaining water treatment plants, emphasizing safe practices and procedures.standards for various water uses.

**Unit-1**

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

**Unit-2**

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

**Intake structures:** Different types, design criteria.

**Unit-3**

**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 ofcoagulant, design criteria and numerical examples.

**Unit-4**

**Filtration:**Theory, types, hydraulics of filter bed, design criteria and design of filters, filter backwash, operationalproblems and trouble shooting.

**Adsorption Process:** Types, factors affecting adsorption, kinetics and equilibrium – different isotherm equations andtheir applications.

**Unit-5**

**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 anddeflouridation – Principles and design.Trace organic contaminants in water supplies and their removal.Bench Scale and Pilot Plant studies in water treatment. Rural Water Supply Systems.

**Outcomes:**

On completion of this course, students are able to

* Understand the principles and operation of water treatment systems
* Appraise the suitability of the design of treatment plants and unit processes
* Evaluate process operations and performance
* Understand coagulation, flocculation, and sedimentation, filtration, and disinfection processes.

***Text Book***

1. Fair G.M., Geyer J.C. *Water and Waste Water Engineering.* John Wiley Publications.

2. Weber W.J. *Physico - Chemical Processes for Water Quality Control*.

***Reference Book***

1. Raju, B.S.N. *Water Supply and Wastewater Engineering.* Tata McGraw Hill Pvt. Ltd.

2. CPHEEO Manual on *Water Supply and Treatment***.**

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| **L-T-P** | **MCI063A-Water Resources Engineering and Applied Hydraulics** | **Credits: 4** |
| **4-0-0** |

**Objectives** The course is designed to deal with surface and groundwater, addressing both water quantity and quality, learning to understand human influences on the hydrological system, and apply tools, for the proper integration of hydrological knowledge and analysis in water resources planning and management.

**Unit-1**

**Hydrology:** Water resources of the world, India and Karnataka, National Water Policy, Hydrologic cycle, estimation of missing precipitation and rain gauge density.

**Unit-2**

**Hydrograph theory:** Unit hydrograph-derivation, flow routing, low flow analysis. Urban Hydrology - Run-off estimation – Design of Storm Water Drains.

**Unit-3**

**Unsteady Flow through Conduits:** Water hammer analysis, Water hammer protection methods - surge tanks, Flow Measurements – Area –Velocity method, Weir method, flumes, end-depth method & chemical and radioactive tracers method.

**Unit-4**

**Groundwater:** Basic equations of flow, confined and unconfined aquifers, sea water intrusion, artificial recharge, groundwater pollution, borewells - types & design principles, open wells – types, yield tests.

**Unit-5**

**Basics and applications of Remote Sensing:** in water resources management, Hydraulic transients- flow through bends & constriction.

**Outcomes:**

On completion of this course, students are able to

* Understand theories and concepts in surface and subsurface hydrology, the physical, chemical and biological interactions between the hydrosphere, the lithosphere, the biosphere and the atmosphere.
* A thorough awareness of natural and human-induced variations of hydrological systems.
* Evaluate and analyze hydrological systems and processes at a wide range of scales in both space and time for the purpose of water resources assessment, natural hazard assessment and mitigation, and environmental planning and management.

***Text Book***

1.Raghunath H.M. *Advanced Hydrology.* Wiley Eastern Ltd New Delhi

2. Subramanya K.S, *Advanced Hydrology.* Tata McGraw Hill, New Delhi

***References:***

1.Linsley, Kohler, Paulhes. *Hydrology for Engineers.* McGraw Hill.

2. Mays L.W.*Water Resources Engineering*. John Wiley and Sons Publications.

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| **L-T-P** | **MCI064A-Remote Sensing and GIS in Environmental Engineering** | **Credits: 4** |
| **4-0-0** |

**Objective:** It is aimed at students looking to gain a sound appreciation of the principles and practice of Remote Sensing and how to use it to help address important societal monitoring requirements and science questions. It develops a strong interdisciplinary understanding of critical perspective on Remote Sensing and its role in monitoring the environment. Itprovides understanding of how Remote Sensing data can be combined with and used in wider environmental modeling.

**Unit-1**

**Fundamentals of Remote Sensing:** Definition, Physics of Remote Sensing, Electromagnetic Radiation and its interactions with atmosphere, Spectralreflectance of earth features, Resolution Spectral, Spatial, Temporal and Radiometric.

