Aquatic Environment Management- Course Curriculum at a Glance

Ph. D. **MAJOR COURSES**		
	CORE COURSES	**9 credits**
AEM 601	Advances in Aquatic Environmental Studies	1+2
AEM 602	Ecology of Plankton and Benthos	2+1
AEM 603	Biotechnology in Aquatic Environment	2+1
	OPTIONAL COURSES	**6 credits**
AEM 604	Estuarine and Coastal Oceanography	2+1
AEM 605	Aquatic Plant Resources and Environment	2+1
AEM 606	Environmental Impact Assessment	1+1
AEM 607	Management and Utilization of Wastewater	2+1
AEM 608	Application of Remote Sensing and GIS in Fisheries	1+1
AEM 609	Dispersal and Fate of Pollutants	1+1
AEM 610	Restoration Ecology	1+1

AQUATIC ENVIRONMENT MANAGEMENT

Course Contents

Ph.D.

AEM601 ADVANCES IN AQUATIC ENVIRONMENTAL STUDIES 1+2

Objective To impart knowledge on various aspects of advances in aquatic environment studies.

Theory

Unit I Reclamation of degraded habitats

Unit II Environmental monitoring- EIA, economics and auditing

Unit III Management of aquatic resources

Unit IV Global warming and climate change- impact on biodiversity

Unit V Management of disasterswith reference to aquatic environment

Practical Analysis of ions; Calculation of shoreline development index and other indices of lake productivity; Studies on eutrophication in natural waters-tanks and ponds; Collection, preservation and estimation (quantitative and qualitative) of bio-indicator organisms in polluted water;Demonstration of reclamation andbio-manipulation; Prediction of impact of global warming on ecosystem; Interaction with Govt. and Non-Govt. Organizations engaged for disaster management.

AEM 602 ECOLOGY OF PLANKTON AND BENTHOS 2+1

Objective To impart theoretical and practical knowledge of ecology of plankton and benthos.

Theory

Unit I Community ecology – Structure and function

Unit II Plankton- Life history, important plankters, predator-prey relationship;
Role of plankters in food chain, trophic level and food-webs

Unit III Characterization of benthic habitats; Benthic resources; role of benthos in bio-turbation and reclamation

Unit IV Plankters and benthos as pollution indicators;biofiltersand bio-monitors.

Practical Collection and analysis of soil and water in relation to plankton and benthic ecology; Collection and preservation of plankton and benthos;Identification of plankters, benthos; Experiment to explore the role of benthos in nutrient transformation

AEM 603 BIOTECHNOLOGY IN AQUATIC ENVIRONMENT 2+1

Objective To educate about the application of biotechnology in aquatic environment management.

Theory

Unit I Microbial bioremediation of degraded water and various pollutants

Unit II Phytoremediation of degraded water and various pollutants

Unit III Probiotics, Bioreactors, Biosensors, Bio-fertilizers

Unit IV Biotechnological approaches for bio-energy and bio-fuels

Unit V Production of single cell protein,microbial enzymes and biomolecules, Industrial application

Unit VI Molecular tools for biotechnological applications; Culture-independent techniques

Practical Bioremediation, phytoremediation, biosensors, Isolation of prospective bacteria as bio-remediator, bio-fertilizer; enzyme assays; Mass culture of bacteria; Gel electrophoresis; DNA isolation and amplification; RFLP analysis; Meta-genomics; Genomic libraries.

AEM 604 ESTUARINE AND COASTAL OCEANOGRAPHY 2+1

Objective To impart knowledge on the dynamics of estuarine and coastal environment.

Theory

Unit I Estuary concept; Characteristics; Buoyancy input as freshwater; biodiversity, mangrove, mudflat, sea-grass ecosystems

Unit II Physical, chemical and biological dynamics in estuarine and coastal ecosystems

Unit III Salinity distribution; Freshwater fraction; Flushing time of an estuary and methods of determination; Sediment transport in estuarine ecosystem

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

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.

AEM 605 AQUATIC PLANT RESOURCES AND ENVIRONMENT 2+1

Objective To impart knowledge on the aquatic plant resources and environment.

