### M.Sc. ENVIRONMENTAL SCIENCE SEMESTER – I

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**TOTAL CREDITS : 78**

### ELECTIVES

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UNIT I  EMPIRICAL STATISTICS  9
Types of Sampling – Description of discrete and continuous data – Measures of
central tendency and dispersion for grouped and ungrouped data – Measures of
position – Box and Whisker plot.

UNIT II  ONE DIMENSIONAL RANDOM VARIABLES  9
Random variables - Probability function – moments – moment generating
functions and their properties – Binomial, Poisson, Geometric, Uniform,
Exponential, Gamma and Normal distributions.

UNIT III  ESTIMATION THEORY  9
Unbiased Estimators – Method of Moments – Maximum Likelihood Estimation
- Curve fitting by Principle of least squares – Regression Lines.

UNIT IV  TESTING OF HYPOTHESIS  9
Sampling distributions - Type I and Type II errors - Tests based on Normal, t, $\chi^2$
and F distributions for testing of mean, variance and proportions – Tests for
Independence of attributes and Goodness of fit.

UNIT V  DESIGN OF EXPERIMENTS  9
Analysis of variance – One-way and two-way classifications – Completely
randomized design – Randomized block design – Latin square design.

L +T: 45+15 = 60 PERIODS

BOOKS FOR REFERENCE:
1. R.E. Walpole, R.H. Myers, S.L. Myers, and K. Ye, “Probability and Statistics
   Limited, New Delhi, 2000.

EV9311  ENVIRONMENTAL POLICIES AND LEGISLATION  L T P C
                                                 3 0 0 3

OBJECTIVE:
To impart knowledge on the policies, legislations, institutional frame work
and enforcement mechanism for environmental studies

UNIT I  INTRODUCTION  9
Indian Constitution and Environmental Protection – National Environmental policies –
Precautionary Principle and Polluter Pays Principle – Concept of absolute liability –

UNIT II WATER (P&CP) ACT, 1974

8
Power & functions of regulatory agencies - responsibilities of Occupier Provision relating to prevention and control Scheme of Consent to establish, Consent to operate – Conditions of the consents – Outlet – Legal sampling procedures, State Water Laboratory – Appellate Authority – Penalties for violation of consent conditions etc. Provisions for closure-directions in apprehended pollution situation.

UNIT III AIR (P&CP) ACT, 1981

8
Power & functions of regulatory agencies - responsibilities of Occupier Provision relating to prevention and control Scheme of Consent to establish, Consent to operate – Conditions of the consents – Outlet – Legal sampling procedures, State Air Laboratory – Appellate Authority – Penalties for violation of consent conditions etc. Provisions for closure-directions in apprehended pollution situation.

UNIT IV ENVIRONMENT (PROTECTION) ACT 1986

13
Genesis of the Act – delegation of powers – Role of Central Government - EIA Notification – Sitting of Industries – Coastal Zone Regulation - Responsibilities of local bodies mitigation scheme etc., for Municipal Solid Waste Management - Responsibilities of Pollution Control Boards under Hazardous Waste rules and that of occupier, authorisation – Biomedical waste rules – responsibilities of generators and role of Pollution Control Boards

UNIT V OTHER TOPICS

7
(a) Relevant Provisions of Indian Forest Act, Public Liability Insurance Act, CrPC, IPC
(b) Public Interest Litigation - Writ petitions - Supreme Court Judgments in Landmark cases.

REFERENCES
1. CPCB (1997) “Pollution Control acts, Rules and Notifications issued there under “Pollution Control Series – PCL/2/1992, Central Pollution Control Board, Delhi.

TOTAL: 45 PERIODS
OBJECTIVE:
To educate the students in the area of air, water and soil microbiology and the applications of microorganisms in wastewater treatment and reclamation of pollutants.

UNIT I INTRODUCTION
Classification and culturing of microorganisms, isolation of microorganisms – Pure culture technique – Enrichment culture – Preservation of microorganisms – Identification – Biochemical and molecular biology techniques - Microbial nutrition – Carbon, nitrogen, sulfur – Effective microbial solution.

UNIT II MICROBIAL PHYSIOLOGY

UNIT III MICROBIOLOGY OF ENVIRONMENT
Distribution of microorganisms in contaminated sites – soil, air, water – Interaction of microorganisms – Characteristics – Factors affecting microbial population – Algae in water supply systems – Problems and control – Extremophiles – Adaptation and survival.