**Unit-2**

**Platforms Sensors and Image Processing:** Aerial Photographs, Active and passive sensors, Data products, Various satellites in orbit and their sensors. ImageProcessing – Visual and digital image, Interpretation, Interpretation keys, Methodology, Training sets, Ground truthverification, Image analysis, Image enhancement, Rectification, Classification methods, Users accuracy, Producersaccuracy and overall accuracy.

**Unit-4**

**Introduction to GIS:** Data entry, storage and maintenances, Data output. Data analysis, Hardware and software.

**Unit-5**

**Applications of Remote Sensing and GIS:** Applications of remotely sensed data for identifying solid waste disposal, forest fire mapping, EIA studies etc., Optimalrouting of solid waste using GIS – Case study, Environmental siting of industries and zoning atlas development,Remodeling of water distribution system using GIS, Environmental degradation assessment using RS and GIS.

**Outcomes:**

On completion of this course, students are able to

* Develop a sound understanding of the nature, purpose and underlying principles of Remote Sensing.
* Understand the range of available Remote Sensing technologies and be able to match these to particular kindsof scientific and management problem
* Develop a critical awareness of the strengths and limitations of monitoring using Remote Sensing and the widerrole of Remote Sensing in environmental modeling and monitoring.

***Text Book:***

1. Lillies T.M., Kiefer, R.W.*Remote Sensing and Image Interpretation.* John Wiley and Sons,

2. Burrough, P.A., McDonnell, R.A.*Principles of Geographical Information Systems.*Oxford University Press.

***Reference Book:***

1. Mishra H.C. *GIS Hand Book.* GIS India, Shanthi Nivas, Hyderabad.

2. Syed R., Edward M. *Water Works Engineering: Planning, Design and Operation.* New Delhi India:Eastern Economy Edition, PHI Learning Private Limited.

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| **L-T-P** | **MCI065A-Environmental Lab-I** | **Credits: 2** |
| **0-0-2** |

**List of Experiments:**

1. Water quality:Principles of measurement and testing of water for parameters like pH, TDS, NO3, PO4-P, Hardness, Turbidity, residual chlorine, breakpoint chlorination, DO, Chlorides, Jar test for coagulant dosing.

Waste water quality: COD, BOD, TOC, SS, VSS, heavy metals using AAS,Colour Measurement and its removal using O3, Microscopy.

2. Environmental Microbiology: Apparatus used for a microbiological laboratory. Methods ofsterilisation and disinfections. Culture media: Media preparation semi-synthetic and syntheticmedia. Liquid, Solid and semisolid media, nutrient agar, PDA media. Gram staining techniquesfor detection of gram positive and gram negative bacteria. Bacteriology of drinking water anddomestic sewage -MPN techniques for total coliform, faecal coliform and Faecal Streptococci(FS), membrane filtration techniques for faecal coliform and total coliform.

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| **L-T-P** | **MCI066A-Remote Sensing and GIS Lab** | **Credits: 2** |
| **0-0-2** |

**List of Experiments:**

1. Study of the given stereo pairs of aerial photographs for the geometricelements and determination of area, scale and distances
2. Visual Interpretation of given stereo pairs of aerial photographs for the Drainage Pattern, Physiography of the area, Landuse/Landcover patternetc.
3. Use of stereoscope for the analysis of stereo pairs of aerial photographs.
4. Position and Navigation data collection using hand-held GPS receiver
5. Introduction to basic operations of Erdas Imagine software and Arc-GIS software dataexport/ import, satellite image reading and manipulations.
6. Geo-Referencing of remote sensing satellite images.
7. Digital remote sensing image Classification using ERDASand Arc-GIS Imaginesoftware.
8. Mapping and assessmentin various fields such as soil classification & degradation; water pollution; air quality; solid waste management etc. using ERDASand Arc-GIS Imaginesoftware.

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| **L-T-P** | **MCI007A-Seminar** | **Credits: 2** |
| **0-0-2** |

**SEMESTER-II**

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| **L-T-P** | **MCI067A-Atmospheric EnvironmentalPollution and Control** | **Credits: 4** |
| **4-0-0** |

**Objectives:** Introduction of major problems in indoor air pollution and control, regulations, describe general air pollution problems, meteorological definitions, air transport equations and pollution controlmatters and devices.

**Unit-1**

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

**Unit-2**

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

**Unit-3**

**General characteristics of stack emissions, plume behavior, heat island effect. Pollutants dispersion models** –description and application of point, line and areal sources.