Theory

Unit I Aquatic plant resources- Definition and concept ; Species diversity of aquatic plants in diverse habitats , Bio-prospecting- definition and concept, bio-prospecting of aquatic plants , Economic importance of aquatic plants in fisheries and aquaculture, Environmental factors affecting aquatic plant resources, Role of aquatic plants as bio-filter in decontamination and management of wastewater; Aquatic plants as a source of livelihood

Unit II Role of phytoplankton density in GIS based Potential Fishing Zone advisory generation, algae as a source of food and value added compounds – pigments, biofuels, fine chemicals and pharmaceutical drugs; Aquatic weed management; Harmful algae and their management; Impacts of algal blooms on fisheries, bio-control of algal blooms, bio-manipulation, top-down cascading effects

Unit III Impact of environmental factors on aquatic plant resources - Environmental flow, industrial pollution, aqua-cultural practices, irrigation and drainage, habitat fragmentation and habitat degradation, Bio-invasion and its impact on aquatic plants

Unit IV Management of aquatic plant resources, methods for increasing productivity of water bodies through thermal energy and artificial upwelling , artificial sea ranching , plants as FAD's, Utilization of aquatic plants for environmental management, Algae and angiosperm plants as bio-indicators , Bioremediation of contaminated water through aquatic plants, global warming mitigation through algal biomass and biofuel production; Cultivation of economically important aquatic vegetation *viz.*Trapa and makhana.

Unit V Conservation measures for aquatic plant resources - marine parks, biosphere reserves, International conventions for conservation of aquatic ecosystems, Ramsar convention, Lake conservation programs, Conservation and applications of polar algal resources

Practical Documentation of economically important plants from freshwater and marine habitats (local), techniques for algal cultivation and maintenance of pure cultures, Spirulina and Chlorella cultivation – indoor and outdoor; Extraction of pigments from algae (Carotenoids and Phycocyanin) and analysis of pigments in relation to wavelength and light intensity, Heavy metal removal by algae and macrophytes.

AEM 606 ENVIRONMENTAL IMPACT ASSESSMENT 1+1

Objective To impart theoretical and practical knowledge of environment impact assessment for sustainable development.

Theory

Unit I Environmental legislations;Concepts and approaches to Environmental Impact Assessment (EIA)

Unit II EIA with reference to aquaculture projects, coastal industries and other developmental activities.

Unit III Environmental audit and analysis

Unit IV International and national environmental protection standards; Environmental quality monitoring; ISO-14000

Practical Field visits for EIA and SIA of certain aquacultural projects; Case study and EIA report preparation; Setting of the environmental audit programme

AEM 607 MANAGEMENT AND UTILIZATION OF WASTEWATER 2+1

Objective To impart theoretical and practical knowledge on management and utilization of wastewater.

Theory

Unit I Industrial and domestic wastewater characteristic; Conventional and advanced treatment methodsfor wastewater

Unit II Waste recycling and waste management in aquaculture

Unit III Wastewater disposal criteria - national and international standards

Unit IV Production of Biogas and biofuel from sewage; Wastewater-fed aquaculture

Unit V Integrated wastewater management

Practical Estimation of physicochemical characteristics of wastewater (BOD, COD). 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.).

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

Objective To impart theoretical knowledge and practical skill on application of remote sensing and GIS in oceanographic studies and aquatic environment management planning.

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 drogue 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.).

AEM 609 DISPERSAL AND FATE OF POLLUTANTS 1+1

Objective To impart theoretical and practical knowledge on dispersal and fate of pollutants.

Theory

Unit I Common transport processes of pollutants

Unit II Influence of winds, tides, waves and currents on the dispersal of pollutants

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

Unit IV Lifecycle analysis; Bio-concentration, Bioaccumulation and Bio-magnification

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.

AEM 610 RESTORATION ECOLOGY 1+1

Objective To acquire theoretical and practical knowledge on ecological restoration.

Theory

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

Unit II Emerging concepts-Assembly, Stable states; Biotic and abiotic flows and cultural interactions; Application of theory-Invasion, competitive dominance and resource use

Unit III Restoration planning; Wetland Assessment, Delineation, and Regulation; Recovery process, Mitigation,Rehabilitation**,** and Reclamation; Ecological Engineering – Ecosystem approach for restoration;Dynamics and restoration of degraded wetlands; Removal of threats to the health and integrity of the restored ecosystem. Use of constructed wetlands to eco-restoration.

Unit IV Socioeconomics of recovery process.

Practical Collection and segregation of native and non-native species from a degraded 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. Designing a sustainable ecosytem