

M.Sc., Marine Biology (Syllabus - April 2011 Onwards)
(Semester Pattern)

Course Code	Theory / Practical	Assessment		Credit	Total Marks
		Internal	External		
I SEMESTER					
MABO 411	Physical Oceanography	40	60	4	100
MABO 412	Chemical Oceanography	40	60	4	100
MABO 413	Biological Oceanography	40	60	4	100
MABO 414	Invertebrates	40	60	4	100
MABO 415	Practical - I covering courses 401, 402, 403 & 404	40	60	4	100
II SEMESTER					
MABO 421	Vertebrates	40	60	4	100
MABO 422	Marine Biotechnology	40	60	4	100
MABO 423	Cell Biology	40	60	4	100
MABO 424	Marine Microbiology	40	60	4	100
MABO 425	Practical - II covering courses 421, 422, 423 & 424	40	60	4	100
III SEMESTER					
MABO 511	Physiology and Biochemistry	40	60	4	100
MABO 512	Marine Ecology	40	60	4	100
MABO 513	Fish and Fisheries	40	60	4	100
MABO 514	Practical - III covering courses 501, 502, 503 and Field Trip Report	40	60	4	100
IV SEMESTER					
MABO 521	Marine Pollution	40	60	4	100
MABO 522	Coastal Aquaculture	40	60	4	100
MABO 523	Ocean Policies and Management	40	60	4	100
MABO 524-530	Soft Core I	40	60	2	100
MABO 531-537	Soft Core II	40	60	2	100
		Total		72	1900

Soft Core I – Any one of the course to be selected by the student.

MABO 524 – Benthic Ecology (Offered by Dr. K.A. Jayaraj)

MABO 525 – Marine Environmental Impact Assessment (Offered by Dr. T.Ganesh)

MABO 526 – Marine Ornamental Fishes (offered by Dr. S.Venu)

MABO 527 – Methods in Marine Zooplankton Ecology (Offered by Dr. Gadi Padmavati)

MABO 528 – Marine Biodiversity and Conservation
(Offered by Dr. Jayant Kumar Mishra)

MABO 529 – Bacteriological Assessment of Seafood and Water Quality
(Offered by Dr. R. Mohanraju)

MABO 530 – Remote Sensing and GIS (Offered by Dr. P.M.Mohan)

Soft Core II – Any one of the course to be selected by the student.

MABO 531 – Biostatistics and Computer Applications in Biosciences
(Offered by Dr. T.Ganesh)

MABO 532 – Molecular Taxonomy of Fishes (Offered by Dr. S.Venu)

MABO 533 – Ecotoxicology (Offered by Dr. Gadi Padmavati)

MABO 534 – Bioactive Marine Natural Products (Offered by Dr. Jayant Kumar Mishra)

MABO 535 – Marine Organisms - Collection and Preservation
(Offered by Dr. R.Mohanraju)

MABO 536 – Meiobenthology (Offered by Dr. P.M.Mohan)

MABO 537 – Coral and Mangrove Ecosystems (Offered by Dr. P.M.Mohan)

SEMESTER -I

MABO-411 PHYSICAL OCEANOGRAPHY

TOTAL CREDIT: 4

TOTAL HOURS:60

UNIT-I

12 HOURS

Introduction - oceanography - history of physical oceanography - expeditions - marine biological institutions. Origin of oceans - bottom topography - abyssal hills - plains: submarine canyons - ocean trenches. Recent developments & modern challenges in oceanography - satellite oceanography - Automated ocean observatory.

UNIT-II

10 HOURS

Physical properties of seawater - density, viscosity, surface tension, conductivity and their relationship, temperature distribution in the sea - heat budget - light - UV radiation - acoustics.

UNIT-III

12 HOURS

Dynamics of the ocean - general surface circulation - wind and thermohaline circulation. Forces causing currents - boundary currents - Langmuir circulation - geostrophic currents - turbidity currents - monsoon and trade winds - upwelling.

UNIT-IV

14 HOURS

Waves - currents and tides - theories of waves - tidal waves - formation of swells - internal and standing waves - tsunami - tide generating forces - tidal currents - tidal effects in coastal areas - importance of tide tables - tide and wave energy. Long-term and short-term sea level variation and tectonics - storm surges and climate change - tropical cyclones and impact on coastal zone.

UNIT-V

12 HOURS

Estuaries - origin and classification - estuarine circulations - estuarine zonation- lagoons. Sedimentation - origin and physical properties of sediments - lithogenous - biogenous - cosmogenous - distribution and transport of sediments - determination of age of sediments.

Text Books

1. Grant Gross, M., 1993 Oceanography: A view of the earth (Sixth Edition). Prentice Hall Inc. New Jersey.
2. Thurman, H., 2001. Introduction to Oceanography, Prentice Hall Inc. New Jersey.

Reference Books

1. Sverdrup, H.U., Johnson, M.W. and Fleming, R.H., 1958. The Oceans- their Physics, Chemistry and General Biology, Prentice- Hall Inc. New Jersey.
2. Pickard, G.L. and Emery, W.J., 1995. Descriptive Physical Oceanography. Pergamon Press, London.

MABO-412 CHEMICAL OCEANOGRAPHY

TOTAL CREDIT: 4

TOTAL HOURS:60

UNIT-I

10 HOURS

Introduction to marine chemistry - ocean as a chemical system - origin of sea salts - properties of water molecules - differences between fresh and seawater.

UNIT-II

13 HOURS

Chemical composition of seawater - ionic - major and minor constituents - constancy of ionic compositions and factors affecting constancy - major and minor elements - trace elements - their importance - distribution. Chemistry of seawater constituents - concept of chlorinity and salinity - methods of measurements.

UNIT-III

13 HOURS

Radio nuclides in the sea - origin - distribution and use as tracers of water masses. Dissolved gases - carbon dioxide - origin - importance and distribution. Oxygen - origin and factors governing the distribution. Other gases - nitrogen - hydrogen sulphide - methane - methane hydrate.

UNIT-IV

14 HOURS

Nutrients - inorganic - origin - distribution and important role in the fertility of the sea. Nitrogen - Phosphorus and Silicon in the sea - distribution - cycling - regeneration concept - "new and regenerated" production - N:P ratio. Mineral wealth of the sea - salts - glauconite - petroleum - phosphorite - manganese nodules - potential - economy of extraction. Desalination - recovery of chemicals.

UNIT-V

10 HOURS

Organic matter - dissolved - particulate and colloidal species - sources - classification - composition - distribution - seasonal variation - ecological significance - growth promoting and growth inhibiting effects - biogeochemical cycle. Isotope chemistry - carbon isotope - oxygen isotope - sulphur isotope - hydrogen isotope - classification - estimation - uses of these isotopes in chemical oceanography.

Text Books

1. Millero, F.J., 2006. Chemical Oceanography. CRC Press, New York.
2. Pilson, M.E.Q., 1998. An introduction to the chemistry of the sea. Prentice Hall Inc., New Jersey.

Reference Books

1. Pilson, M.E.Q., 1998. Introduction to the Chemistry of the Sea. Pearson Education.
2. Grasshoff, K., 1999. Methods of Sea water Analysis. Wiley VCH, New York.

MABO-413 BIOLOGICAL OCEANOGRAPHY

TOTAL CREDIT: 4

TOTAL HOURS:60

UNIT-I

10 HOURS

Sea as a biological environment - divisions of marine environment zones - pelagic - benthic - oceanic - coastal zones.

UNIT-II

15 HOURS

Marine diversity - plankton - nekton - benthos - classification. Composition - ecology. Phytoplankton - zooplankton - methods of collection - identification - interrelationship. Harmful Algal Blooms (HAB) - red tide phenomenon - causes and its effects.