**Monitoring of particulate matter and gaseous pollutants** – respirable, non-respirable and Nano - particulate matter.CO, CO2, Hydrocarbons (HC), SOX and NOX, photochemical oxidants.

**Unit-4**

**Air Pollution Control equipment for particulate matter & gaseous pollutants** – gravity settling chambers, centrifugalcollectors, wet collectors, fabric filters, electrostatic precipitator (ESP).– adsorption, absorption, scrubbers, condensation and combustion.

**Unit-5**

**Indoor Air Pollution** – sources, effects and control.

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

**Outcomes:**

On completion of this course, students are able to

* Identify anthropogenic sources and atmospheric effects to pollutions
* Understand Regional, global pollution transport mechanisms
* Appreciate development of transport equations and applications, stack
* Learn theory and development of pollution control devices: Cyclone, electrostatic particle precipitator, packed towers,gravitational separator, bag house.

***Text Books:***

1. Wark K., Warner C.F.*Air Pollution - Its Origin and Control.* Harper &Row Publishers, New York.

2. Lee C.C., Lin S.D. *Handbook of Environmental Engineering Calculations*. McGrawHill, New York.

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| **L-T-P** | **MCI068A-Ecology and EnvironmentalImpact Assessment** | **Credits: 4** |
| **4-0-0** |

**Objective:** The course introduces process of environmental impact assessment and policy decision making as requiredunder the National Environmental Policy Act (NEPA) and the regulations of the Council of Environmental Quality (CEQ).Topics include identification of purpose and need for any actions affecting the environment, development of objectivesand decision criteria, and various techniques for assessing impact and comparing alternatives for a given environmentalintervention. The strengths and weaknesses of various approaches are evaluated with techniques that allow analysis ofmultiple objectives and conflicting uses of environmental resources. The goals of this course, in addition to gaining an understanding of the discipline of ecology, include developing andimproving skills in scientific writing, basic mathematics, statistics, and in the use of computer spreadsheets.

**Unit-1**

**Ecology:** Classification of Ecosystems, Structure and Function of Ecosystems, Energy flow in Ecosystems, EcologicalNiche and succession, Bio-geo-chemical cycles, Ecological Pyramids.

**Unit-2**

**Aquatic and Terrestrial Ecosystems:** Diversity and dominance Indices, Ecosystem Models.

**Climate change and biodiversity**

**Unit-3**

**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. Stepby-step procedure for conducting EIA and Limitations of EIA, Prevention of SignificantDeterioration (PSD) Programme. Carrying capacity concept.

**Unit-4**

**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) andDisaster Management Plan (DMP).

**Unit-5**

**EIA Case Studies** –Thermal Power Plant, Mining, Fertilizer, Construction Projects, Airport, Water and WastewaterTreatment Plants.

**Outcome:**

On completion of this course, students are able to

* Develop an appreciation of the modern scope of scientific inquiry in the field of Ecology
* Become familiar with the variety of ways that organisms interact with both the physical and the biologicalenvironment
* Develop an understanding of the differences in the structure and function of different types of ecosystems
* Appreciate the purpose and role of EIA in the decision-making process
* Understand the strengths of EIA in regard to environmental management
* Understand the technical and social/political limitations of EIA
* Know the administration and procedures that apply in the student’s jurisdiction
* Understand the screening process
* Understand the scoping process and how it is applied
* Know the options for estimating environmental and social impacts
* Know the format of an EIA Report (Environmental Impact Statement, or Environmental Statement)
* Appreciate the factors that assist, and detract, from the usefulness of the EIA Report
* Understand the purpose of developing follow-up procedures, and the options for designing these procedures

***Text Books:***

1. Krebs J.*Ecology - The Experimental Analysis of Distribution and Abundance.* Harper International.

2. Hall C.A.S., Day J.W. *Ecosystem Modeling in Theory and Practice: An Introductionwith Case Historie.* John Willey.

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| **L-T-P** | **MCI069A-Wastewater Treatment Engineering** | **Credits: 4** |
| **4-0-0** |

**Objective:** To provide a basic description and understanding of the principal unit processes used in the treatment ofwastewater. This will include coverage of the scientific basis of each unit process, as well as the conventional approachto their engineering design. In the area of wastewater treatment, the course will provide an understanding of the kinetictheory of biological growth and apply it to typical aerobic processes, and an appreciation of the purpose and practice ofsludge treatment.