UNIT IV MICROBIOLOGY OF WASTEWATER TREATMENT

UNIT V APPLICATION OF MICROORGANISMS FOR RECLAMATION
Microorganisms as sources of protein – Biofertilizer – Bacterial, fungal, algal – Biocontrol agents – Enzyme production by microorganisms, chemotherapeutic agents – Redox reactions in microbial degradation of macromolecules – Soil, water and air.

TOTAL: 45 PERIODS

REFERENCES
OBJECTIVE:
To provide students with an overview of applied ecology from the level of the individual organism to populations, communities and ecosystems.

UNIT I  INTRODUCTION  8

UNIT II  ECOSYSTEMS OF THE WORLD  10

UNIT III  ECOLOGICAL ECONOMICS  10
Valuing ecosystems – Market and non market valuation – Environmental Accounting – Environmental indicators.

UNIT IV  RESTORATION ECOLOGY  9
Principles of restoration ecology – Disturbance and recovery – Restoring damaged sites Role of Protected Areas – International conventions and their role in ecorestoration.

UNIT V  ECOLOGICAL ENGINEERING AND ECOTECHNOLOGY  8

TOTAL: 45 PERIODS

TEXT BOOKS:

REFERENCES:
OBJECTIVE:
To introduce the concept of sustainable development and principles of environmental management to establish functional linkages among the social, economic and environmental spheres.

UNIT I  CONCEPT OF SUSTAINABLE DEVELOPMENT  9

UNIT II  SUSTAINABILITY AND THE TRIPLE BOTTOM LINE  9
Components of sustainability – Complexity of growth and equity - Social, economic and environmental dimensions of sustainable development – Environment – Biodiversity – Natural Resources – Ecosystem integrity – Clean air and water – Carrying capacity – Equity, Quality of Life, Prevention, Precaution, Preservation and Public participation.- Structural and functional linking of developmental dimensions – Sustainability in national and regional context

UNIT III  SUSTAINABLE DEVELOPMENT AND INTERNATIONAL RESPONSE  9

UNIT IV  SUSTAINABLE DEVELOPMENT OF SOCIO-ECONOMIC SYSTEMS  9

UNIT V  FRAMEWORK FOR ACHIEVING SUSTAINABILITY  9

REFERENCES:

TOTAL: 45 PERIODS
EV9315       AIR POLLUTION CONTROL       L T P C
                        3 0 0 3

OBJECTIVE:
To impart knowledge on the principles and design of control of indoor / particulate / gaseous air pollutant and its emerging trend

UNIT I      BASIC CONCEPTS       12
The structure of atmosphere – Definition, Scope and Scales of Air Pollution – Sources of air pollution – Natural and Artificial, Classification of Pollutants, Quantity and Composition of particulate and gaseous pollutants – Effect of different air pollutants on man, animals, vegetation, property, aesthetic value and visibility, Air Pollution Episodes, Air Pollution monitoring and regulatory control, Ambient Air Quality standards, Emission limits, Ambient Air and stack sampling, Equipment for Ambient Air and stack sampling, Methods of sampling.

UNIT II   METEOROLOGY AND AIR POLLUTION       8

UNIT III  CONTROL OF PARTICULATE AND GASEOUS POLLUTANTS       12
Working principle of various types of particulate control equipment – settling chamber, cyclone separators and scrubbers, fabric filters and electrostatic precipitators, Working principles of various types of gaseous pollutant equipment – incineration, absorption, adsorption, condensation and bio filters.

UNIT IV   EMERGING TRENDS       8

UNIT V   NOISE CONTROL       5

TOTAL: 45 PERIODS

REFERENCES:
1. Lawrence K. Wang, Norman C. Parelra, Yung Tse Hung, Air Pollution Control Engineering, Tokyo, 2004
OBJECTIVE:
To educate and train the students in experiments related to microbiological analysis of air, water, soil and wastewater.