UNIT-III

12 HOURS

Primary - secondary and tertiary production - methods for measuring the productivity - factors affecting productivity. CO₂ sequestration - productivity in different oceans. Energy flow through marine food webs - microbial loop - trophic structure and efficiency.

UNIT-IV

12 HOURS

Coastal System - mangroves - seaweeds - sea grass - salt marshes - sand dunes - coral reefs - occurrence - distribution - adaptation, ecology and economic importance.

UNIT-V

11 HOURS

Biological resource assessment and management - using remote sensing techniques and Geographical Information System (GIS). Coastal biodiversity - conservation - management. Critical habitats and biological hot spots.

Text Books

1. Sumich, J.L., 1999. Introduction to the biology of marine life. Seventh edition. The Mc Graw Hill Companies Inc.
2. Nybakken, J.W., 2001. Marine biology – An ecological approach. Fourth edition. Addison Wesley Edu. Pub. Inc.

Reference Books

1. Carmelo, T.R., 1997. Identifying Marine Phytoplankton by Academic Press
2. Naskar, K. and Mandal, R., 1999. Ecology and Biodiversity of Indian Mangroves V. I & II, Daya Publishing House.

MABO-414 INVERTEBRATES

TOTAL CREDIT: 4

TOTAL HOURS:60

UNIT-I

13 HOURS

Classification - life history and phylogenetic relationship of Protozoa and Sponges. Coelenterate - polymorphism, life history - theories of Coral reefs - distribution. Polychaete - classification - morphology - reproduction and adaptive radiation.

UNIT-II

10 HOURS

Functional morphology - development - evolution - nemertinea - entoprocta - ectoprocta - phoronida - pogonophora. Chaetognatha - classification - distribution, morphology, anatomy, embryology, evolution. Brachiopoda - classification - morphology - paleontology and evolution.

UNIT-III

13 HOURS

Crustacea - classification - comparative morphology - moulting - larval forms - evolution and paleontology.

UNIT-IV

13 HOURS

Mollusca - classification - general characters with reference to bivalves - gastropods - cephalopods.

UNIT-V

11 HOURS

Echinodermata - water vascular system - larvae - their comparative morphology - evolution. Prochordata - classification - comparative morphology - reproduction - early development - larval metamorphosis.

Text Books

1. Meglitsch, P., 1991. Invertebrate Zoology. Oxford press, New York.
2. Pechenick, J.A., 2000. Biology of Invertebrates. Tata McGraw Hill.

Reference Books

1. Kaestner, A., 1967. Invertebrate Zoology. V. I - III. Willey Interscience Publishers, New York.
2. Barnes, R.D., 1980. Invertebrate Zoology. Fourth Edition. Saunders College Publishers, Philadelphia.

MABO-415 PRACTICAL –I

TOTAL CREDIT: 4

**TOTAL HOURS:60
15 HOURS**

1. Measuring devices - I Secchi Disc, Lux meter, Turbidity meter.
2. Measuring devices - II Current meter, Echo Sounder.
3. Water sampling devices: Nansen, Niskin.
4. Sediment sampling devices: Van -Veen grab - Petersen grab, Vertical gravity corer.

15 HOURS

5. Estimation of Salinity.
6. Estimation of Dissolved Oxygen.
7. Determination of **Nitrite**, Nitrate.
8. Determination of Inorganic Phosphate, Silica.

15 HOURS

9. Identification of Phytoplankton- Diatoms, Dinoflagellates, Blue green algae.
10. Identification of Zooplankton- Copepods, Hydromedusae, Chaetognatha, Larval forms.
11. Identification of locally available Seaweeds, Seagrass, Mangroves.
12. Extraction and Estimation of Chlorophyll-a, Primary productivity.

15 HOURS

13. Identification of polychaetes, decapods, gastropods, echinoderms.
14. Mounting of gastropod radula.
15. Anatomy of shrimp.
16. Identification of minor phyla – Nematoda, Nemertinea, Sipunculida.

SEMESTER - II

MABO - 421 VERTEBRATES

TOTAL CREDIT: 4

TOTAL HOURS:60

UNIT-I

10 HOURS

Origin of chordates - geological time scale - progression of vertebrates through time - chordate features - theories on origin of chordates.

UNIT-II

13 HOURS

Evolution of bony fishes and amphibian - characteristic features of ancestral vertebrates - classification - evolution of jawless - primitive jawed vertebrates. Evolution and adaptive radiation of elasmobranch - bony fishes. Origin and distribution of amphibia - anatomical peculiarities - affinities of urodele and apoda.

UNIT-III

13 HOURS

Reptiles and marine birds - origin of reptiles - adaptive radiation of contemporary reptiles - turtles - amphibian - reptilian features of *Seymouria* - mammal like reptiles - rise and fall of dinosaurs - including mesozoic marine reptiles - importance of coastal and marine birds.

UNIT-IV

13 HOURS

Evolution of mammals - general characters of mammals - classification and evolution of monotremes - marsupials - placentals - aquatic mammals- classification - adaptation - evolution of cetaceans - sirenians. Aquatic adaptation - respiratory - circulatory mechanisms - comparative anatomy of skin derivatives.

UNIT-V

11 HOURS

Developmental biology - gametogenesis - fertilization - cleavage - development upto gastrulation with special reference to *Amphioxus*. Embryology - with special reference to marine vertebrates, fish, bird, mammal.

Text Books

1. Farland, W.N., Pouch, F.H., Cod, T.J and Heisser, J.B., 1979. Vertebrate Life. McMillan Publishing Inc. New York.
2. Young, J.Z., 2006. The Life of Vertebrates. Oxford University Press.

Reference Books

1. Colbert, et al., 1991. Evolution of the Vertebrates. John Willey & Sons Inc., New York.
2. Minkoff, E.C., 1983. Evolutionary Biology, Addison Wesley Publishing Company, Massachusetts

MABO- 422 MARINE BIOTECHNOLOGY

TOTAL CREDIT: 4

TOTAL HOURS:60

UNIT-I

12 HOURS

Biotechnology in marine science - history of marine biotechnology - application in aquaculture, pharmaceutical, nutritional, environment bioremediation, bio-fouling, bio-corrosion and bio-adhesive. Genetics in marine biotechnology - need of molecular genetics techniques. Gene structure - mutation - molecular mechanism - genetic manipulation.

UNIT –II

14 HOURS

Developmental biotechnology - induced breeding - in-vitro fertilization - cryo - preservation - biotechnological tools - ELISA - FISH - PCR - Gene probes - dot-immuno binding activity - monoclonal antibodies - principles of cloning - transgenic technology. Transcriptional and translational regulations of developmental process in marine invertebrates. Homeotic gene - genetic regulation in early embryonic development - gene expression. Biosafety & ethics.

UNIT-III

12 HOURS

Bioactive marine natural products - introduction to marine natural products - anti tumor - tumor promoting - anti inflammatory - analgesic - anti viral agents - antibiotic - cytotoxic - antimicrobial compounds. Isolation techniques - liquid-liquid extraction - chromatography - conventional techniques for bioactive marine natural products - labile proteins - marine toxins. Commercial development of marine natural products - chitosan - chitin.

UNIT-IV

10 HOURS

Algal biotechnology - marine algae - role in biotechnology - single cell protein - hydrocolloids - agarose - carrageen - alginates - other by products. Marine enzymes - sources - applications. Marine lipids - sources - applications.