**Unit-1**

**Objectives of wastewater treatment:** Characteristics, flow variations, types of reactors and reactors analysis.Wastewater Treatment Flow Diagrams and Hydraulic Profile.

**Unit-2**

**Kinetics of biological treatment systems: B**io kinetic constants and their determination, batch and continuous systems.

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

**Unit-3**

**Theoretical principles and design:S**uspended growth system - conventional activated sludge process and itsmodifications. Attached growth system – trickling filter, bio-towers and rotating biological contactors. Principles anddesign of stabilization ponds.

**Unit-4**

**Advanced Wastewater Treatment:** Need and technologies used. Nitrification and Denitrification Processes,Phosphorous removal. Wastewater disinfection.

**Unit-5**

**Sludge Processing: S**eparation - sludge thickeners, volume reduction, conditioning and digestion – aerobic andanaerobic.

**Rural wastewater systems: S**eptic tanks, two-pit latrines, eco-toilet, soak pits.

**Outcome:**

On completion of this course, students are able to understand

* A process flow sheet.
* Appropriate treatment methods for municipal and certain industrial effluents.
* How water and wastewater treatment plants operate.
* Simple design equations for water and wastewater treatment plant.
* The chemical and biological principles behind unit processes used in water and wastewater treatment unitprocesses.
* The concept of a unit operation and a unit process.
* The fundamental scientific processes underlying the design and operation of wastewater treatment plant.
* The management of residuals from water and wastewater treatment.
* The methods that are used for the design of a water and wastewater treatment plant.

***Text Book:***

1. Metcalf, Eddy I. *“Wastewater Engineering - Treatment and Reuse.* TataMcGraw Hill Publishing Co. Ltd., New Delhi.

2. Karia G.L. Christian R.A.*Wastewater Treatment Concepts and Design Approach.* Prentice Hall of India Pvt. Ltd., New Delhi.

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| **L-T-P** | **MCI070A-Solid Waste Management** | **Credits: 4** |
| **4-0-0** |

**Objective:** To provide detailed knowledge and skills in the management, treatment, disposal and recycling options forsolid wastes, while focusing on key engineering and technical aspects involved. Understanding of the basic principles ofwaste and resource management will be supplemented, where appropriate, by practical problem-solving exercises inthe context of civil engineering.

**Unit-1**

**Land pollution and control:** Land Pollution sources and their impacts, general control measures.

**Unit-2**

**Solid waste** – Sources, Engineering classification, Characterization, Generation and Quantification.Transport - collection systems, collection equipment, transfer stations, collection route optimization.

**Unit-3**

**Treatment methods:** Methods of refuse processing, recovery, recycle and reuse, composting – aerobic and anaerobic,incineration, pyrolysis and energy recovery.

**Unit-4**

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

**Unit-5**

**Recent Developments in Solid Wastes Reuse and Disposal:** Power Generation, Blending with construction materialsand Best Management Practices (BMP), Role of various organizations in Solid Waste Management – Governmental,Non-Governmental, Citizen Forums.

**Biomedical Waste management:** Biomedical (Handling and Management) Rules 2008, sources, treatment and disposal.

**Outcome:**

On completion of this course, students are able to

* Understand and apply the basic scientific and sustainability principles behind waste management, for solvingpractical waste management challenges
* Understand the fundamental principles of existing and emerging technologies for the treatment of waste and recoveryof value from waste
* Appreciate the increasing importance of waste and resource management in achieving environmental sustainability

***Text Book:***

1. Tchobanoglous G., Theissen H., EIiassen R.*Solid Waste Engineering - Principles andManagement Issues.* McGraw Hill, New York.

2. Pavoni J.L.*Handbook of Solid Waste Disposal.*

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| **L-T-P** | **MCI071A-Environmental Lab-II** | **Credits: 2** |
| **0-0-2** |

**List of Experiments:**

1. Monitoring of ambient air quality for total suspended particulate matter and respirable SPM.

2. Measurement of CO, HC, H2S and NH4in exhausts.

3. Measurements of SO2and NOx in ambient air.

4. Detection of levels of noise pollution in residential/commercial/industrial and silent/sensitiveareas of Jaipur city.

5. Demonstrate the feasibility of the geolocation of a sound source by simultaneous noise powermeasurements

6. Demonstrate, with a bell jar, that a material medium such as air is needed for transmission ofsound waves.

7. Determine the relationship between air pressure and sound decibel.

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| **L-T-P** | **MCI072A-Computer Applications Laboratory** | **Credits: 2** |
| **0-0-2** |

Introduction to DOS & UNIX operating system environment along with file handling commands

(like- open, copy, rename, delete etc.)

