

MAJOR COURSES OFFERED IN MFSc (AQUATIC ENVIRONMENT MANAGEMENT):

* AQUATIC ENVIRONMENT AND BIODIVERSITY (2+1) - AEM 501
Theory: UNIT I: Concepts in aquatic environment: Aquatic environment/ecosystem – components-structure and functions; Ecological concepts – succession, homeostasis, natality and mortality, r and k selection; Concepts of habitat and ecological niche; carrying capacity. UNIT II: Environmental concerns: Environmental concerns – population explosion, industrialization, urbanization, and natural calamities; Overexploitation of resources; Environmental stresses; Global Warming; Ozone Depletion. UNIT III: Biodiversity: Biodiversity – Definition and concept; Factors influencing aquatic biodiversity; Types of biodiversity - Species diversity in different ecosystems, Genetic Diversity, and Habitat Diversity; Biodiversity indices and their significance; Concepts of Index of Biotic Integrity (IBI); Economic appraisal of biodiversity; Global diversity patterns and loss of biodiversity.
Practical: Collection of fauna and flora from different ecosystems; Analysis of Biodiversity at community, population and species levels through different methods; Case studies.
*CHEMICAL INTERACTIONS IN THE AQUATIC ENVIRONMENT (2+1) - (AEM 502)
Theory: UNIT I: Basic chemistry principles: Chemical reaction kinetics, chemical equilibria and redox chemistry, solubility concept, dissolution kinetics, processes controlling elemental cycling in the earth's crust, oceans and atmosphere. UNIT II: Soil properties: Soil structure and texture; Composition of oxide and silicate minerals in relation to surface chemical processes; Charge and double layer, and mineral equilibrium; Silicate weathering, transformation, weathering products; Ion exchange - concept and source of cation exchange capacity (CEC), adsorption on to clay minerals of major cations, specific adsorption of major and minor nutrients, and heavy metal ions. UNIT III: Nutrient dynamics: Chemistry of soil-nutrient interactions and water permeability; Organic substances - biological processes in the degradation and conversion of organic matter; Humus and biogeochemical substances - structure, reactivity, solubility and mobility; Transport of substances - nutrients (e.g., phosphate, nitrate, ammonia, Ca and K), Soil-water interactions – availability of nutrients and productivity of aquatic ecosystem. UNIT IV: Pollutant dynamics: Pollutant cycling, bio-accumulation, bio-availability, speciation and transport of contaminants (e.g.,

pesticides and heavy metals).

Practical:

Sample Collection techniques; Determination of physicochemical parameters of soil and water - pH, electrical conductivity, redox potential, soil texture, bulk density, particle density, porosity, hydraulic conductivity, organic carbon, total and available nitrogen, phosphorus, potassium and micronutrients; C/N ratio; clay colloids in the soil; CEC; Adsorption/fixation of ions on clay minerals.

*** INTEGRATED COASTAL ZONE MANAGEMENT - 2+1 (AEM 503)**

Theory

UNIT I

Coastal resources: Coastal natural resources systems: flora and fauna, trophic relationship, nutrient production, cycle and transport; Mangrove ecosystem - species diversity and distribution of mangroves in India, Other inter-tidal system- Seagrass system, Coral reef system, Sandy beach system, Lagoon and estuary system.

UNIT II

Developmental activities and biodiversity loss: Ecological issues, Nonsustainable development, Pollution, threats to biodiversity, habitat destruction, Depletion of fisheries resources, impacts of global environment changes, Multiple uses of the Coastal Zone, Urban settlement, Industrial development, waste disposal, Shore protection works, ports and marine transportation. Land transportation infrastructure, Water control and supply projects, sea fisheries, Aquaculture, Coastal forest industries, Coastal agriculture, industries.