UNIT-V

12 HOURS

Bioinformatics - introduction - internet and bioinformatics - bioinformatics servers - European Bioinformatics Institute - National Centre for Biotechnological Information - DNA, Data Bank of Japan - analysis of genome content and organization - analysis of protein content - organization - protein structural analysis - identification - signature motifs in protein - secondary structure prediction - DNA sequence - structural analyses - DNA sequence alignment - phylogeny - basic logical alignment tool - 3D, molecular visualizer - drug designing.

Text Books

1. Le Gal, Y. and Halvorson, H.O. (Eds.) 1997. New Developments in Marine Biotechnology, Plenum Pub. Corp.
2. Colegate, S.M. and Molyneux, R.J. 2008. Bioactive Natural Products (Second Edition). CRC Press.

Reference Books

1. Scheper, T. (Ed.), 2005. Marine Biotechnology. V.I, Springer.
2. Gautam, N.C. (Ed.), 2007. Comprehensive of Biotechnology. V.IV, Shree Publ.

MABO-423 CELL BIOLOGY

TOTAL CREDIT: 4

TOTAL HOURS:60

UNIT-I

12 HOURS

Introduction - cell - prokaryotic - eukaryotic - characteristics cell wall - composition - function. Plasma membrane - structure - function - fluid mosaic - model - membranes - lipids - protein transport across the membranes - passive - active - phagocytosis - endocytosis - role of clatherin coated vesicles.

UNIT –II

12 HOURS

Endoplasmic reticulum - golgi complex - lysosomes - exocytosis - phagocytosis - endocytosis - plant cell vacuoles. Structure of mitochondria - organization - respiratory chain - structure of chloroplast - photophosphorylation - structure of nucleus - nucleolus - nuclear membrane - transport across nuclear membrane.

UNIT –III

12 HOURS

Molecular aspects - cell division - cell cycle - regulation - apoptosis - necrosis. Gene as a functional unit - DNA replication - transcription - translation - transduction - transformation. RNA - types of RNA - functions - translation - relationship between genes and proteins - genetic code. Water - inorganic - organic constituents of cell minerals - polysaccharides - proteins - lipids - nucleic acids - vitamins - enzymes - functions.

UNIT- IV

11 HOURS

Extracellular matrix - collagen - proteoglycans - fibronectin - laminins - integrins - selectin - cadherins - role of tight junctions - gap junctions - role of G- proteins coupled receptors - cAMP - tyrosine kinase in cell signal transductions.

UNIT-V

13 HOURS

Study of cells using microscopes - light, phase contrast, dark field, fluorescence, polarization and electron microscope. Modern trends in cell biology - cellular inclusions at ultra structural level - cell divisions - cell and tissue culture.

Text Books

1. Alberts, B., Bray, D., Lewis, J., Roberts, K. and Watson, J.D., 1996. Molecular Biology of the cell. Garland Publishing Inc., New York,
2. Sheller, D.E. and Bianchi, 2002. Cell and Molecular biology

Reference Books

1. De Robertis, E.D.P., and De Robertis, E.M.F., 1996. Cell and Molecular Biology, B.I Waverly Pvt. Ltd New Delhi.
2. Thorpe, N.O., 1984. Cell biology, John Wiley & Sons, New York.

MABO-424 MARINE MICROBIOLOGY

TOTAL CREDIT: 4

TOTAL HOURS:60

UNIT-I

10 HOURS

Introduction to marine microbiology. Diversity - ecology - physiology - marine archaea, cyanobacteria, bacteria, actinomycete, viruses - role in marine ecosystems.

UNIT-II

13 HOURS

Importance of taxonomy - bacterial classification and the Linnaean system. Whittaker's five kingdom classification - three domain concept of Carl Woese Phylogenetic tree. Unculturable - culturable bacteria - conventional and molecular approach to microbial diversity in nature - PCR - FISH - RFLP - DGGE - molecular phylogeny 16S rRNA, 18S rRNA genomic similarity - DNA homology - DNA-RNA homology - G+C ratio - rRNA sequencing. Fatty acid analysis and genomic sequencing. Metagenomics - introduction - genomics - proteomics.

UNIT-III

13 HOURS

Microbes in ocean processes - biogeochemical cycling of carbon - nutrients - significance of microbial food webs for marine productivity. Extremophiles - halophiles - acidophiles - alkaliphiles - psychrophiles - barophiles - baropsychrophiles - thermophiles - hyperthermophiles - mesophiles. Bacteria and their interaction with other organism - marine invertebrates. Coral microbiology - symbiotic relationship and diseases. Hydrothermal vent bacteria - deep-sea microbes - bioluminescence.

UNIT-IV

12 HOURS

Microflora of aquatic animals. Pathogenic microorganisms - fish, shellfish - impact to human beings. Bacterial - fungal - pathogens in seafood - spoilage in processing - preservation. Pollution microbiology - fecal and total coliforms. Microbial technology - fermentor - batch - continuous culture - bench top - kinetics of product recovery. Microbial products - primary - secondary metabolites - antibiotics - enzymes.

UNIT-V

12 HOURS

Microbial degradation of natural and recalcitrant xenobiotics. Biotransformation - bioaccumulation - bioremediation - biomineralization. Microbial biofilms - mats - stromatolites. Microbial diversity in anoxic ecosystems - anaerobes - methanogens. Microbes - bioleaching of ore and metal corrosion - biofouling.

Text books

1. Paul, J., 1999. Marine Microbiology. Elsevier.
2. Kirchman, L., 2000. Microbial Ecology of the Oceans. John Wiley and sons.

Reference books

1. The Prokaryotes 1992. A handbook on the biology of Bacteria. V. I to IV. Springer & Verlag New York.
2. Kemp et al., 1993. Aquatic Microbial Ecology. Lewis Publishers.

MABO-425 PRACTICAL-II

TOTAL CREDIT: 4

**TOTAL HOURS:60
15 HOURS**

1. Respiratory organs of fish.
2. Morphology of integument and its derivative.
15 HOURS
3. Chromatography concepts – Different types of chromatographic techniques.
4. HPLC – reverse phase columns, separation of compounds of biological interest.
5. Construction of genomic DNA library.
6. Gel Electrophoresis.
15 HOURS
7. Differentiation of animal and plant tissue.
8. Isolation of whole genome DNA from fishes.
9. Preparation of mitochondrial DNA.
10. Extraction of chloroplast.
15 HOURS
11. Isolation of pathogenic organisms from seafood, water and sediment.
12. Identification of unknown bacteria- separation of mixed cultures.
13. Isolation, maintenance and preservation of pure cultures
14. Characterization- biochemical tests - staining of bacteria, cell morphology.

SEMESTER - III

MABO-511 PHYSIOLOGY AND BIOCHEMISTRY

TOTAL CREDIT: 4

TOTAL HOURS:60

UNIT-I

10 HOURS

Introduction - physiology - feeding - rachakonda mechanism of feeding - digestive enzymes and their role with food habits. Respiratory structure and function - factors affecting respiration. Structure and function of blood pigments - role in transport of O₂ and CO₂.

UNIT-II

13 HOURS

Physiology of ionic and osmoregulations - ions in body fluids - mechanism of ionic regulation - responses to osmotic condition - types of osmoregulatory adaptation. Physiology of nervous system - impulse generation and condition - inter-neuronic transmission - integration of information. Physiology of endocrine system - hormones - neurohormones - hormones of reproduction in fin fishes and shell fishes - hormone induced colour change in crustacean.

UNIT- III

10 HOURS

Physiology - rhythms-circadian - tidal and lunar rhythms in marine and estuarine animals - environmental factors responsible for biorhythms - significance of biorhythms.