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

* Exercises on data sorting and searching, matrix operation, numerical Integration and curve fitting.
* Exercises on statistical analysis of data – mean, median, std. Deviation & variance for grouped
* and ungrouped data.
* Population forecast: AM, GM, incremental and logistic curve method.
* Rising main design, pumping UNIT design and water distribution system (two to three loops).
* Design of water treatment units – Cascade aerator & Spray aerator, Plain Sedimentation tank,
* Clariflocculator tank, Filters (rapid and slow) – Mechanical rapid mix unit.
* DO model for river (streeter – phelps) and lake, river mixing zone water quality – critical point method.

2. Running following application software packages:

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

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| **L-T-P** | **MCI013A-Seminar** | **Credits: 2** |
| **0-0-2** |

**Semester III**

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| **L-T-P** | **MCI073A-Transport Processes andModelling of Aquatic System** | **Credits: 4** |
| **4-0-0** |

**Objectives:** To make students learn evaluation and control techniques of water quality management in streams, lakes, andestuaries. Mathematical analyses of patterns of water movement and their relation to water quality. Fate and transport ofcontaminants in natural aquatic systems, design and management of environmental and water resource systems.

**Unit-1**

**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.

**Unit-2**

**Steady-state water quality modeling: M**odels for conservative and non-conservative substances.

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

**Unit-3**

**1-D Oxygen balance models:** Streeter-Phelps equation, critical point method.

**Calibration and verification of 1**-D oxygen model. Error measures.

**Unit-4**

**Mixing zones in rivers: T**ypes 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 oxygenmodels for lakes under completely mixed and stratified conditions.

**Eutrophication models: S**implified nutrient loading models for rivers and lakes.

**Unit-5**

**Ocean disposal of wastewater:** Siting and design of outfalls.

**Ground water quality modeling concepts: F**ormulation 1-D & 2-D models with decay and retardation for instantaneoussources, plume delineation studies.

**Outcome:**

On completion of this course, students are able to understand

* Contaminant transport and fate
* Ecological and human effects assessment
* Environmental decision criteria
* Monitoring strategies
* Environmental exposure assessment
* Development of pollutant transport, fate and persistence models; model parameter estimation.

***Text Book:***

1. Thomann R.V., Mueller J.A.*Principles of Water Quality Management and Control.* Harper & Row Publications.

2. Schnoor J.L. *Environmental Modelling – Fate and Transport of Pollutants in Water, Air andSoil.* John Wiley and Sons.

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| **L-T-P** | **MCI074A-Industrial Wastewater Treatment** | **Credits: 4** |
| **4-0-0** |

**Objectives:** To provide an understanding of the mechanisms and processes used to treat waters that have beencontaminated in some way by anthropogenic industrial or commercial activities prior to its release into the environment orits re-use. To understand various terms used in industrial wastewater treatment and to acquaint with different stepsinvolved in treatment of industrial wastewater.

**Unit-1**

**Effects of Industrial Wastes** on sewerage system and sewage treatment plants and receiving water bodies. Effects ofwaste additions on physical and chemical properties of soil.

**Unit-2**

**Effluent standards and receiving water quality standards**. Different aspects and choices of various disposalalternatives.

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

**Unit-3**

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

**Wastewater Treatment in specific industries:** Distillery, Sugar, Pulp and paper, Cement, Textile, Dairy, Fertilizer,Pesticides, Pharmaceutical,

**Unit-4**

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

**Radio Active Wastes treatment**- Low activity and high activity radiation, application of radioactive techniques forwastewater treatment. Bio-Remediationof contaminated soils.

**Unit-5**

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

**Outcome:**

On completion of this course, students are able to

* Learn physical/chemical/biological characteristics of and the evaluation technique for various industrial wastewater
* Understand the theory, engineering application, and design technique for the industrial wastewater treatment unitprocesses.