UNIT III

Coastal Zone Management: Integrated Coastal Zone Management (ICZM): its need and benefits, Principles, Goals and objectives of the ICZM programme; Scope, Extent of jurisdiction, Boundaries of the coastal zone, policies and planning for coastal resource management; Management mechanisms- Pollution control, Protected areas (sanctuaries, marine parks and biosphere reserves), Protection from natural hazards; Socioeconomic impacts and its assessment, Disaster management for coastal environment.

UNIT IV

Coastal tourism: Beach resorts, restaurants and parks within the coastal zone as per existing rules and regulations. Impact of pollution on coastal resources.

Practical

Analysis of soil and water characteristics of coastal areas where man made impacts have established; Assessment of damages of water quality; Collection, preservation and identification of coastal biological communities; Survey of different coastal zones; Visit to the protected areas.

AQUATIC POLLUTION AND WASTEWATER MANAGEMENT - 2+1

(AEM – 504)

Theory

UNIT I

Aquatic pollution and its management: Aquatic pollution – sources, types and their impacts; Pollution problems of groundwater resources –sources of contamination, management issues.

UNIT II

Pollutants - Sewage, pesticides, oils, metals, radioactive wastes, biomedical wastes, etc. Common transport processes of pollutants in the aquatic environment; dispersal of pollutants; Algal blooms and their management, Methods of pollution surveys.

UNIT III

Waste disposal and water quality criteria used in different parts of world - national and international standards; ISO-14000(EMS), EIA, Management strategies.

UNIT IV

Wastewater management: Wastewaters - classification and characteristics of sewage and industrial effluents; treatment methods for water and waste water; Principles of aeration, chlorination, ozonation and U.V. irradiation.

UNIT V

Waste recycling and utilization in aquaculture; Design and construction of water filtration devices; aerobic and anaerobic treatment of wastewater.

UNIT VI

Wastes from fish processing units and their treatment; solid waste management; removal of nitrogen and phosphorus from waste water; Role of aquatic macrophytes in treatment of wastewater.

Practical

Collection and preservation of wastewater samples; Physicochemical analysis of wastewater - total dissolved and suspended solids, DO, BOD, COD, H₂S,, NH₃-N, NO₂-N, NO₃-N, PO₄-P, CH₄, heavy metals and pesticides; Use of algae for waste water treatment; Visit to a sewage treatment plant, fish processing unit and other industries; Exercise on interpretation of water quality data for evaluation of aquatic health.

ECOLOGY AND MANAGEMENT OF LIMNETIC ENVIRONMENT -2+1

(AEM – 505)

Theory

UNIT I

Types: Categorization of different limnetic fisheries resources - lacustrine, riverine and coldwater systems; Wetlands, Floodplain wetlands, swamps - characteristics, flora and fauna.

UNIT II

Characteristics: Physical and chemical characteristics of limnetic environment and its relationship with the organisms; influence on metabolism, behavior and orientation of animals; Biological productivity in relation to fishery potential; Trophic relationships in the wetland ecosystem - nutrient production, and transport, Trophic succession; Dynamics of lentic and lotic systems; Water budgeting

in limnetic ecosystems.

UNIT III

Conservation and Management: Functions of wetlands; Habitat degradation- causative factors and controlling/management measures; Destruction of wetlands - causes and consequences; Restoration, conservation and management of wetlands; Resource enhancement; Management of water bodies for economy-driven activities; Management through Biomanipulation studies- top-down and Bottom-up methods; Integrated Environment Management (IEM) Programme-involvement of human element; River continuum concept and new paradigm shift; River linking; International conventions - Ramsar; Environmental laws and

regulations; Index of Biotic Integrity (IBI); modeling studies; Wetland mapping using remote sensing; Geographical Information System (GIS)- Definition, Concepts and application.

Practical

Collection, preservation and analysis of flora and fauna (including phytoplankton, zooplankton and benthos) of wetland ecosystem; Case studies on soil and water quality assessment; Survey and sampling of lentic and lotic waters; Calculation of shoreline development index and morphometry; Determination of carrying capacity; Field visits to selected reservoirs, lakes/wetlands and rivers.