UNIT-IV

15 HOURS

Biochemical basis of life - chemistry of carbohydrates, protein, lipids and their metabolism. Types of enzymes - functions. Isoenzymes and co-enzymes. Significance of PUFA. Vitamins and their role.

UNIT-V

12 HOURS

Biochemical methods - Centrifugation - Precipitation - Solvent extraction - Chromatography (Ion Exchange, size exclusion, affinity, adsorption, hydrophobic interaction, TLC, GLC, HPLC. Colorimetry - fluometry - spectrophotometry - visible, UV, IR, NMR, MASS.

Text Books

1. Sloman K.A., Wilson, R.W. and Balshire, S., 2006. Behaviour and physiology of Fish. Elsevier Academic Press, USA.
2. Nelson, D.L. and Cox, M.M., 2003. Lehninger Principles of Biochemistry. Macmillan, New Delhi.

Reference Books

1. Vernberg W.B. and Vernerg, F.J., 1972. Environmental Physiology of Marine Animals. Springer, New York.
2. Berg, J.M., Tymoczko, J.L. and Styrrer, 2002. Biochemistry. W.H. Freeman & Co.

MABO-512 MARINE ECOLOGY

TOTAL CREDIT: 4

TOTAL HOURS:60

UNIT-I

14 HOURS

Marine environment - ecological factors - light - temperature - salinity - pressure. Classification of marine environment - pelagic environment - planktonic and nektonic adaptations - benthic environment - intertidal, interstitial, deepsea adaptation. Other coastal environments - estuaries, lagoons, mangroves, seagrass, coral reefs. Hydrothermal vents.

UNIT-II

12 HOURS

Animal association in marine environment - endoecism - inquilinism - phoresis - epizoism - mutualism - communalism - symbiosis - parasitism. Marine zoogeography with reference to Indian - Arctic - Antarctic Oceans.

UNIT- III

12 HOURS

Population ecology - group attributes - population growth - density variations - concept of carrying capacity. Dispersal - prey-predator relationship - density dependant - density independent factors.

UNIT -IV

12 HOURS

Community ecology - structure and composition - diversity - stability - concept of niche - succession - community wise adaptation - fouling and boring community - economic importance - anti-fouling measures.

UNIT-V

10 HOURS

Marine Ecosystems - concepts - principal components - marine food chains - trophic structure - food web - ecological pyramids - energy flow - evolution and management - system ecology and modeling.

Text Books

1. Levinton, J.S., 2000. Marine ecology, Biodiversity and function. Oxford University Press.
2. Bertness, M.D, Gaines, S.D. and Hay, M.K., 2000. Marine Community Ecology Sinauer Associates.

Reference Books

1. Gage, J.D. and Tyler, P.A. 1991. Deep Sea Biology, Cambridge University Press, Cambridge.
2. William, C., 1991. Seashore life between the tides. Dover Publication.

MABO-513 FISH AND FISHERIES

TOTAL CREDIT: 4

TOTAL HOURS:60

UNIT-I

10 HOURS

Introduction to marine fisheries - history - world fisheries. Classification of fin and shell fishes with special reference to species of commercial importance. Preparation of dichotomous keys.

UNIT –II

12 HOURS

Marine fisheries resources of India - pelagic - demersal - oceanic - deep-sea. Fisheries resources of Andaman and Nicobar Islands. Ancillary fisheries resources - seaweeds - chank - crab - lobsters - bivalves. Fisheries resource potential and present level of exploitation. Exploratory fisheries survey. Estimation of exploited marine fisheries resource.

UNIT- III

10 HOURS

Digestive system of fishes - food and feeding habits - feeding adaptations - food analysis indices. Reproductive system of fishes - maturation and spawning - methods of study - relative condition factor - fecundity. Circulatory - respiratory systems of fishes. Migration - causes - methods used for the study.

UNIT-VI

14 HOURS

Fishing craft and gears - traditional - modern. Chart reading - position fixing for ground selection. Fishing aids - echo-sounder - SONAR - GPS - remote sensing. Fisheries forecasting. Fresh fish handling at onboard and landing centers. Fish preservation methods - freezing - drying - salting - smoking - canning. Fisheries by products - fish meal - fish oil - fish protein concentrate - chitin - chitosan - isinglass - shark fin rays. Surimi and fish minced products.

UNIT –V

14 HOURS

Fish population dynamics - concepts of stock - fish stock assessment - maximum sustainable yield (MSY) - overfishing. Age and growth of fishes. Dimensions of growth - estimation of growth parameters - length - weight relationships. Fishing regulations - closed seasons and protected areas. Fisheries statistics - mean - mode - median - regression - Chi-square - correlation - analysis of variance. Softwares used in fisheries – FISAT - PRIMER.

Text Books

1. Moyle, P.B. and Cech, J.J., 1990. Fishes: An Introduction to Ichthyology. Prentice Hall.
2. Bond, C.E., 1979. Biology of Fishes. W.B. Saunders Company, Philadelphia.

Reference Books

1. Bal, D.V., and Rao, K.V. 1990. Marine Fisheries of India. Tata Mcgraw Hill Pub. Co.
2. Srivastava, C.B.L. and Mahal, K., 1999. A text book of fishery science and Indian fisheries. Shree Publishers.

MABO-514 PRACTICAL – III

TOTAL CREDIT: 4

**TOTAL HOURS:60
20 HOURS**

1. Effect of temperature on marine vertebrates.
2. Effect of salinity on marine vertebrates.
3. Proximate composition of fish.
4. Estimation of Amino Acids.

20 HOURS

5. Interstitial fauna - macro and meiofauna - Methods of collection, sorting and preservation techniques.
6. Rocky shore fauna - Methods of collection, sorting and preservation techniques.
7. Sandy shore fauna - Methods of collection, sorting and preservation techniques.
8. Identifications of Pelagic and Benthic fauna.

20 HOURS

9. Identification of common fin and shell fishes of Andaman waters
10. Study on the external morphology of fin fishes and preparation of dichotomy keys.
11. Fishery biology - food and feeding - maturity and spawning - length and weight relationship.
12. Collection of data on fisheries resources and interpretation.
13. Submission of First and Second Field Trip Report
(Two fieldtrips (one in each year) will be conducted for observation, analysis and its interpretation and this to be consolidated and submitted in the form of a report at the end of third semester. This will be evaluated by the programme committee and the grade/mark will be awarded along with the practical work.)

SEMESTER - IV

MABO-521 MARINE POLLUTION

TOTAL CREDIT: 4

TOTAL HOURS:60

UNIT-I

10 HOURS

Marine pollution-definition - role of GESAMP - major pollutant - sources - transport path - dynamics.

UNIT –II

12 HOURS

Sewage pollution - industrial - agricultural - domestic - impact on marine environment - treatment methods. Detergents - composition - eutrophication - ecological significance. Marine debris - plastics - litter - impact in the marine environment.

UNIT –III

14 HOURS

Heavy metal pollution - sources - distribution - fate - analytical approaches. Pesticide pollution - classification - sources - distribution - fate and ecological impacts with special reference to marine fishes, birds and mammals.

UNIT- IV

12 HOURS

Oil Pollution - composition - sources - biological impacts on fishes, birds and mammals - treatment techniques. Ballast water and bio-invasion. Aquatic noise. Thermal pollution - sources - uses of waste heat. Role of biocides - chlorine - ecological impacts. Radioactive pollution - sources - natural - artificial -biological effects of radiation.

UNIT-V

12 HOURS

Environmental monitoring methods - critical pollutants - objectives, status, limitations and biological indicators - bioaccumulation - biotransformation - mussel watch - water quality assessment. Use of analytical instruments - AAS - ICP - GLC.