LIST OF EXPERIMENTS:

1. Study of instruments and equipments used in the Microbiology Laboratory.
2. Isolation and enumeration of microorganisms from air
3. Isolation and Enumeration of microorganisms from water
4. Isolation and Enumeration of microorganisms from soil
5. Determination of growth curve of bacteria
6. Identification of bacteria by staining techniques
7. Developing mutants by Physical Methods
8. Developing mutants by Chemical Methods.
9. Isolation of anaerobic bacteria
10. Estimation of DNA by spectrophotometer
11. Determination of molecular weight of DNA by electrophoresis.
12. Determination of Total coliforms and Faecal Coliforms by MPN technique.
13. Determination of coliforms by Membrane Filter Technique

TOTAL: 60 PERIODS

REFERENCES
OBJECTIVE:
To educate the students in the area of water, air and soil chemistry

UNIT I  GENERAL  10
Stoichiometry – First and Second law of Thermodynamics – Gibb’s free energy –
Chemical potential – Oxidation and Reduction, Nernt equation pH-pE diagrams,
Chemical Equillibria, Acid – Base reactions – Solubility product ,Application in heavy
metals removal– Solubility of gases in water — Chemical kinetics – Colloids and
Coagulation, water treatment- Sorption- Radio nuclides and nuclear energy.

UNIT II  AQUATIC CHEMISTRY  10
Transport and transformation of chemicals – Phase Interactions Degradation of food
stuffs(carbohydrates, proteins), Detergents, Pesticides, hydrocarbons(aliphatic and
aromatic) – Photolysis – Volatility – Classification of elements — Complex formation
— Hydrophobic interactions – Chemical speciation.

UNIT III  ATMOSPHERIC CHEMISTRY  9
Photochemical reactions in the atmosphere- Degradation of VOCs– Chemical
process for the formation of inorganic and organic particulate matter – Oxygen and
Ozone chemistry.-Photochemical smog.

UNIT IV  SOIL CHEMISTRY  8
Soil classification– Inorganic and organic components of soil –physical and chemical
properties of soil- Acid -base and ion exchange reactions-Leaching-Salt affected soil.

UNIT V  GREEN CHEMISTRY  8
Principles of green chemistry – Clean synthesis, — Atom economy – Environmental
factor ‘E’ and Quotient ‘Q’, Nano materials, CNT, T, O.

TOTAL: 45 PERIODS

REFERENCES:
2. Sawyer,C.N., MacCarty,P.L.andParkin, G.F., Chemistry for Environmental
3. De, A.K.,Environmental Chemistry, New Age International (P) Ltd, Publishers,
OBJECTIVE:
To educate the students on the working principles of various physical, chemical and biological treatment systems for water and wastewater.

UNIT I  INTRODUCTION
Pollutants in water and wastewater -characteristics, Standards for performance - Significance and need for treatment.

UNIT II  PHYSICAL TREATMENT METHODS

UNIT III  CHEMICAL TREATMENT METHODS
Principles of Chemical treatment - Precipitation - processes, hydroxide, Sulphide precipitation of complexed metals, solidification and stabilization - Photolysis, photochemical principles, application - chemical oxidation and reduction - Disinfection - Application in water and wastewater treatment - Ion exchange, Electrolytic Methods, soil remediation - ion-exchange, technology, applicability - Solvent extraction - Liquid membrane - photolysis- Advanced Oxidation Reduction methods - Applications.

UNIT IV  BIOLOGICAL PROCESSES IN WASTEWATER TREATMENT
Rationale of Biological Control of environmental Pollution – Role of Microorganisms 0- Bacterial growth and Biological oxidation – Kinetics of Biological growth.

UNIT V  BIOLOGICAL POLLUTION CONTROL SYSTEM
Aerobic treatment processes – Suspended and attached growth processes. Activated sludge process, including variation Tricking filters, Rotating biological contactors Packed bed reactors and stabilization ponds, Anaerobic treatment processes- Anaerobic digester, septic tank, anaerobic filter, Upflow anaerobic sludge blanket reactor (UASB) and Anaerobic ponds- Biological Nutrient Removal - Nitrogen removal – Biological Phosphorous removal- Residual measurement – Sludge digestion – Sludge dewatering and disposal

TOTAL: 45 PERIODS

REFERENCES
OBJECTIVE:
To expose the students to the need, methodology, documentation and usefulness of environmental impact assessment and to develop the skill to prepare environmental management plan.

UNIT I INTRODUCTION

UNIT II COMPONENTS AND METHODS FOR EA

UNIT III SOCIO-ECONOMIC IMPACT ASSESSMENT

UNIT IV ENVIRONMENTAL MANAGEMENT PLAN

UNIT V SECTORAL EIA

REFERENCES:
OBJECTIVE:
To impart knowledge on toxicology, risk assessment and remediation.

UNIT I BIOCHEMICAL TOXICOLOGY 12
Toxicants, Distribution, Metabolism of toxicants, sites of action, classification of toxicity – acute and sub-acute toxicity bioassay, Factors influencing toxicity, Elimination of toxicants, Methods of toxicity testing – Evaluation - statistical assessment, sediment toxicity, Bio- chemical markers/indicators, Toxicokinetics, Bioconcentration, Bio-accumulation and Bio magnification in the environment.