ENVIRONMENTAL BIOTECHNOLOGY - 1+1 (AEM 506)

Theory

UNIT I

Fundamentals of environmental biotechnology: Environmental biotechnology- concepts and scope; conventional and modern approaches, Interrelationship of xenobiotics with other environmental variables; IPR issues related to environmental biotechnology.

UNIT II

Genetically-improved strains: Genetically-improved strains – basic concepts, application in waste management, pesticide degradation, heavy metal remediation, oil removal; Nitrogen fixation; Phosphate solubilization; Cellular and molecular markers of environmental pollution monitoring and management.

UNIT III

Microbial consortia: Consortia of microbes for environmental protection – Concept, scope and feasibility.

UNIT IV

Biological treatment and utilization of wastes: Bioreactors – principles and application in nitrification, denitrification, reduction of BOD; Production of biofuels, fermented products and biogas from wastes, Nutrient uptake by aquatic organisms.

Practical

Genomic and plasmid DNA isolation; PCR and gel electrophoresis, Cloning; Single-cell protein production; Case studies on wastewater treatment/recirculatory systems; Quantification of N fixation, nitrification; Screening of microbes for biodegradation properties.

ENVIRONMENTAL TOXICOLOGY - 1+1 (AEM 507)

Theory

UNIT I

Toxicity and metabolism: Factors influencing toxicity- environmental, genetic and nutritional; Measurement and evaluation of the ecological effects of toxicants; Metabolism of toxic substances by aquatic organisms - consequences, synergistic and antagonistic effects; Acute poisons and accumulative poisons; Bioaccumulation and biomagnification; Systemic effects of toxic metals, pesticides and herbicides; Effect of select toxicants on aquatic life and detoxification.

UNIT II

Toxicity evaluation: Toxicity Testing - Microcosm and Mesocosm Tests, Dose-Response Relationships, Toxicity Bioassay.

Practical

Toxicity evaluation of heavy metals on selected organisms by bioassay techniques; Toxicity assessment of pesticides, PCBs and oil on selected organisms; Analysis of heavy metals from aquatic ecosystems; Toxicity testing methods.

ANALYTICAL TECHNIQUES IN ENVIRONMENTAL SCIENCES - 1+1 (AEM 508)**Theory**

UNIT I

Overview and concepts: An overview of qualitative and quantitative analytical techniques used in environmental science; Sampling techniques and procedures; Factors affecting the choice of an analytical technique; Interferences and their removal, Field kits and their application.

UNIT II

Photometric techniques: Theory, instrumentation and application of colorimetry and spectrophotometry.

UNIT III

Separation techniques: Chromatography – theory, instrumentation and applications of thin layer, paper, ion-exchange, size exclusion, high performance liquid and gas; Methods of preparing biological samples for chromatographic analysis; Theory and applications of electrophoresis; Principles and uses of ultracentrifugation.

UNIT IV

Tracer techniques: Scintillation counters and radio isotopes in environmental research.

Practical

Quantitative estimation of organic and inorganic pollutants and toxicants by UV-Visible spectrophotometer, AAS, HPLC, GC.

PLANKTONOLOGY - 1+1 (AEM 509)**Theory**

UNIT I

Plankton diversity and productivity: Classifications of plankton; Primary and secondary production - estimation, significance, affecting factors; Production - biomass (P/B ratio); Indices of productivity; Community interrelationships.

UNIT II

Ecology of phytoplankton: Phytoplankton (freshwater and marine) - methods of assessment, spatial and temporal variations, succession, diversity; Nanoplankton; Algal blooms; Role in carbon sequestration.

UNIT III

Ecology and life history of zooplankton: Zooplankton (freshwater and marine) – ecology of the major taxa, their food and feeding, reproduction of important zooplankton, life history stages; swarms; Indicator species; Predator-prey relationship; Impact of grazing in the aquatic ecosystem; Vertical migration of zooplankton; Larval ecology of benthic invertebrates.