***Text Book*:**

1. Nemerow N.N. *Liquid Waste of industry theories.* Practices and Treatment. AddisonWilley New York.

2. Azad N. S. *Industrial Wastewater Management Hand Book.*McGraw Hill book Co.,New York.

3. Ross R.D. *Industrial Waste Disposal.*  Reinhold Environmental Series – New York.

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| **L-T-P** | **MCI016A – Dissertation Part - I** | **Credits: 12** |
| **0-0-12** |

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| **Elective Subjects (one from each group)** | | | |
| **Elective I** | | **Elective II** | |
| MCI075A- | Non – Point Sources of Pollution and Management | MCI078A- | Global Warming and Climate Change |
| MCI076A- | Occupational Safety and Health | MCI079A- | Hazardous Waste Management |
| MCI077A- | Environmental Planning and Management | MCI080A- | Advanced Atmospheric Environmental Engineering |

**Elective I**

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| **L-T-P** | **MCI075A-Non – Point Sources of Pollution and Management** | **Credits: 4** |
| **4-0-0** |

**Objective:** To provide an understanding to protect the quality of water resources from the adverse effects of nonpointsource (NPS) water pollution. Types of regulated point sources include wastewater treatment facilities, municipal stormwater systems, and concentrated animal feeding operations. NPS pollution occurring from rainfall flows off the land,roads, buildings, and other features of the landscape are discussed in the modules.

**Unit-1**

**Introduction:** Non-point Pollution, Problem, definitions, magnitude of Non-Point Pollution, Non-point Pollution ControlLaws, Waste Assimilative Capacity and Stream Standards

**Unit-2**

**Pollution from the Atmosphere:** Atmospheric Inputs – fall out, rainfall, Overland routing of the precipitation excess,interflow ground water flow.

**Groundwater Pollution:** Sources of Groundwater Contamination, Groundwater Movement.

**Unit-3**

**Pollution from impervious urban areas:** Introduction Deposition and Accumulation of Pollutants on ImperviousSurfacesRemoval of Solids from street Surfaces, Porous Pavement.

**Non-point Pollution Simulation Models:** Basic Concepts Brief Description Available Nonpoint Pollution SimulationModels.

**Unit-4**

**Land use and non-point pollution:** Effects, Comparative Assessment of Pollution Impact from land use, agriculturalrunoff, mining area runoff, Effect of hydrologic Modifications

**Management Practices of Non-point pollution control:** Introduction, Source Control Measures Collection Control and Reduction of Delivery.

**Unit-5**

**Planning for Nonpoint Pollution Control:** Introduction, Water Quality Planning Process, Selection of Best ManagementPractices for Non -Point Source Pollution Control – detention ponds, exfiltration and infiltration trenches, vegetativeswales.

**Outcome:**

On completion of this course, students are able to

* + Utilize Simulation Models for tracing nonpoint source pollution
  + Develop management solutions for nonpoint source pollution control
  + Select best management solutions for nonpoint source pollution control

***Text Book***

1. Novotny V.,Chesters G.,*Hand Book of Non-Point Pollution, Sources and Management.*Van Nostrand Reinhold Environmental Engineering Series, New York.

2. Pavoni J L, *Hand Book of Water Quality Management Planning.* Van NostrandReinhold, Environmental Engineering Series.New York.

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| **L-T-P** | **MCI076A-Occupational Safety and Health** | **Credits: 4** |
| **4-0-0** |

**Objective:** To identify risks, link to individual behaviors, evaluate precautions and preparations, identify correctprocesses and procedures, identify critical points, improve decision making

**Unit-1**

**Introduction:** Occupational Safety and Health Act, Occupational Safety and Health Administration, right to know Laws.

**Indian Acts** – LaborAct, Factories Act, OSHA.

**Unit-2**

**Ergonomics:** need, Task Analysis, Preventing Ergonomic Hazards, Ergonomics Programme.

**Accident** – Causation, investigation methods and different models.

**Unit-3**

**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.

**Unit-4**

**Occupational Health:** Health and Safety Considerations, Personal Protective Equipment.

**Unit-5**

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

**Outcome**

On completion of this course, students are able to

* Contribute to the development and maintenance of a healthy and safe work environment
* Interpret and apply legislative requirements, industry standards, and best practices in a variety of workplaces
* Apply risk management principles to anticipate, identify, evaluate and control physical, chemical, biologicaland psychosocial hazards
* Collect, manage, and interpret information and data to identify trends and issues in the workplace
* Design, support, and evaluate health and safety programs and implement procedures using project management,principles and processes appropriate to the task
* Affect/manage change by advancing OH&S principles within management systems, cultures, practices, andpriorities.