UNIT II GENETIC TOXICOLOGY 12
Xenobiotics – Chemical carcinogenesis – Genotoxicity assays – Neurotoxicity, Skin toxicity, Immunotoxicity. Renal toxicity, Endocrine disruptors, hormones, receptors.

UNIT III INDUSTRIAL TOXICOLOGY 8
Toxicity of monomers, solvents, intermediates, products – toxic substrates – Metals and other inorganic Chemicals, Organic Compounds – Persistent chemicals.

UNIT IV RISK ASSESSMENT AND REMEDIATION 8
Procedures for assessing the risk – Risk measurement and Mitigation of environmental disorders – Factors in risk assessment.

UNIT V CASE STUDIES IN RISK ASSESSMENT 5
Pharmaceutical, Petroleum, Carbide industry, Textile and Leather Industry Case study.

TOTAL: 45 PERIODS

REFERENCES
OBJECTIVE:
To educate the student on the various Operation & Maintenance aspects of Common Effluent Treatment Plants.

UNIT I ELEMENTS OF OPERATION AND MAINTENANCE OF WASTEWATER TREATMENT PLANTS
Introduction - Plant operation roles - Plant Maintenance program - Knowledge of process and equipment - Proper and adequate tools - Spare units and parts - Laboratory control - Records and Reports - House keeping - Safety measures - Corrosion prevention and control - Industrial effluent management units - Effluents - Effluent management - Waste minimization - Process modification - Clean technology developments - Effluent treatment scheme

UNIT II COMMON EFFLUENT TREATMENT PLANTS (CETPS) – SUSTAINABILITY
Operation - disposal of effluent and residues - Constraints - Number and type of contributing units - Plant capacity - Location - Ownership and management - Management structure - Influent and effluent characteristics - Collection and conveyance system - Effluent treatment plant - Treatment process at CETPs - Case Studies.

UNIT III SAMPLING AND ANALYSIS OF EFFLUENTS

UNIT IV OPERATION AND MAINTENANCE OF TREATMENT UNITS
Screening - Bar screens - Equalisation - Equalisation basins - Strategy for operation – Physico-chemical treatment - Chemical storage and mixing equipment - Chemical metering equipment - Positive displacement pumps - Flash mixer – Clarifiers - Operation guidelines for clarifier - Operation and maintenance - Start-up and maintenance inspection - General - Motors and Divers - Pumps - Chemical feed systems - Rapid mix and flocculators - Clarifiers - Normal operation - Chemical feed system - Flash mixer - Flocculation tanks - Clarifiers - Abnormal operation - Safe working habits - Jar test for selection of coagulant and their dosages - Sludge management – Case Studies.
UNIT V  OPERATION AND MAINTENANCE OF COLLECTION AND CONVEYANCE SYSTEMS


TOTAL: 45 PERIODS

REFERENCES:

EV9326 SOLID AND HAZARDOUS WASTE MANAGEMENT

OBJECTIVE:
To impart knowledge on the elements of managing solid waste from municipal and industrial sources and application of principles related to these topics including design criteria, methods and equipments.

UNIT I SOURCES, CLASSIFICATION AND REGULATORY FRAMEWORK

Types and Sources of solid and hazardous wastes - Need for solid and hazardous waste management – Elements of integrated waste management and roles of stakeholders - Salient features of Indian legislations on management and handling of municipal solid wastes, hazardous wastes, biomedical wastes, lead acid batteries, electronic wastes, plastics and fly ash – Financing waste management.

UNIT II WASTE CHARACTERIZATION AND SOURCE REDUCTION


UNIT III STORAGE, COLLECTION AND TRANSPORT OF WASTES

Handling and segregation of wastes at source – storage and collection of municipal solid wastes – Analysis of Collection systems - Need for transfer and transport –
Transfer stations Optimizing waste allocation – compatibility, storage, labeling and handling of hazardous wastes – hazardous waste manifests and transport

UNIT IV WASTE PROCESSING TECHNOLOGIES

Objectives of waste processing – material separation and processing technologies – biological and chemical conversion technologies – methods and controls of Composting - thermal conversion technologies and energy recovery – incineration – solidification and stabilization of hazardous wastes - treatment of biomedical wastes

UNIT V WASTE DISPOSAL


TOTAL: 45 PERIODS

REFERENCES

EV9327 GLOBAL WARMING & CLIMATE CHANGE

OBJECTIVE:
To educate the students, to understand the earth climate systems and global warming, the impact of climate change on society and the adaptation and mitigation measures of climate change impacts.