Text Books

1. Clark, R.B., 1992. Marine pollution. Third edition Clavendron, Press Oxford.
2. Williams, 1996. Introduction to Marine Pollution Control. John Wiley.

Reference Books

1. Johnston, R., (Ed.), 1976. Marine Pollution, Academic Press, London.
2. Kennish, M.J., 1994. Practical handbook on estuarine and marine pollution. Elsevier.

MABO- 522 COASTAL AQUACULTURE

TOTAL CREDIT: 4

TOTAL HOURS:60

UNIT-I

12 HOURS

Introduction to aquaculture - general principles - present status - scope - importance. World aquaculture production and trends. General characteristics of major cultivable fin and shell fishes of India - estuarine - marine - fin fishes (sea bass - groupers - pearl spot - mullets - milkfish); shell fishes (shrimps - crabs - lobsters - mussels - oysters - clams). Seaweed culture.

UNIT –II

12 HOURS

Farming of fin and shell fish - traditional - extensive - modified extensive - semi intensive - intensive culture practices. Monoculture - polyculture - composite culture - pond - cage - pen - raft - rope culture. Mariculture practices. Sea ranching.

UNIT –III

12 HOURS

Selection of suitable sites - farm construction - pond preparation - fertilization - stocking - monitoring - harvesting. Management practices - feed management - types of feeds - water management - control of predators - parasites - diseases.

UNIT- IV

14 HOURS

Hatchery facilities and management - brood stock management - hormonal manipulation - genetic manipulation - micro injection - electrophoration - gene gun - protoplast fusion technique - natural and induced breeding - seed production techniques - breeding - hatchery - nursery phases. Hybridization - selective breeding - in-breeding - out breeding - hybrid vigor. Sex control and sex reversal in fishes. Chromosomal manipulation - gynogenesis - androgenesis - polyploidy. Cryopreservation of gametes. Culture of live feed organisms - microalgae - brine shrimp - rotifers.

UNIT-V

10 HOURS

Modern techniques in aquaculture - Eco-friendly fish farming. Artificial reefs and fish aggregating devices. Eco-labelling. New trends in coastal aquaculture. Regulations in coastal aquaculture.

Text Books

1. Pillay, T.V.R., 1990. Aquaculture principles & practices. Fishing news Ltd., London.
2. Santhanam R., Ramanathan, N. and Jegatheesan, G., 1990. Coastal aquaculture in India, CBS publishers and distributors.

Reference Books

1. Stickney, 1995. Principles of Aquaculture. John Wiley and Sons.
2. John, B.E., 1997. Sustainable Aquaculture. John Wiley and Sons.

MABO-523 OCEAN POLICIES AND MANAGEMENT

TOTAL CREDIT: 4

TOTAL HOURS:60

UNIT-I

05 HOURS

Scientific expeditions - ascertaining the wealth of the sea. Three-major Oceans - importance. Historical evolution of ideas on ocean as a common heritage of mankind.

UNIT –II

17 HOURS

Evolving the Law of the Sea. - Geneva conventions - UNCLOS series - Exclusive Economic Zone (EEZ) - its significance - comparative survey of specific issues - North Sea oil, gas and fishery - George Bank- Bombay High.

UNIT –III

13 HOURS

The Regional Seas Programme of UN - global significance. Antarctic treaty and importance. Endangered marine animals - CITES convention, marine protected areas - biosphere reserves - marine biosphere - marine parks.

UNIT- IV

10 HOURS

Beach sand - mineral deposits with special reference to India - marine metalliferous mud - placer deposits. Scientific economic - geo - political aspects of seabed exploration - mining - seabed treaty. Coastal Regulatory Zone - importance - changes due to development - coastal management issues - comparison between temperate and tropical countries - coastal zone management - integrated management - policies - programmes.

UNIT-V

15 HOURS

Role of National and International agencies and organizations in ocean management - ICAR - MoEF - MoES - NBA - MPEDA - IMO - FAO - UNEP - INMARSAT - IUCN - SCAR - SCOR - IPR - GOOS. Ocean policy (India) - research and management. Geographical Information System (GIS) - uses of GIS in ocean management. Water leasing policy.

Text Books

1. Robert, K., 2009. Coastal Planning and management. CRB publication.
2. Roonwal, G.D. (Ed.) 1986. The Indian Ocean exploited mineral and petroleum resources, Springer Verlag, Berlin.

Reference Books

1. Borgeses, E.M. and Ginsburg, N. (Eds.) 1978. Ocean Year Books - I to XX. The University of Chicago Press, Chicago
2. Juda, L., 1998. International Law and Ocean Use Management: The Evolution of Ocean Governance. Routledge.

MABO 524-530 SOFT CORE I

Each student should select one of the soft cores from MABO524-MABO530. Minimum three students opt for a particular soft core, it will be offered.

MABO-524 BENTHIC ECOLOGY

Offered by Dr. K.A.Jayaraj

TOTAL CREDIT: 2

TOTAL HOURS:30

UNIT-I

06 HOURS

Introduction - benthos - classification - importance - mussel watch programme - benthos of coastal waters - deep ocean - mid-ocean ridge community - trophic dynamics - estuarine community - EIA studies.

UNIT –II

06 HOURS

Methods of sampling - photography - under water television - camera - diving - design of sampling programme - Sediment analysis - bulk benthic processes - bioturbation - sediment sculpting - animal sediment relationships.

UNIT –III

06 HOURS

Macrofauna techniques - intertidal observation - collection - sampling gear - treatment - sorting of sample.

UNIT- IV

06 HOURS

Meiofauna techniques - sampling - treatment - sorting of samples - extraction - sub-sampling - examination - determination of biomass.

UNIT-V

06 HOURS

Phytobenthos - sampling techniques - separation of live populations - estimation of biomass - primary productivity measurements.

Text Books:

1. Giere, O., 2009. Meiobenthology – The Microscopic Motile fauna of the aquatic sediments. Second Edition. Springer Publication.
2. Eleftheriou, A. and McIntyre, A., 2005. Methods for the study of marine benthos. Third edition. Blackwell science Ltd., U.K.

Reference Books

1. Haynes, J.R. 1981. Foraminifera. Macmillan publishers Ltd., London.
2. Higgins, R.P. & Thiel, H. 1988. Introduction to the study of meiofauna. Smithsonian Institution Press, Washington, DC.

MABO-525 MARINE ENVIRONMENTAL IMPACT ASSESSMENT

Offered by Dr. T.Ganesh

TOTAL CREDIT: 2

TOTAL HOURS:30

UNIT-I

05 HOURS

Introduction - Environmental Impact Assessment (EIA) - types of EIA - rapid EIA - comprehensive EIA - environmental clearance - coastal regulation zone - baseline studies - collection of primary and secondary data.

UNIT –II

05 HOURS

Design and sample collection - Site selection - precision - size of samples - variability in biotic communities - appropriate spatial and temporal replication - data collection - field observation.

UNIT –III

07 HOURS

Marine environment – hydrodynamics (tides - tidal ranges - waves - current velocity) - water quality - physical (pH - temperature - salinity - total suspended solids - turbidity) - chemical (dissolved oxygen - BOD - nutrient analysis - heavy metals) - biological (Fecal coliforms - phytoplankton - zooplankton - benthos) - sediment quality - sand - silt - clay fraction analysis - wet sieving method - total organic carbon - organic matter estimation - wet oxidation - Loss On Ignition (LOI) methods.

UNIT- IV

05 HOURS

Identification of marine benthic invertebrates - polychaetes - gastropods - bivalves.