***Text Books:***

1. Goetsch D.L.*Occupational Safety and Health for Technologists.*  Engineers and Managers,Prentice Hall.

2. Heinrich H.W.,*Industrial Accident Prevention.*McGraw Hill Publication,New York.

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| **L-T-P** | **MCI077A-Environmental Planning and Management** | **Credits: 4** |
| **4-0-0** |

**Objectives:** To introduce the basic knowledge of current environmental management systems applied in both public andprivate sectors. Class discussions will cover conventional development of ISO 14001 Environmental ManagementSystems (EMS) for various levels of organizations. Possible extensions of internal and external environmental auditing,environmental label, and life cycle assessment can be made based on relevant Total Quality Environmental Management(TQEM) requirements. Case studies emphasize enterprise strategic environmental management planning fororganizations and their stakeholders, in the context of environmental regulatory, law and policy. The topics are linked witheco-product evaluation, environmental performance evaluation, and green production planning to search for strategiescompatible with ISO 14001-accreditation.

**Unit-1**

**Environment and Sustainable Development: C**arrying capacity, relationship with quality of life, carrying capacity andresource utilization.

**Unit-2**

**Engineering Methodology in Planning and its Limitations: C**arrying capacity based short and long term regionalplanning.

**Unit-3**

**Environmental Protection:** Economic development and social welfare consideration in socio economic developmentalpolicies and planning.

**Unit-4**

**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.

**Unit-5**

**Environmental Economics**: Introduction, economic tools for evaluation, Green GDP, Cleaner development mechanisms and their applications.

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

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

**Outcomes:**

On completion of this course, students have

* A sound understanding of the principal environmental policy issues confronting managers in diverse geographicaland culture situations
* An awareness of the ethical and moral issues involved in seeking the wise and sustainable use of resources
* A range of relevant practical skills, particularly in the fields of impact assessment, audit and law

***Text Book:***

1. Lohani B.N.*Environmental Quality Management.* South Asian Publishers, New Delhi

2. Chanlett,*Environmental Protection.* McGraw Hill Publication, New York.

**Elective II**

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| **L-T-P** | **MCI078A-Global Warming and Climate Change** | **Credits: 4** |
| **4-0-0** |

**Objective:** To provide an understanding of the factors responsible for climate change, the biological and sociologicalconsequences of such changes; and the possible engineering, economic, and legal solutions to avoid more extremeperturbations.

**Unit-1**

**Energy Issues and Climate Change,**Alternate Energy Sources

**Unit-2**

**Green-House Effect** as a Natural Phenomenon, Green House Gases GHGs) and their Emission Sources Quantificationof CO2 Emission, Global Warming Potential (GWP) of GHGs.

**Unit-3**

**Modeling Climate change, Ozone layer depletion and its control,Impacts of climate change:** Global and India, Temperature Rise, Sea Level rise, Coastal Erosion and landslides, Coastal Flooding, Wetlands, Estuaries Loss Impact of ocean current on global climate, EL-NINO & LA-NINA effects.

**Unit-4**

**Kyoto Protocol:** Importance, Significance and its role in Climate Change.

**Carbon Trading** - Mechanisms, Various Models (European, Indian) Global and Indian Scenario.

**Unit-5**

**Cleaner Development Mechanisms:** Various Projects related to CO2 Emission Reduction.

**Alternatives of Carbon Sequestration:** Conventional and non-conventional techniques, Role of Countries and Citizensin Containing Global Warming.

**Outcome:**

On completion of this course, students are able to

* Measure climate factors and how they change
* Understand connections between global warming and human activities
* Identify effects of climate change on biodiversity and ecosystems in different biomes and aquatic systems
* Model possible scenarios for future climate change
* Achieve possible ways to deal with climate change.

***Text Books:***

1. Bolin B. *Carbon Cycle Modelling.*John Wiley and Sons Publications.

2. Linden E.*The Winds of Change: Climate, Weather and the Destruction of Civilizations.*Simon and SchusterPublications.

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| **L-T-P** | **MCI079A-Hazardous Waste Management** | **Credits: 4** |
| **4-0-0** |

**Objectives:**To provide an understanding of hazardous waste engineering principles and management issues, Wastesources, characteristics, generation, collection, transfer and transport, Waste recycling, reuse, recovery, treatment anddisposal. This course is designed to provide students with the necessary background and knowledge pertaining to theengineering design of hazardous waste facilities.

**Unit-1**

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

**Unit-2**

**Hazardous Waste Characterization**, Designated Hazardous Wastes.

**Waste Minimization and Resource Recovery:** Approaches, Development of a Waste Tracking System, Selection ofwaste Minimization Process, Case Studies.