UNIT IV

Sampling and preservation techniques: Plankton nets and recorders, catching efficiency of various nets; Plankton fixatives and preservatives.

Practical

Collection, preservation and quantitative estimation of phytoplankton and zooplankton; Identification and classification of various phytoplankton and zooplankton; Preparation of permanent slides; Logging, cataloguing and sorting procedures.

FISHERIES OCEANOGRAPHY - 1+1 (AEM 510)

Theory

UNIT I

Oceanographic factors in fisheries: Effects of physicochemical and biological oceanographic factors on adaptation, behaviour, abundance and production of aquatic organisms; Space and time scales in oceanographic analysis; Speed and magnitude of short-term changes in the ocean; Synoptic oceanographic analysis – currents, waves, tides, amplitudes, stratification, related chemical factors, upwelling and circulation patterns.

UNIT II

Forecasting systems: Fisheries forecasts – interpretation and use of ocean thermal structure in fisheries; Fisheries forecasting system in India and other countries – remote sensing; Global Positioning System (GPS). Application of Remote Sensing in fisheries; Application of echo-sounders and SONAR.

UNIT III

Coastal fishery: Coastal fishery and hydrography- introduction, scope and factors affecting; shoreline protection and influence of developmental activities on coastal hydrography.

UNIT IV

Factors affecting marine fisheries: Environmental factors influencing the seasonal variations in fish catches in the Arabian Sea and the Bay of Bengal.

Practical

Oceanographic data analysis – water temperature, salinity, pH, nutrients, benthos and sediment characteristics; Fisheries forecasting systems; Oceanographic equipment and fish finding devices.

(Oceanographic data analysis – water temperature, salinity, pH, nutrients, benthos and sediment characteristics shall be taught through manuals and PPTs.

Fisheries forecasting systems; Oceanographic equipment and fish finding devices shall be shown & taught through manuals, PPTs. videos and study tours).

AQUATIC MICROBIOLOGY - 2+1 (AEM 511)

Theory

UNIT I

Cell structure and function: Prokaryotic and eukaryotic cell structure, cell membrane, cell wall, proteins, nucleic acids - structure, properties and interactions, microbial growth.

UNIT II

Distribution and classification: Microbial community in freshwater, estuary and marine environment (types and abundance). Microbial dependency on physical, chemical and biological factors of the environment; Classification of aquatic microorganisms, Microbes in extreme environments and their significance - thermophiles, psychrophiles, halophiles and barophiles.

UNIT III

Microbial interaction with matter: Microbial interaction - role of microbial population on the biogeochemical cycles (C, N, P, S, Si and Fe), Xenobiotic and inorganic pollutants; Microbial degradation of natural and synthetic compounds.

UNIT IV

Microorganisms and public health: Water-borne pathogens of public health importance - protozoans, bacteria, enteroviruses; Microbial toxins; Microbial standards for different water uses.

UNIT V

Microbes and aquatic environment: Principles and applications of bioprocesses – bioremediation, biofertilization, biofilms, bio-leaching, biocorrosion, bio-fouling; Microorganisms as bioindicators, bioremediators and biosensors; Microbial biomass production - single cell protein; Bioprospecting.

Practical

Sampling methods; Isolation, identification and enumeration of algae and bacteria from diverse aquatic habitats; growth kinetics; Management of algal and bacterial cultures; Quantification of microbial activities in nutrient cycles; Microbial sensitivity testing; Demonstration of biofilms.