UNIT-V

08 HOURS

Ecological quality measures - univariate measures (species diversity indices) - multivariate measures (Bray-Curtis similarity - multivariate dispersion indices - principal component analysis - cumulative dominance curves or ABC curves). Biological indicators - benthic indicators - Marine Biotic Indices - [BENTIX, AMBI, Benthic Quality Index (BQI) - Ecological quality (EcoQ)] - Taxonomic Sufficiency (TS). Prediction of impacts - risk assessment - environmental management - monitoring - preparation of EIA report using computational software. (Field trip data collection - data interpretation).

Text Books

1. Eleftheriou, A., and McIntyre, A.D., 2005. Methods for the study of Marine Benthos. Blackwell Science Ltd.
2. Clark, R.B 1992. Marine pollution. Third edition Clarendon, Press Oxford.

Reference Books

1. Environmental guidelines for Ports and Harbour Projects - 1998. Ministry of Environment and Forest, Govt. India.
2. Borja A., and Perez, F.J.V., 2000. A marine Biotic Index to establish the ecological quality of soft-bottom benthos within European estuaries and coastal environments. Marine Pollution Bulletin, V.40.

MABO-526 MARINE ORNAMENTAL FISHES

Offered by Dr. S.Venu

TOTAL CREDIT: 2

TOTAL HOURS:30

UNIT- I

08 HOURS

Introduction - marine ornamental fishes - distribution - importance - criteria for selection. Resource analysis - survey - species distribution - abundance.

UNIT - II

06 HOURS

Life history traits of marine ornamental fishes - food spectrum - sex ratio - maturation - spawning – fecundity - length-weight relationships - distribution - habitat.

UNIT - III

04 HOURS

Marine aquarium - basic concepts - merits - challenges. Aquarium management - feed formulation - feeding techniques - water quality maintenance. Types of aquaria - tropical - reef - community tank. Biotope - public aquaria.

UNIT- IV

08 HOURS

Breeding and hatchery production of marine ornamental fishes - brood stock management - feeding - spawning - hatching - larval rearing. Models for breeding and rearing. Health management in marine aquaria. Stress and diseases - viral, bacterial, fungal, other parasites and protozoan's.

UNIT-V

04 HOURS

Marine ornamental fish trade - trends - prospects and issues - international and national trade potential - conservation management. Red data list of endangered - vulnerable - threatened fishes.

Text Books

1. Cato, J.C. and Brown, C.L., 2003. Marine ornamental species: collection, culture and conservation. Ballagh, International Inc.
2. Sunderraj, V., and Satheesh, J.M., 2005. Tropical marine aquarium. TRP publishers.

Reference Books

1. Doy, V.K. 1997. Hand book on aquafarming: Ornamental fishes. MPEDA.
2. Kurup, B.M., Boopendranath, M.R., Ravindram, K., Saira Banu and Gopalakrishnan, A., 2008. Ornamental fish breeding forming and trade. TRP publishers.

MABO-527 METHODS IN MARINE ZOOPLANKTON ECOLOGY

Offered by Dr. Gadi Padmavati

TOTAL CREDIT: 2

TOTAL HOURS:30

UNIT-I

06 HOURS

Definition - zooplankton - size - classification - habitat - depth distribution - length of planktonic life.

UNIT –II

06 HOURS

Sampling methods - vertical - horizontal - oblique hauls - quantitative sampling - qualitative sampling - standard sampling - sampling of live plankton for laboratory experiment.

UNIT –III

06 HOURS

Fixation and preservation of samples - storage - labeling - log sheets - splitting - sorting - counting individuals - observation - identification - dissection - staining - mounting technique - identification of species.

UNIT- IV

06 HOURS

Processing and measurement - biomass - wet weight - dry weight - dry organic weight - body length - length and weight relationship. Biochemical composition - estimation of carbohydrate - protein - total lipid.

UNIT-V

06 HOURS

Rearing and culture - rearing conditions - water quality - physico-chemical parameters - preparation of media - techniques for the culture of feed organisms - phytoplankton - zooplankton.

Text Books

1. Raymont, J.G.E., 1963. Plankton and Productivity in the Oceans. Pergamon press, New York
2. Parsons, T.R., Takahashi, M. and Hargrave, B., 1977. Biological Oceanography, Second edition. Pergamon press, Oxford.

Reference Books

1. Makoto, Omori and Tsutomu Ikeda, 1984. Methods in Marine Zooplankton Ecology, Wiley & Sons. Inc. Canada.
2. Levinton, J.S., 1982. Marine Ecology. Prentice-Hall Inc., New Jersey.

MABO-528 MARINE BIODIVERSITY AND CONSERVATION

Offered by Dr. Jayant Kumar Mishra

TOTAL CREDIT: 2

TOTAL HOURS:30

UNIT-I

06 HOURS

Introduction - marine biodiversity - importance - levels of biodiversity - biodiversity indices. Definition of extinction of marine bio-resources - rate of extinction - causes of extinction - island / intertidal biogeography - vulnerability to extinction.

UNIT –II

06 HOURS

Conservation - essential concepts for small populations - problems of small population - applied population biology - establishment of new populations - ex-situ conservation strategies - conservation categories of species - legal protection of species.

UNIT –III

06 HOURS

Marine protected areas - designing of protected areas - managing protected areas - restoration ecology.

UNIT- IV

06 HOURS

Impediments to marine biodiversity conservation - insufficient scientific information - inadequate transfer of information - cultural and biological diversity - differing benefits and costs harming aquatic life - jurisdictional gaps and overlaps - use of marine environment - immunity from public scrutiny - fragmented decision making.

UNIT-V

06 HOURS

Conservation and sustainable development - traditional societies - Government action - local legislation - national laws - National Biodiversity Act and National Biodiversity Authority. International approaches to conservation and sustainable development - ongoing problems - possible responses - role of conservation biologists.

Text Books

1. Primack, R.B., 2004. A Primer of Conservation Biology, Sinaur Asso. Inc. Publ.
2. Sutherland, W.J., 2000. The Conservation Handbook: Research, Management and Policy. Blackwell Sci. Ltd.

Reference Books

1. Norse, E.A., 1993. Global Marine Biological Diversity; Island Press.
2. McManus, J.W., 1998. A Framework for future Training in Marine and Coastal Protected Area Management. ICLARM.

MABO-529 BACTERIOLOGICAL ASSESSMENT OF SEAFOOD AND WATER QUALITY

Offered by Dr. R.Mohanraju

TOTAL CREDIT: 2

TOTAL HOURS:30

UNIT-I

04 HOURS

Introduction to microscopes - phase contrast, interference, dark field, fluorescence, electron microscope, Atomic force microscope.

UNIT –II

04 HOURS

Safety and hygiene in the laboratory. Sterilization techniques - steam - UV - chemical.

UNIT –III

08 HOURS

Bacterial contamination of seafood - water - sampling enumeration - culturing of bacteria in air - water - sediment - fishes - bivalves.

UNIT- IV

08 HOURS

Bacterial examination of seafood - spoilage - quality assessment - quality assurance programs - HACCP - quality standards - codex alimentarius - International food standards.

UNIT-V

06 HOURS

Assessment of marine pathogens and public health. Drinking water criteria - National and International standards.

Text Books

1. Kemp, P.F., Sherr, E.B.S. and Cole, J.J. 1993. Handbook of methods in Aquatic Microbial Ecology. CRC Press.
2. Bitton, G., 1994. Wastewater Microbiology. Wiley-Liss Inc.

References

1. Whitman, K.A., 2000. Finfish and Shellfish Bacteriology Manual Techniques and Procedures. Iowa state press.
2. Austin, B. and Austin, D.A., 1999. Bacterial Fish Pathogens. John Wiley.