**Unit-3**

**Transportation of Hazardous Waste: R**equirements, regulations, containers, bulk and non-bulk transport, EmergencyResponse.

**Unit-4**

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

**Thermal treatment -** Incineration and pyrolysis.

**Unit-5**

**Sanitary landfill: D**esign approach, leachate and gaseous collection system. Facility Siting and Process Selection fortreatment, storage, disposal facility (TSDF).

**Soil contamination and site remediation: B**ioremediation processes, monitoring of disposal sites.

**Outcome**

On completion of this course, students are able to

* + - Build knowledge of hazardous materials and wastes with respect to definitions, regulations, communication of healtheffects, prioritization and prevention of releases, response to releases, emissions to soil, air and water,transportation, treatment, disposal, storage, and minimization.
* Build problem solving and communication skills for managing hazardous materials and wastes, particularly in termsof recognizing dangerous situations, prioritizing and recommending management actions, and writing and speakingclearly about problems and solutions.
* Apply knowledge and problem solving and communication skills to specific problems in order to practice the role ofhealth and safety professionals in managing hazardous materials and wastes.

***Text Book:***

1. LaGrega M.D., Buckingham P.L.*Hazardous Waste Management.* McGrawHill International Edition.

2. Wentz C.A. *Hazardous Waste Management.* McGraw Hill International Edition.

***References:***

1. Fawcett. *Hazardous and Toxic Materials: Safe Handling and Disposal.* John Wiley.

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

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| **L-T-P** | **MCI080A-Advanced Atmospheric Environmental Engineering** | **Credits: 4** |
| **4-0-0** |

**Objectives:** Course introduces Atmospheric Processes and Chemical Reactions, Characteristics of atmosphericboundary layer and its depth. It enlightens students on Urban Air Quality Simulation Modeling and its inherent problems,dispersion of Heavy Gases, design of Industrial Ventilation Systems.

**Unit-1**

**Atmospheric Processes and Chemical Reactions:** Definition of terms aerosols, particle, photolysis, gas to particleconversion, condensation, evaporation, dissolution, sublimation, specific heat, conduction, radiation. Mechanicalturbulence, forced convection, advection, equation of state, first law of thermodynamics. Reaction Rates (Gas PhaseSpecies) Atmospheric gases and their molecular structures, chemical reactions and photo processes, reaction rates,reaction rate coefficients, sets of reactions, stiff systems.

**Unit-2**

**Atmospheric Boundary Layer:** Characteristics of atmospheric boundary layer-boundary layer depth, mean velocitypower-law profile, Log-Log velocity profile, spectral description of turbulence, turbulence intensity, Reynolds stressparameter, spectral density function, integral length scale, inertial subrange and small scales. Turbulent fluxes ofmomentum, turbulent fluxes of energy and water vapor, friction velocity, surface roughness lengths, bulk aerodynamicequations for eddy diffusion, monin-obukhovsimilarity theory, eddy diffusion above the surface layer, ground surface temperature and moisture.

**Unit-3**

**Urban Air Quality Simulation Modeling:** General need, alternative approaches, basic model applications, generalcomposition of models, Numerical modeling Approaches-Gaussian diffusion models, physical basis of the massconservation approach, mathematical foundation of the mass conservation approach.

**Unit-4**

**Inherent problem in air quality simulation modeling:** Boundary conditions, spatial resolution and compatibility withavailable data. Transportation related modeling-street canyon models, highway models, airport models. Air qualitysimulation models for Quasi-Inert pollutants-sulfur dioxide and particulate models, carbon monoxide models. Air qualitysimulation models for photochemical pollutants-background, features of photochemical air quality simulation models,model evaluation, model validation.

**Unit-5**

**Dispersion of Heavy Gases:** Introduction, characteristics of heavy gas flow, introduction to numerical modeling of heavygas dispersion, requirements for physical models (non-dimensional parameters, choice of scaling variables).

**Outcome:**

On completion of this course, students are able to

* Understand Atmospheric Processes and Chemical Reactions
* Effectively utilize knowledge of design on Industrial Ventilation Systems
* Learn Urban Air Quality Simulation Modeling

***Text Book:***

1. Warren B. Johnson et. al. *Air Pollution.* Academic Press, New York.

2. Wark K., Warner C.F., Davis. W.T., *Air Pollution*-*its origin and control.*,Harper and Row Publication.

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| **L-T-P** | **MCI023A – Dissertation Part - II** | **Credits: 28** |
| **0-0-28** |