UNIT I EARTH’S CLIMATE SYSTEM.


UNIT II OBSERVED CHANGES AND ITS CAUSES.

Observation of Climate Change – Changes in patterns of temperature, precipitation and sea level rise – Observed effects of Climate Changes – Patterns of Large Scale Variability – Drivers of Climate Change – Climate Sensitivity and Feedbacks – The

UNIT III IMPACTS OF CLIMATE CHANGE.


UNIT IV CLIMATE CHANGE ADAPTATION AND MITIGATION MEASURES


UNIT V CLEAN TECHNOLOGY AND ENERGY.


TOTAL: 45 PERIODS

REFERENCES

1. IPCC Fourth Assessment Report – The AR4 Synthesis Report,
OBJECTIVE:
To train the students in the laboratory in the determination of pollutants present in air, water, wastewater and soil.

LIST OF EXPERIMENTS:

1. Calibration of Pipette
3. Measurement of Electrical Conductivity of aqueous solution using conductivity meter
4. Measurement of turbidity of water sample – Nephelometry
5. Determination of alkalinity of water sample by titrimetry
6. Determination of hardness of water sample by titrations (EDTA)
7. Determination of chloride of water sample by titrations (Mohr’s method)
8. Determination of sulphate of water sample using colorimeter
9. Determination of phosphate of water sample using colorimeter
10. Determination of nitrite of water sample by azo dye method
11. Determination of ammonia in waste water sample
12. Determination of DO by Winkler’s method
13. Determination of BOD of wastewater sample
14. Determination of COD of wastewater sample
15. Determination of SO₂ in air by spectrophotometric method
16. Determination of SPM using High volume sampler
17. Determination of potassium in soil.
18. Determination of surface area of activated carbon by acetic acid method
19. Determination of partition co-efficient of acetic acid between water & CCl₄
20. Determination of rate constant of a wastewater treatment method

TOTAL: 60 PERIODS

REFERENCES

OBJECTIVE:
To educate the students on the analytical techniques of environmental disturbances with reference to air, water and soil.

UNIT I INTRODUCTION

Objectives of monitoring-Monitoring net work, Planning ,system design- Sampling devices, preservation ,Classification of analytical methods– Selection of a suitable method - Reliability of analytical data-Statistical analysis- Quality control and assurance,

UNIT II ELECTROANALYTICAL METHODS

Principle, instrumentation and environmental applications of conductometry, potentiometry, coulometry, electrophoresis and polarography – Field Instruments.

UNIT III SPECTROSCOPIC METHODS

Principle, instrumentation and environmental applications of atomic emission, absorption and fluorescence spectroscopy – Molecular UV, visible, IR spectroscopy and scattering methods.

UNIT IV CHROMATOGRAPHIC METHODS

Principle, instrumentation and environmental applications of GC, HPLC and Ion chromatography.

UNIT V OTHER METHODS

Principle, instrumentation and environmental applications of NAA, XRF, XRD, SEM,TGA and Mass spectrometry, Continuous monitoring analysis – fluorescent analyzer for SO₂, chemiluminescent analyzer for NOx, NDIR for CO, Flow injection analyzer.

TOTAL: 45 PERIODS

REFERENCES

3. Roger Reeve, Introduction to Environmental Analysis, John Wiley & Sons Ltd,2002
OBJECTIVE:
To impart an understanding of systems approach as per ISO 14001 and skills for the management of Environmental issues.

UNIT I ENVIROMENTAL MANAGEMENT STANDARDS

UNIT II PREVENTIVE ENVIRONMENTAL MANAGEMENT
Pollution control vis a vis Pollution Prevention - Opportunities and Barriers – Cleaner production and Clean technology, closing the loops, zero discharge technologies - source reduction, raw material substitution, toxic use reduction and elimination, process modification – Cleaner Production Assessment- Material or resource balance – CP option generation and feasibility analysis

UNIT III ENVIRONMENTAL MANAGEMENT SYSTEM
EMAS, ISO 14000 - EMS as per ISO 14001– benefits and barriers of EMS – Concept of continual improvement and pollution prevention - environmental policy – initial environmental review – aspect and impact analysis – legal and other requirements-objectives and targets – environmental management programs – structure and responsibility – training awareness and competence- communication – documentation and document control – operational control – monitoring and measurement – management review