MABO-530 REMOTE SENSING AND GIS

Offered by Dr. P.M.Mohan

TOTAL CREDIT: 2

TOTAL HOURS:30

UNIT-I

04 HOURS

Introduction - scope of remote sensing in natural resources survey - developments in aerial photography - modern developments - advantages - limitations.

UNIT –II

07 HOURS

Earth resource satellites - early history of space imaging - landsat programme - sensors onboard - polar orbiting - geostationary - ocean monitoring satellites. Thermal - multispectral scanning - blackbody radiation - radiation from real materials - atmospheric effects - thermal energy detectors - interpretation of thermal scanner imagery.

UNIT –III

07 HOURS

Digital Image Processing - Image rectification and restoration - image enhancement - spatial feature manipulation - multi image manipulation - image classification - supervised image classification - unsupervised classification - data merging. Image interpretation - elements interpretation - tools and techniques - image Processing Software - application in coastal studies.

UNIT- IV

06 HOURS

Geographical Information Systems (GIS) - definition - development - data sources - data structures - raster and vector - data capturing - pre-processing. Data base management systems in GIS - data manipulations - product generation - environmental GIS. Data acquisition system using GPS - on line GPS applications.

UNIT-V

06 HOURS

Geographical Information System - spatial data - sources of error - data quality - database design - convention - mapping concepts - coordinate systems. Methods of spatial interpolations in GIS - visualizations in GIS.

Text Books

1. Agarwal, C. S. and Garg, P. K., 2000. Textbook on Remote Sensing in Natural Resources Monitoring and Management. Wheeler Publishing, New Delhi.
2. Heywood, I., 2006. An Introduction to Geographical Information Systems. Prentice Hall.

Reference Books

1. Lillisand, T.M. 2003. Remote Sensing and Image Interpretation. John Wiley and Sons.
2. Martin, S. 2004. An Introduction to Ocean Remote Sensing. Cambridge.

MABO 531-537 SOFT CORE II

Each student should select one of the soft cores from MABO531-MABO537. Minimum three students opt for a particular soft core, it will be offered.

MABO-531 BIostatistics AND COMPUTER APPLICATIONS IN BIOSciENCES

Offered by Dr. T.Ganesh

TOTAL CREDIT: 2

TOTAL HOURS:30

UNIT-I

07 HOURS

Basic components of computers - hardware - CPU - input - output - storage devices. Software - operating systems (DOS - windows - linux). Scope of computers in biosciences. Introduction - internet - applications. Introduction - MS excel - MS access - use of worksheet to enter data. Use of in-built basic statistical functions for computations - graphical representation (bar diagram – histogram - scatter plots - pie-chart) of data.

UNIT –II

05 HOURS

Introduction - scope of biostatistics - population - sample - variable - parameter. Collection - organization - representation of data - sampling and sampling design - tabulation - frequency distribution - cumulative frequency curves - graphic representation.

UNIT –III

08 HOURS

Measures of central tendency - mean - median - mode. Measures of dispersion - variability - range - mean deviation - standard deviation - standard error - skewness - kurtosis - correlation - regression analyses - tests of significance - Chi-square test - variation ratio F-test - student's t-test - Analysis of Variance (ANOVA).

UNIT- IV

05 HOURS

Biological data analysis - species diversity indices - Margalef's diversity - shannon-Wiener Index - evenness index - fisher's index - simpson index - biodiversity indices - taxonomic diversity - taxonomic distinctness - variation in taxonomic distinctness index - phylogenetic diversity index - Bray-Curtis similarity - Correspondence Analysis (CA) - Canonical Correspondence Analysis (CCA).

UNIT-V

05 HOURS

Practical classes - hands-on training - collection - organization - graphical representation - interpretation of field - work data using ecology /statistics software (MS excel, MS access - SPSS - PRIMER).

Text Books

1. Khan, I.A. and Khanum, A. 1997. Fundamentals of Biostatistics. Elsevier
2. Mitchell, K. and Glover, T. 2001. Introduction to Biostatistics. McGraw Hill, Publishing Co.

Reference Books

1. Gould, J.F. and Gould, G.F. 2001. Biostats Basics: A Student Hand Book. First edition. W.H. Freeman Company.
2. Clarke, K.R. and Warwick R.M. 2001. Change in marine communities: an approach to statistical analysis and interpretation. PRIMER-E, Plymouth.

MABO-532 MOLECULAR TAXONOMY OF FISHES

Offered by Dr. S.Venu

TOTAL CREDIT: 2

TOTAL HOURS:30

UNIT-I

04 HOURS

Taxonomy - basic concepts - systematic - classification - recent trends and approaches.

UNIT –II

06 HOURS

Taxonomy in relation to chromosomal morphology - evolution - chromosomal rearrangements - speciation. Molecular taxonomy in relation to DNA characteristics - protein sequences. Neutral theory of molecular evolution - genetic markers for taxonomy.

UNIT –III

08 HOURS

Methods in molecular systematic - sampling - isolation of fish genomic DNA - PCR - purification - uses of nuclear and mitochondrial DNA sequences - uses of different molecular markers at different levels of phylogeny - RAPD - AFLP – SNP - Mitochondrial DNA markers - RFLP.

UNIT- IV

06 HOURS

Processing molecular data - phylogenetic inference using different methods - Parsimony - maximum - likelihood - bayesian. DNA sequencing - genotyping - bioinformatics tools in fish taxonomy. Construction of phylogenetic tree - cladistics - cladograms - phenetics.

UNIT-V

06 HOURS

Applications of molecular phylogenesis - organismal phylogeny - evolutionary biology - character evolution - timing the evolutionary tree - tracing the biogeographic history - evolutionary and developmental genetics - biodiversity conservation.

Text Books

1. Page, R.D.M. and Holme, E.C., 1998. Molecular Evolution: A Phylogenetic approach. Springer Verlag.
2. Hills, D.M., Moritz, C. and Mable, B.K., 1996. Molecular Systematics, Second edition. Academic press.

Reference Books

1. Hewitt, G.M., Andrew, W.B., Peter, J.J. and Young, W. (Ed.), 1991. Molecular techniques in taxonomy, Springer Verlag.
2. Kocher, T.D., 1997. Molecular systematics of fishes. Academic Press.

MABO-533 ECOTOXICOLOGY

Offered by Dr. Gadi Padmavati

TOTAL CREDIT: 2

TOTAL HOURS:30

UNIT-I

06 HOURS

Introduction - toxicology - pollution monitoring - role of GESAMP - mass balance model - bioindicators.

UNIT –II

06 HOURS

Toxicity testing methods - fixed dose procedure - factors influencing toxicity - exposure routes - synergistic - antagonistic effects acute toxicity - chronic toxicity - subchronic toxicity - carcinogenicity.

UNIT –III

06 HOURS

Study of LC₅₀ - lethal - sublethal effects - ecotoxicological studies - experimental ecosystems - types of mesocosms and microcosms - role of micro and mesocosms - effects of toxicants to plankton - fish and shell fish.

UNIT- IV

06 HOURS

Methods of sampling - seawater - sediments - biological samples. Estimation of pesticides - heavy metals - hydrocarbon. Harmful Algal Bloom. Bioconcentration, bioaccumulation, biomagnifications, biotransformation. Degradable - non-degradable toxicants.

UNIT-V

06 HOURS

Methods for analyzing pesticides - heavy metals - hydrocarbon - data analysis - interpretation.

Text Books

1. Wayne, G.L. and Ming-Hoyo, 2003. Introduction to environmental toxicology. Taylor and Francis.
2. Aravind Kumar, 2003. Aquatic Environment & Toxicology. Daya Publishing House.