***Compulsory for Masters Programme.**

MAJOR COURSES OFFERED IN Ph.D. (AQUATIC ENVIRONMENT MANAGEMENT):

ADVANCES IN AQUATIC ENVIRONMENTAL STUDIES - 2+1 (AEM 601)
Theory UNIT I Factors effecting productivity of aquatic ecosystems and their interactions; phosphorus, nitrogen and silica cycles; minor metallic elements; organic matter in lake waters. Dynamics of flowing water; Indices of productivity; pollution index –usefulness and limitations. UNIT II Eutrophication – causative factors, effects on water quality, fish and other biota; measures to control the lake degradation due to eutrophication. UNIT III Biomanipulation: Concept and approaches- studies on Planktivorous, Benthivorous and Omnivorous fish. Biological control of macrophyte and eutrophication. UNIT IV Biomonitoring of aquatic environment, scope and process; Bioindicator organisms and its Characteristics; Assessment of water quality through bioindicators. UNIT V Global warming and green house effects- process and impact on aquatic environment; Integrated environment management (IEM), Role of human element in IEM, Analytical Behavior Analysis Approach (ABAA) for IEM. UNIT VI Natural disasters: formation, causes and effects; effects on aquatic habitat and coastal population; Concerns and management; mitigation process; preparedness, Anthropogenic activities leading to environmental disasters. Man-made aquatic environmental degradation; effects on aquatic life. Practical Analysis of ions; Calculation of shoreline development index and other indices of lake productivity; Studies on eutrophication in natural water tanks and ponds; Collection, preservation and estimation (quantitative and qualitative) of bioindicator organisms in polluted water. Demonstration of Biomanipulation experiment; Preparation of disaster kits for coastal fisher; Interaction of the Govt. and Non-Govt. Organizations engaged for disaster management.
BIOTECHNOLOGY FOR CLEANER ENVIRONMENT - 1+1 (AEM 602)
Theory

UNIT I

Pollution Control: Cleaner technologies, Reducing environmental impact of industrial effluents, Toxic site reclamation.

UNIT II

Microbial transformation of toxic metals, Removal of spilled oil and grease deposits, 'Biorational' or 'Environmentally Safe' weed and pest control, Bio-fertilizers, Bio-sensors and biochips to detect environmental pollutants.

UNIT III

Application of biotechnological tools in biomonitoring of aquatic environment; Renewable or bio-energy and bio-fuels from aquatic environment, Energy and fuel production using micro-organisms; Production of food: Single cell protein, Algal biotechnology for production of food; Use of microbes for improving soil fertility, biodegradation.

UNIT IV

Biodiversity and its conservation: Current levels of biodiversity, alpha and beta biodiversity, *in situ* and *ex situ* conservation-gene banks, species conservation. Intellectual Property Rights (IPR) and protection (IPP): IPP and aquatic genetic resources (AGR).

Practical

Quantification of faunal changes in polluted water; Gel electrophoresis; Total DNA isolation; Mitochondrial DNA isolation, Separation and detection of fragments, Comet assay, Micronucleus test, Sister Chromatid exchange; Assessing the molecular and cellular level changes in the Aquatic organisms; Genomic libraries and the development of species specific probes. Southern hybridization; RFLP analysis, PCR mechanics.

BENTHIC ECOLOGY - 1+1 (AEM 603)

UNIT I

Benthic habitat- rocks, reefs, marshes and sediments that form the habitat; recycling of nutrients and the burial and storage of organic matter.

UNIT II

Community ecology; Physical, chemical and biological factors effecting benthic population; abundance and distribution of benthic communities major groups- their life cycles, food and feeding habits and ecological significance; Role in maintaining ecological balance; Recruitment dynamics; Predator prey interaction; Invasive species.

UNIT III

Human impacts; modification of coastal habitats, and major alterations of biogeochemical cycles; contaminants; Benthic organisms as pollution indicators and biomonitors.

Practical

Collection and analysis of soil and water of nearby benthic habitat; collection, identification and preservation of macro and micro benthos; study of food and feeding habit of some benthic population.

OCEANOGRAPHY - 2+1 (AEM 604)

Theory

UNIT I

Definition of an estuary; Buoyancy input as freshwater.

UNIT II

Dynamics of the gravitational circulation; Mixing of fresh and salt water; Sources of energy for mixing. Estuarine circulation, Richardson number.

Contributions to the salt flux.