UNIT IV ENVIRONMENTAL AUDIT
Environmental management system audits as per ISO 19011- – Roles and qualifications of auditors - Environmental performance indicators and their evaluation – Non conformance – Corrective and preventive actions -compliance audits – waste audits and waste minimization planning – Environmental statement - Due diligence audit

UNIT V APPLICATIONS
Applications of EMS , Waste Audits and Pollution Prevention opportunities in Textile, Sugar, Pulp & Paper, Electroplating, Mining, petroleum refining, Tanning industry, Dairy, Cement, Chemical industries, etc

TOTAL: 45 PERIODS

REFERENCES:
OBJECTIVE:
The course focuses primarily on marine resources. Particular emphasis will be given to teaching methodology for monitoring, managing and conserving marine resources in coastal environment.

UNIT I   MARINE ENVIRONMENT AND COASTAL PROCESS  8
Seas and oceans, Continental area, Coastal zone, Properties of sea water, Coastal eco system, Communities of the marine environment, Marine Bio-diversity, Importance of Coastal Environment – food, transportation, recreation, Coastal hydrodynamics, Interaction between water and coastal sediments, shore line changes, sea level rise

UNIT II   MARINE RESOURCES  12
Food web and energy fluxes, Nutrient enrichment, Biomass, Economic Importance of marine biota – Microbes, Benthos., Algae, Seaweeds Seagrass, Coral reef, Mangroves – importance, interaction of mangroves with other allied and nearby coastal ecosystems – estuaries, lagoons, salt marshes etc.

UNIT III   ENERGY RESOURCES  8

UNIT IV   ENVIRONMENTAL AND SOCIO-ECONOMIC ISSUES  8
Human intervention on marine resources, Marine pollution sources and effects, Need for conservation, Resource allocation conflicts, Coastal threats – Indian scenario, Coastal economic concepts, Issues in ecological security of coast - Protecting livelihood of coastal communities, stake holders.

UNIT V   COASTAL ZONE MANAGEMENT  9

TOTAL: 45 PERIODS

REFERENCES
EV9002  GEO-INFORMATICS FOR ENVIRONMENTAL MONITORING

OBJECTIVE:
To educate the students on aspects of Remote Sensing and GIS Applications for monitoring and management of environment.

UNIT I  INTRODUCTION TO REMOTE SENSING

UNIT II  REMOTE SENSING TECHNIQUES
Energy recording technology, Aerial photographs, Photographic systems – Across track and along track scanning, Multispectral remote sensing, Thermal remote sensing, Microwave remote sensing – Active and passive sensors, RADAR, LIDAR, Satellites and their sensors.

UNIT III  DATA PROCESSING

UNIT IV  GEOGRAPHICAL INFORMATION SYSTEM
Introduction to GIS, GIS concepts – Spatial and non spatial data, Vector and raster data structures, Data analysis, Database management – Overview of GIS software’s.

UNIT V  REMOTE SENSING AND GIS APPLICATIONS
Monitoring and management of environment, Conservation of resources, sustainable land use, Coastal zone management – Limitations

TOTAL: 45 PERIODS

REFERENCES
EV9003 OCCUPATIONAL HEALTH AND INDUSTRIAL SAFETY

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OBJECTIVE:
To educate the students the health hazards expected and the safety measures to be followed in the industry.

UNIT I INTRODUCTION

UNIT II OCCUPATIONAL HEALTH AND HYGIENE

UNIT III WORKPLACE SAFETY AND SAFETY SYSTEMS
Features of the satisfactory design of work premises HVAC, ventilation. Safe installation and use of electrical supplies. Fire safety and first aid provision. Significance of human factors in the establishment and effectiveness of safe systems. Safe systems of work for manual handling operations. Control methods to eliminate or reduce the risks arising from the use of work equipment. Requirements for the safe use of display screen equipment. Procedures and precautionary measures necessary when handling hazardous substances. Contingency arrangements for events of serious and imminent danger.

UNIT IV TECHNIQUES OF ENVIRONMENTAL SAFETY

UNIT V EDUCATION AND TRAINING
Requirements for and benefits of the provision of information, instruction, training and supervision. Factors to be considered in the development of effective training programmes. Principles and methods of effective training. Feedback and evaluation mechanism.

