M.Sc., Marine Biology (Syllabus - April 2008 Onwards)  
(Semester Pattern)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Theory / Practical</th>
<th>Assessment</th>
<th>Credit</th>
<th>Total Marks</th>
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SEMESTER -I
UNIT I 16 HOURS
Introduction to Oceanography - history of oceanography - expeditions, marine biological Institutions, origin of oceans - bottom topography, abyssal hills-plains: submarine canyons - ocean trenches.

UNIT II 5 HOURS

UNIT III 12 HOURS
Dynamics of the ocean - general surface circulation - wind and thermohaline circulation. forces causing currents, boundary currents, Langmuir circulation, Geotropic currents, turbidity currents, monsoon and trade winds, Upwelling.

UNIT IV 15 HOURS

UNIT V 12 HOURS
Estuaries - origin and classification – estuarine circulations- estuarine zonation- lagoons. Sedimentation- origin and physical properties of sediments (lithogenous, biogenous and cosmogenous), distribution and transport of sediments, determination of age of sediments.

Text Books

Reference Books
MABO-411 CHEMICAL OCEANOGRAPHY

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-
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- BOD and COD. Other Gases – nitrogen,
hydrogen sulphide, methane.

UNIT-IV  14 HOURS
Nutrients- Inorganic, origin, distribution and important role in the fertility of the sea.
Nitrogen, Phosphorous and Silicon in the sea- distribution, cycling, regeneration concept-
“new and regenerated” production, N: P ratio. Mineral wealth of the sea- salts,
glaucnite, 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.

Text Books
   Hall New Jersey.

Reference Books
UNIT-I  

UNIT-II  
Adaptation of plankton- structural (weight, increase of surface area, flotation) physiological (specific gravity, water content, fat content, mono and divalent ions, gas, defensive vacuoles) mechanisms. Phytoplankton and Zooplankton interrelationship- microbial loop- red tide phenomenon- causes and effects.

UNIT-III  

UNIT- IV  

UNIT-V  
Salt marsh and sand dune vegetation -morphological, anatomical and physiological features, ecological role, uses and conservation. Biological resource assessment and management using remote sensing techniques and Geographical Information System (GIS).

Text Books

Reference Books
MABO-413 INVERTEBRATES

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 and evolution Nemertinea, Entoprocta, Ectoprocta, Phoronida, Pogonophora.

UNIT –III     13 HOURS
Crustacea – classification, comparative morphology, crustacean appendages, larval forms, evolution and paleontology.

UNIT- IV      13 HOURS
Mollusca –classification, general characters with reference to bivalves, gastropods and cephalopods.

UNIT-V        11 HOURS
Echinodermata- water vascular system, - larvae, their comparative morphology and evolution. Prochordata - classification and comparative morphology, reproduction and early development, larval metamorphosis.

Text Books:

Reference Books:
MABO-451 PRACTICAL -I


4. Estimation of Salinity.


7. Determination of Reactive Phosphate and Total phosphorous.

8. Determination of Silicate.


10. Identification of Zooplankton- Copepods, Hydromedusae, Pteropods, Chaetognatha, Thaliaceae and planktonic Larvae.

11. Identification of locally available Seaweeds, Seagrasses and Mangrove plants.


SEMESTER - II
UNIT -I 12 HOURS
Origin of chordates; geological time scale - progression of vertebrates through time, chordate features and theories on the origin of chordates.

UNIT - II 13 HOURS

UNIT -III 13 HOURS
Reptiles and Marine birds - origin of reptiles - adaptive radiation of contemporary reptiles, turtles, amphibian and reptilian features of *Seymouria,* mammal like reptiles, rise and fall of dinosaurs, including Mesozoic marine reptiles - importance of coastal and marine birds.

UNIT - IV 11 HOURS

UNIT - V 11 HOURS
Developmental biology - gametogenesis, fertilization, cleavage, development up to gastrulation with special reference to *Amphioxus.* Embryology (with special reference to marine vertebrates - fish, bird and mammal). Nuclear transplantation - embryo transplantation, artificial insemination

Text Books

Reference Books
3. Howard Elliott Winn Behavior of Marine Animals; Vertebrates Publisher: Plenum Pub Cor.
UNIT-I  
Ecology of coastal, shallow and deep sea microorganisms - importance and their significance. Diversity of microorganisms - Archaea, bacteria, cyanobacteria, algae, fungi, viruses and actinomycetes in the mangroves and coral environs.

UNIT-II  
Importance of taxonomy – conventional and modern methods. General microbial techniques. Unculturable forms. 16S rRNA genomic similarity - content of guanine (G) + cytosine (C) (%GC), DNA-DNA homology, Fatty acid analysis and genomic sequencing using Microbial identification system (GCFAME), DNA hybridization, polyphasic taxonomy.

UNIT-III  
Nutrient cycles - Role of microorganisms in carbon, nitrogen, phosphorous and sulphur cycles in the sea under different environments including mangroves.

UNIT-IV  

UNIT-V  
Microbial biodegradation - natural and synthetic material in the marine environment- pesticide, cellulose degradation, hydrocarbon production. Bioremediation of xenobiotics – oil, heavy metals, pesticides, plastics, etc. Mining and metal biotechnology.

Text books  
1. Austin, B, and D.A Austin 1999. Bacterial Fish pathogens- Diseases of Farmed and Wild Fish. Springer Publisher.  

Reference Books  
UNIT-I  
Introduction to Cell, Prokaryotic & Eukaryotic, their characteristics cell wall, composition, function. Plasma membrane, structure, function, fluid mosaic, model, membranes, lipids and protein transport across the membranes- passive, active; phagocytosis, endocytosis, role of clatherin coated vesicles.