UNIT III

Simplified salt balance using the steady state salinity distribution to predict the concentration of a pollutant. Freshwater fraction. The flushing time of an estuary and methods of determining it.

UNIT IV

Waves in shallow waters, transformation, refraction and reflection; Mass transport. Return flow. Rip current. Long shore currents. Momentum balance.

UNIT V

Sediment transport. Base studies on sedimentation in Estuaries effects of man –made structures and breakwaters on coastal sedimentation. Standing waves and harbor resonance.

Practical

Measurement of tidal currents in estuaries analyses of tidal heights – Net flow and residence time computations. Computation of salt and nutrient flux. Construction of wave refraction diagrams. Computation of long shore currents and sediment drift beach profiles.

(Measurement of tidal currents in estuaries analyses of tidal heights – Net flow and residence time computations shall be taught from manual's PPT's and videos.

Computation of salt and nutrient flux. Construction of wave refraction diagrams. Computation of long shore currents and sediment drift beach profiles shall be taught from PPT's, manuals and videos).

ORGANIC PRODUCTION AND PLANT PIGMENTS - 2+1 (AEM 605)

Theory

UNIT I

Concepts of production; measurements of rate of production – oxygen technique, radiotracer technique (C14), in-situ measurements.

UNIT II

Phytoplankton production in an isolated, non isolated communities in flowing and standing waters, measurement of rates of production from changes in phytoplankton biomass.

UNIT III

Measurement of photosynthesis under laboratory conditions; factors regulating aquatic production; The role of Enzymes in relation to photosynthesis; The photosynthetic pigments, their location in the chloroplast, The role of accessory pigments during photosynthesis; Molecular organisation of chlorophylls, phycobilins and carotenoids; Pigment degradation products – phaeopigments – phaeophytin and phaeophorbides.

UNIT IV

Chloroplast – structure and function of grana and lamellae. Structure of chloroplast membrane – in relation to energy coupling and transport.

UNIT V

Application of remote sensing in studies on chlorophyll and other pigments.

UNIT VI

Production rates – direct measurement of zooplankton reproduction – marking populations. Laboratory measurements of physiology of zooplankton – feeding, respiration and excretion.

Practical

Estimation of primary production in waters –by Light and Dark Bottle method and radioactive carbon C14 technique. Laboratory studies to understand the impact of nutrients and light on primary production using selected algal cultures. Laboratory studies on the oxygen consumption, filtration and grazing by selected zooplankters. Collection of water samples from selected aquatic environments for the estimation of different plant pigments – chlorophylls and carotenoids; Estimation of pigments in some of the selected aquatic weeds.

ENVIRONMENT IMPACT ASSESSMENT - 1+1 (AEM 606)

Theory

UNIT I

Environmental Impact Assessment (EIA): Process, evaluation and methodology; Social Impact Assessment (SIA) as a part of EIA-principals and process; EIA of aquacultural projects, coastal industries and other developmental activities.

UNIT II

Environmental audit: Concept, setting up an audit programme, typical audit process, carrying out the audit, benefits of environmental auditing, Environmental audit programme in India.

UNIT III

International and national environmental protection standards; Environmental quality monitoring; ISO-14000-Environment Management System (EMS)-present status; Impacts on developing countries.

Practical

Field visits for EIA and SIA of certain aquacultural projects; EIA report preparation; Setting up of Environmental audit programme.

MANAGEMENT AND UTILIZATION OF WASTEWATER - 2+1 (AEM 607)

Theory

UNIT I

Advance treatment methods-Principles and procedures; ozonation, U.V. irradiation etc; Oxidation of sediment; Aerobic and anaerobic treatment process; Role of aquatic macrophytes in biological treatment of waste water; Wastewater treatment through the use of solar energy; Basic design of water and wastewater treatment plants. Removal of nitrogen and phosphorus from wastewater.