TOTAL: 45 PERIODS

REFERENCES
1. Environmental and Health and Safety Management by By Nicholas P. Cheremisinoff and Madelyn L. Graffia, William Andrew Inc. NY, 1995
2. Effective Environmental, Health, and Safety Management Using the Team Approach by Bill Taylor, Culinary and Hospitality Industry Publications Services 2005

EV9004  DISASTER MANAGEMENT AND MITIGATION

OBJECTIVE:
To impart knowledge on various natural and man made disasters and the mitigation measures to be followed.

UNIT I  NATURAL DISASTERS
Basic concepts – Global problem – Time and space in disaster – Geological hazards
Earth Quake and Landslides – hydrological hazards – Cyclone – Flood – Epidemics
– Sea level rise – Tsunami - Forest fire

UNIT II  MAN MADE DISASTERS

UNIT III  MITIGATION

UNIT IV  RESPONSE AND RELIEF
Characteristics, operations and logistics for response and recovery – Medical emergencies – Post disaster review – Disaster Legislation – Resources and Utilization – Cost reduction and effective analysis.

UNIT V  ENVIRONMENTAL ISSUES

TOTAL: 45 PERIODS

REFERENCES
OBJECTIVE:
To impart knowledge on principles, technologies and economics of Bio-energy for Energy and environmental conservation.

UNIT I INTRODUCTION

UNIT II BIOMETHONATION

UNIT III COMBUSTION & GASIFICATION

UNIT IV PYROLYSIS & CARBONISATION

UNIT V ECONOMICS OF BIOENERGY

TOTAL: 45 PERIODS

TEXT BOOKS:

REFERENCES:
1. David Boyles, Bio Energy Technology Thermodynamics and costs, Ellis Hoknood, ichester, 1984
EV9006     BIOTECHNOLOGY FOR ENVIRONMENTAL REMEDIATION

OBJECTIVE:
To educate the students on the principles and application of biotechnology in remediation of pollutants.

UNIT I     BASIC CONCEPTS    5

Principles and concepts of environmental biotechnology – Cell physiology – Important Microorganisms - Applications – Current status.

UNIT II     BIODEGRADATION OF TOXIC WASTES    8


UNIT III     MECHANISM OF DETOXIFICATION    8

Environmental fate of organic pollutants – mechanisms of detoxification – oxidation, reduction, and dehydrogenation – Microbial system for Heavy metal accumulation - Biotransformation of metals – Biosorption - Microbial leaching of metals – role of extracellular polymers to detect pollutants.

UNIT IV     BIO REMEDIATION    12


UNIT V     RECOMBINANT DNA TECHNOLOGY AND INTELLECTUAL PROPERTY    12


TOTAL: 45 PERIODS

REFERENCES
4. Foster, C.F. and D.A.J. Wase, Environmental Biotechnology,
5. Jogdand Environmental Biotechnology.

### EV9007 NUCLEAR WASTE MANAGEMENT

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**OBJECTIVE:**
To educate the students about the management and treatment of nuclear waste

**UNIT I GENERAL**

**UNIT II RADIOACTIVE WASTES**
Classification, sources of LLW, 1LW, HLW and transuranic waste – Nature and signification - Pharmakinetics.

**UNIT III TREATMENT OF NUCLEAR WASTE**

**UNIT IV LONGTERM MANAGEMENT OF WASTE**
Packaging and transportation storage, Geological disposal, transmutation, Reuse of waste, space disposal – Decontamination and decommissioning.

**UNIT V RADIATION MONITORING**
Radiation protection, control measures Dose limitation units, Determination of radiation exposure; Risk analysis Accidents involving radioactive waste.

**TOTAL: 45 PERIODS**

**REFERENCES**
OBJECTIVE
To impart knowledge on sustainable aquaculture practices and environmental and ecological concerns associated with it.

UNIT I  INTRODUCTION
Aquaculture basics and history – historical practices and patterns, Role of aquatic resources in food and nutrition. Current trends in global and Indian aquaculture. Farming systems – types and their features – Structures and equipment types of ponds used and construction techniques.

UNIT II  ISSUES IN AQUACULTURE
Environmental issues – Exotic species introduction; escapement; contamination of indigenous gene pool, Salinization of soil and water – over exploitation of wild stocks – mangrove deforestation. Socio-economic issues – Conflicts over water and land use – conflicts of interest between aqua farmers and fishermen and public

UNIT III  AQUACULTURE TECHNOLOGY

UNIT IV  AQUACULTURE ECONOMICS

UNIT V  SUSTAINABLE AQUACULTURE
Strategies for sustainability; Sustainability concept; food security; biosecurity; organic farming; integrated farming; responsible aquaculture; rotational aquaculture; bioremediation; role of biotechnology, traceability. Application of renewable energy in aquaculture – solar energy, wind, and tidal energy.