Reference Books

1. Williams, 1996. Introduction to Marine Pollution control, John Wiley.
2. Hayes, W.J. and Laws E.R., 1991. Handbook of Pesticide Toxicology, V. I to III, Academic Press, New York.

MABO-534 BIOACTIVE MARINE NATURAL PRODUCTS

Offered by Dr. Jayant Kumar Mishra

TOTAL CREDIT: 2

TOTAL HOURS:30

UNIT-I

06 HOURS

Introduction - bioactive marine natural products - significance. Anti tumor - tumor promoting - anti inflammatory - analgesic - anti viral agents - antibiotic - cytotoxic - antimicrobial compounds. Examples of products with the details of source marine organism(s).

UNIT –II

06 HOURS

Isolation and characterization of secondary metabolites from marine organisms. Characterization techniques - IR - UV - NMR - GCMS - FABMS - LCMS.

UNIT –III

06 HOURS

Marine microorganisms as a source of biomedical resources - dinoflagellates as a source of bioactive molecules - chemistry and pharmacology of marine toxins - saxitoxin - brevetoxin - ciguatoxin - tetrodotoxin.

UNIT- IV

06 HOURS

Nitrogen and non-nitrogen containing marine bioactive compounds - polyketides - prostanooids - polyethers - macrolides - terpenes.

UNIT-V

06 HOURS

Commercial development of marine natural products - chitosan as biomaterial - algal products - SCPs - β -carotene - vitamins.

Text Books

1. Colegate, S.M. and Molyneux, R.J. 2008. Bioactive natural products (Third Edition) CRC press.
2. Attaway, D.H. 2001. Marine Biotechnology. V.I, Pharmaceutical and bioactive natural products.

Reference Books

1. Scheper, T., (Ed.), 2005. Marine Biotechnology. Springer.
2. Encyclopedia of Marine Natural Products, 2010. Willey and Blackwell. No. I to III.

MABO-535 MARINE ORGANISMS - COLLECTION AND PRESERVATION

Offered by Dr. R.Mohanraju

TOTAL CREDIT: 2

TOTAL HOURS:30

UNIT-I

06 HOURS

Classification of marine life based on major taxonomic groups major categories of aquatic life (plankton - nekton - benthos).

UNIT –II

06 HOURS

Field visit - local habitats - aquatic - seafood industry - major community types - rocky and sandy intertidal - soft sediment - hard bottom - shallow sub tidal. Mangroves - sea grass - seaweeds - coral reef - associates.

UNIT –III

06 HOURS

Methods of sampling - collection of organisms using different techniques - identification and classification and preparation of Voucher specimens and reporting centre. Preparation of herbarium. Information, collection and documentation of site sampled datasets.

UNIT- IV

04 HOURS

Global marine species assessment - CoML - OBIS - Creefs - COMARGE - CeDAMr - CmarZ - CenSeam - ChEss - CAML - ArcOD - IcoMM - FMAP - HMAP.

UNIT-V

08 HOURS

Methods of Narcotization and preservation. Digitization of specimens- Maintenance - Museum specimens. DNA Bar-coding - marine barcode of life (MABOL) - barcode of life database - Protocol for marine specimens. Digital data banking. Digital submission to OBIS.

Text Books

1. Suthers. I.M. & Rissik, D., 2002. Plankton: A Guide to Their Ecology and Monitoring for Water Quality.
2. De Boyd, 2002. A Guide to Marine Coastal Plankton and Marine Invertebrate Larvae.

Reference Books

1. Mac, E. L., 2004. Ecology of Marine Invertebrates. CRC Press.
2. Pechenik, A.K., 2002. Invertebrate Zoology. CRC Press.

MABO-536 MEIOBENTHOLOGY

Offered by Dr. P.M.Mohan

TOTAL CREDIT: 2

TOTAL HOURS:30

UNIT-I

06 HOURS

Introduction - meiobenthology - the microscopic motile fauna of aquatic sediments - meiofauna - definition - history - ecology - economical importance.

UNIT –II

05 HOURS

Environmental factors: abiotic factors - sediment pores and particles - granulometric characteristics - sediment-water regime - physico-chemical characteristics. Biotic Factors - detritus - Particulate Organic Mater (POM) - Dissolved Organic Matter (DOM) - mucus - empolymers - biofilms – bacteria - microphytobenthos.

UNIT –III

05 HOURS

Sampling - size of sampling - sampling device - processing of meiofaunal samples - preserving meiofauna in their natural void system - extraction of meiofauna - fixation and preservation - processing and identification.

UNIT- IV

07 HOURS

Meiofaunal taxa - systematic account - protista - cnidaria - turbellaria - gnathifera - nemertinea - nemathelminthes - tardigrada - crustacean - acari - arthropoda - annelid - sipuncula - mollusca - tentaculata - entoprocta - echinodermata - chaetognatha - tunicata.

UNIT-V

07 HOURS

Biological characteristics of Meiofauna - adaptation to the biotope - mobile environment; three-dimensional dark - adaptation related to reproduction and development. Evolutionary and phylogenetic effects in Meiobenthology. Patterns of Meiofauna distribution. Meiofauna from selected biotope and regions. Synecological perspectives in Meiobenthology.

Text Books:

1. Olav, G. 2009. Meiobenthology – The Microscopic Motile fauna of the aquatic sediments. Second Edition. Springer Publication.
2. Eleftheriou, A., and McIntyre, A., 2005. Methods for the study of marine benthos. Third edition. Blackwell science Ltd., U. K.

Reference Books

1. Haynes, J.R., 1981. Foraminifera. Macmillan publishers Ltd., London.
2. Higgins, R.P. & Thiel, H. 1988. Introduction to the study of meiofauna. Smithsonian Institution Press, Washington, DC.

MABO 537 CORAL AND MANGROVE ECOSYSTEMS

Offered by Dr. P.M.Mohan

TOTAL CREDIT: 2

TOTAL HOURS:30

UNIT-I

06 HOURS

Coral reefs and Mangroves - introduction - types. Formation and zones. Occurrence and distribution - biology - adaptive characters - reproduction. Environmental parameters of coral reef and mangroves habitats.

UNIT-II

06 HOURS

Reef classification - types - stony (hard) and soft coral. Biodiversity - ecology - Darwin's paradox - solution - retention and recycling - coral survey methods. Biodiversity of mangrove ecosystems.

UNIT-III

06 HOURS

Coral reef and Mangroves associates - fish - invertebrates - algae - seabirds - others. Coral reefs and Mangroves in India. Great barrier reef, Sundarbans.

UNIT-IV

06 HOURS

Ecological roles of coral reefs and mangroves. Threats to corals - tourism - poison fishing - alteration of coastline/island habitats - over exploitation - sedimentation - coral harvesting - dynamite fishing - diseases. Climate change - coral bleaching and recovery - bio-shield. Threats to mangroves.

UNIT-V

06 HOURS

Economic value of corals and mangroves. Conservation and management strategies - organizations involved - artificial reefs.

Text Books

1. Karlson, R.H. 1999. Dynamics of Coral Communities. Kluwer Academic Publishers.
2. McClanahan, T.R., Sheppard, C.R.C. and Obura, D.O., 2000. Coral Reefs of the Indian Ocean, their ecology and conservation. Oxford University Press.

Reference Books

1. Peter, F.S. 2006. Ecology of Fishes on Coral Reefs. First Edition, Academic Press.
2. Venkataraman, K., Satyanarayana, Ch., Alfred, J.R.B. and Wolstenholme, J. 2003. Handbook on Hard Corals of India. Zoological Survey of India, Kolkata, India.