UNIT II

Waste recycling and waste management in aquaculture; Design and construction of water filtration devices; Utilization of

wastewater for mass cultivation of algae and other fish food organisms; Utilization of waste water for aquaculture and Agriculture.
UNIT III
Waste disposal criteria used in different parts of world - national and international standards; Production of biogas from sewage;
Advances in Pollution prevention, Environmental management.
Practical
Estimation of physico-chemical characteristics of wastewater. Estimation of nutrients and contaminant of wastewaters. Analysis of living communities associated with treatment processes; Demonstration of wastewater treatments (ozonisation, chlorination, aeration, precipitation, coagulation etc.).

APPLICATION OF REMOTE SENSING AND GIS IN FISHERIES - 1+1 (AEM 608)

Theory
UNIT I
General consideration, Survey planning, Position fixing; Sampling frequency and duration, Data storage and transmission;
UNIT II
Sensors for temperature and salinity (Via conductivity); The measurement of depth (via pressure); CTD units for estuarine and open ocean work; Sensor calibration techniques; Sensors for measuring flow; Tracking of drogoue buoys. Acoustic Doppler current measurements; Optical measurements; transmittance and subsurface reflectance;
UNIT III
In situ fluorescence for the determination of pigment concentration; Remote sensing optical methods; Satellite measurements of temperature (via thermal I.R.), the interpretation of Microwave (geotropic currents, waves, surface winds).
UNIT IV
Geographical Information System (GIS): Definition, Concepts, Spatial data management. Data base management system. Data Capture, Digitization, Data integration, Projection and Registration, Data Structure, Data Modeling. Visual Image Interpretation; Applications of GIS in aquatic Resource identification; Digital Image Processing (DIP): Different Methods and Approaches
Practical
Position fixing techniques. Operation of C.T.D. units and their calibrations. Various types of current meters and measurement of currents. Wave recorders and measurements. Determination of pigment concentrations. Remote sensors – interpretation of data. Practical on visual interpretation of data from map, Practical on Digital Image Processing (DIP). Field practical on the Application of GPS. Mapping of aquatic environment resources through GIS softwares (ARCVIEW, MAPINFO etc.).

DISPERSAL AND FATE OF POLLUTANTS IN THE OCEAN - 1+1 (AEM 609)

Theory
UNIT I
Common transport processes of pollutants in the ocean.

UNIT II

Influence of winds, tides, Waves and currents on the dispersal of pollutants, mixing due to waves and Wave induced currents; Principles of design of marine waste disposal system.

UNIT III

Pollutant dispersion in coastal waters and estuaries, dispersion near outfall sites; Methods of pollutant dispersal dye diffusion studies.

Practical

Techniques of computation of dispersion coefficients; Calculation of Richardson number, tidal exchange calculation at the estuarine mouth;

Numerical analysis of estuarine dispersion; Simple plume experiments – designs of waste discharge and thermal systems.

(Techniques of computation of dispersion coefficients; Calculation of Richardson number, tidal exchange calculation at the estuarine mouth;

Numerical analysis of estuarine dispersion; Simple plume experiments – designs of waste discharge and thermal systems shall be taught by course manuals, practical book and PPT's.).

RESTORATION ECOLOGY - 1+1 (AEM 610)

Theory

UNIT I

Ecological restoration- Need, concept and definition; Approaches; Rationale for restoration; Differences between conservation and restoration; critical ranges of variability in biodiversity.

UNIT II

Ecological processes and structures, regional and historical contexts, and sustainable cultural practices; Ecosystem integrity; community ecological principles; Disturbance, Succession, Fragmentation, Ecosystem auditing; Ecosystem function.

UNIT III

Emerging concepts-Assembly, Stable states; Biotic and abiotic flows and cultural interactions; Application of theory-Invasion, competitive dominance and resource use; Restoration planning; Wetland assessment, Delineation, and regulation; Recovery process, Mitigation, Rehabilitation and Reclamation; Dynamics and restoration of degraded wetlands; Removal of threats to the health and integrity of the restored ecosystem.