TOTAL: 45 PERIODS

REFERENCES:
OBJECTIVE
To make the students understand and appreciate environmentally responsible travel to relatively undisturbed natural areas that promotes biodiversity conservation, and provides for socio-economic benefits to the local stakeholder communities.

UNIT I INTRODUCTION
Types of tourism – Cultural, Ethnic, Historical. Concept of ecotourism- definitions of Ecotourism Ecotourism and related sub-sectors of the tourism industry- Ecotourism criteria. Protected Areas - definition, categories and roles. advantages and disadvantages of ecotourism.

UNIT II ECOTOURISM AND THE ENVIRONMENT
Ecotourism and the environment, Ecotourism and conservation, Ecotourism and economic benefits, Ecotourism and socio economic benefits, Ecotourism and local community. Ecotourism and education, alternative versus mass tourism, influences of environmental organizations on tourism industry behavior

UNIT III ECONOMICS OF ECOTOURISM
Ecotourism in the national/global context- multiplier concept, direct, indirect and induced economic effects. Impacts of globalization of tourism and tourism industry. Total Quality Management (TQM) of Ecotourism Resorts, ecotourism initiatives and joint projects

UNIT IV MANAGEMENT AND MARKETING OF ECOTOURISM

UNIT V SUSTAINABLE TOURISM DEVELOPMENT
Millennium Development Goals, strategies and tools in eco-tourism and sustainable tourism concepts and main principles of ecotourism, - cultural conflicts in global tourism, - ecotourism initiatives and joint projects, the role of ethics in ecotourism. The future of ecotourism- key trends and future developments.

TOTAL: 45 PERIODS

TEXT BOOK:

REFERENCES:
OBJECTIVE:
To provide a conceptual framework for a thorough understanding of the causes for biodiversity decline and measures to conserve it.

UNIT I  INTRODUCTION  10
History of Life on Earth – evolution of cellular diversity, the origin of species – the fossil evidence, natural selection and microevolution – Evidence for macroevolution – the intelligent design controversy, DNA diversity, Environment – Biodiversity Linkage, Human Evolution and Human diversity, Levels of biodiversity.

UNIT II  ISSUES IN AQUACULTURE  10

UNIT III  AQUACULTURE TECHNOLOGY  10
Biodiversity hotspots of the world. Sustainable use and management of biodiversity – traditional ecological knowledge of the indigenous people in utilization of aquatic resources, utilization of terrestrial bio resources – traditional land use systems – socio-cultural and economic dimensions, access and benefit sharing.

UNIT IV  AQUACULTURE ECONOMICS  8
In situ and Ex situ conservation, traditional methods of conservation, protected areas. Conservation and Management Strategies: Restoration Technologies – Conservation Strategies in Different Countries, Industrial initiatives.

UNIT V  SUSTAINABLE AQUACULTURE  7
Current threats to biodiversity – Social, ethical and policy issues in biodiversity conservation – CBD and its ramifications on biodiversity conservation.

TOTAL: 45 PERIODS

REFERENCES:
MSc in Environmental Science. M.Sc in Environment Science and Technology. INTRODUCTION. The course has a transdisciplinary approach that integrates the science of environmental studies with technical and social issues and includes courses on ecosystem studies, biodiversity conservation, natural resource management, geoinformatics, water and waste water engineering, green technology, environmental lab techniques, sustainable development, urban sustainability and environment and health. The course builds on a candidate’s knowledge of chemistry, biology, statistics, computers, engineering, social The Environmental Science MSc program is a complex interdisciplinary research module with environmental awareness. Our courses are aimed at improving understanding of the environment and the processes that support life on Earth. We are particularly interested in the impacts of human activity in the world around us and in developing ready-to-use approaches for achieving environmental sustainability. The M.Sc. is project-oriented and will make extensive use of case studies typical of the Mediterranean zone. - MSc. Full-time. Our two-year MSc Environmental Science program at University of Windsor offers research opportunities that help develop advanced laboratory and field skills using the institute’s multi-disciplinary approach. University of Windsor Multiple locations. Windsor, Canada. GLIER offers a research-oriented graduate program in environmental research leading to M.Sc. and Ph.D. degrees. The programs support advanced research and develop graduate expertise to assess multiple stressor effects on large lakes and their watersheds.