UNIT IV

Individuals participation in a restoration programme; different human participatory programme; Sustainable cultural practices; constraints and opportunities; Economics of recovery process.

Practical

Collection and segregation of native and non native species from a damaged environment; Making list of historical and cultural interactions; Status of assemblages; calculation of Index of Biotic Integrity; Listing of the threats to the integrity of the ecosystem; Organizing different participatory programme.

MINOR SUBJECT OFFERED FROM FISHERIES RESOURCE MANAGEMENT IN Ph.D. (AQUATIC ENVIRONMENT MANAGEMENT):

ASSESSMENT OF AQUATIC BIODIVERSITY - 2+1 (FRM 601)

Theory

UNIT I

Definitions and measurement: Methods, scales and indices of biodiversity assessment.

UNIT II

Biodiversity (microalgae to aquatic vertebrates) of any three of the following or similar ecosystem: Chilka Lake, Narmada river system, Gangetic system, Jaykwadi reservoir, Himalayan lake, Himalayan river, Hooghly Malah estuarine system, Coramandonal coast, Gulf of Mannar, Gulf of Kutch, Malabar upwelling, Bhitarkanika.

UNIT III

Threats to biodiversity: Overexploitation, land reclamation, pollution, habitation, conversion of agricultural land and aquacultural farms (case studies pertaining to any sensitive marine/estuarine/freshwater hot spots).

UNIT IV

Conservation and Restoration: Declaration of mangrove sanctuaries and mangrove afforestation, marine protected areas, Ganga Action Plan, introduction of exotic species and their implications; potential consequences and conflicts of linking rivers.

UNIT V

Impacts of anthropogenic intervention on aquatic biodiversity: Damming of rivers, construction of sea walls, micro hydel power stations, oil rigs.

UNIT VI

Legal regimes of biodiversity: International and national conventions and Acts for biodiversity.

UNIT VII

Institutionalization of biodiversity conservation (Such as creation of Biodiversity Boards/Authority).

Practical

Preparation of records and inventories of biodiversity of any three critically important ecosystem based on secondary data and field visits- Compilation of all important International and National laws and conventions related to biodiversity

CONSERVATION AND MANAGEMENT OF EXPLOITED FISHERIES RESOURCES - 2+1 (FRM 603)

Theory

UNIT I

Marine parks, marine protected areas, biosphere reserves, closed seasons.

UNIT II

Cryopreservation of exploited and endangered species.

UNIT III

Fishing regulation policies - A critique on the draft Indian Fisheries policy. A critical appraisal of Inland Fisheries Legislation of any two states of India.

UNIT IV

Protection of habitat of corals, mangrove, seaweeds, sea grass beds. Implementation of square cod end mesh – to reduce by-catch.

UNIT V

Legal proceedings / implementation for protection of exploited and endangered fishery resources.

UNIT VI

Total allowable catch, regulation of mesh size for conservation of exploited fishery resources.

UNIT VII

Management of major reservoirs of India; optimal stocking and production of cultivable resources.

UNIT VIII

A comparative study of the marine regulation acts of any two neighboring countries with reference to Environmental Protection Act (EPA).

UNIT IX

Compile the rules relating to marine fisheries exploitation included in the final UNCLOS III treaty.

Practical

Based on the existing policy, suggest and draft ideal inland and marine fishery legislation for any one Indian State. With reference to the laws of the sea (UNCLOS III) treaty recommend ways and means to solve dispute of shared stocks. Develop a framework for conflict resolution of traditional and mechanized fisheries.

ISSUES IN CAPTURE FISHERIES - 1+1 (FRM 607)

Theory

UNIT I

Over- capacity (excessive fishing efforts); Over exploitation. By-catch and Discards.

UNIT II

IUU (Illegal, Unregulated and Unreported) Fishing. Problems encountered in Monitoring, Control and Surveillance (MCS).

UNIT III

Ghost fishing, destructive fishing practices.

Practical

Assessment of fishing capacity; stages of overexploitation, case studies and field visits.