UNIT-II  

UNIT-III  
Molecular aspects of cell division and cell cycle, regulation of cell cycle events, apoptosis, necrosis. Water, inorganic, organic constituents of cell minerals, polysaccharides, proteins lipids, nucleic acids, vitamins, enzymes and their functions

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

UNIT-V  
Study of Cells using microscopes (light, phase 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


Reference Books

MABO-418 BIOCHEMISTRY

UNIT-I 10 HOURS
Biochemical basis of life. Significance of macromolecules and micromolecules – carbohydrates, proteins, lipids and nucleic acids.

UNIT-II 12 HOURS
Chemistry of carbohydrates and their metabolism- structure and functions of monosaccharides, oligosaccharides and polysaccharides- glycolysis, citric acid cycle, HMP pathway, gluconeogenesis, glycogen synthesis and glycogenolysis.

UNIT- III 12 HOURS
Classification and chemistry of lipids: structure and functions of triglycerides, phospholipids, glycolipids, significance of PUFA. Metabolism of fatty acids.

UNIT-IV 16 HOURS
Classification of Proteins and their functions- structure of proteins, essential and nonessential amino acids - chemistry, catabolism, urea cycle, biosynthesis of essential amino acids. Biocatalysts- enzymes- nomenclature, classifications, kinetics and mechanism of action allosteric enzymes, isoenzymes, lysozymes, co-enzymes, cofactors catalytic RNA.

UNIT-V 10 HOURS
Biochemical methods – filtration, centrifugation, sedimentation, solvent extraction, aqueous two phase system, sorption, precipitation, chromatography (ion exchange, size exclusion, affinity, adsorption, hydrophobic interaction, TLC, GLC, HPLC) – Spectrophotometric technique – UV, VISIBLE, IR, NMR, MASS.

Text Books


Reference Books

MABO-452 PRACTICAL-II

1. Functional morphology of respiratory organs of aquatic animals- gills of shark, mullet and mudskipper.

2. Functional morphology of integument and its derivative in different groups (skin, scale, etc).

3. Preparation of bacterial media- culture- nutrient broth, agar medium, agar slants.


5. Isolation of pathogenic organisms from seafood water and sediment.

6. Identification of unknown bacteria- separation of mixed cultures.

7. Isolation, maintenance and preservation of pure cultures


9. Qualitative analysis of carbohydrates- reduction of monosaccharide, reducing and non reducing sugars, pentose, aldos and ketoses.


15. Preparation of mitochondria.

16. Preparation of chloroplasts and nuclei from any tissue and assay for their activity.
SEMESTER - III
MABO 510- MOLECULAR GENETICS

UNIT-I 10 HOURS
Evidence of DNA as genetic material- gene as a unit of mutation and recombination. Molecular nature of the gene, organization of prokaryotic and eukaryotic genomes-replication of DNA- role of different enzymes and accessory proteins in prokaryotic and eukaryotic DNA replication.

UNIT -II 11 HOURS

UNIT -III 11 HOURS
Mutation and Mutagenesis- mechanism of mutation – spontaneous mutations, Induced mutations, reverse mutations, suppressor mutations, chemical mutagenesis by nitrous acid, hydroxylamine, alkylating agents, intercalaters- physical mutation by UV. Mechanism of DNA repairs process- Photo reactivation, excision repair, recombination repair, sos pair mechanism and their regulation- heat shock response.

UNIT- IV 14 HOURS

UNIT-V 14 HOURS
Regulation of Gene Expression- prokaryotes- operon concept- positive, negative and as attenuation control- control sequences- promoter, operator, terminator and attenuator, lac and trp operons and translational regulation model. Eukaryotes – regulation at the level of transcription- role of transcriptional factors, regulation of allosteric enzymes. Cloning gene mapping sequencing chromosomal mapping

Text Books


Reference Books


UNIT-II 12 HOURS

UNIT-III 12 HOURS

UNIT-IV 12 HOURS
Structure and composition, diversity and stability, concept of niche, succession, community wise adaptation, e.g. fouling and boring community.

UNIT-V 10 HOURS

Text Books

Reference Books
MABO-512  OCEAN MANAGEMENT

UNIT-I  05 HOURS
Scientific Expeditions for ascertaining the wealth of the sea. The three-major Oceans-their relative importance. Historical evolution of ideas on Ocean as a common heritage of mankind.

UNIT-II  17 HOURS

UNIT-III  13 HOURS
The Regional Seas Programme of UN- their global significance- Antarctic treaty and its importance- Endangered marine animals- CITES Convention- marine biosphere reserves- marine Parks.

UNIT-IV  10 HOURS
Beach Sand Mineral deposits with special reference to India- marine metalliferous mud and placer deposits. Scientific economic and geo-political aspects of seabed exploration and mining- Seabed treaty. Coastal Zone – importance- changes due to development- Coastal management issues- Comparison between temperate and tropical countries- Coastal Zone management –integrated management, policies and programmes.

UNIT-V  15 HOURS
Role of National and international agencies and organizations in ocean management- FAO, UNEP, DOD, WOCE, WHOI, IOI –Malta, IMO – INMARSAT- IUCN, SCAR, SCOR, Marpol, Traffic. Ocean policy (India) - research and management.

Text Books


Reference Books

MABO-513 FISHERY SCIENCE

UNIT-I 05 HOURS
General Morphology and outline classification of fishes - major groups of fishes of the world and their characteristics – Identification of fishes of Andaman & Nicobar Islands.

UNIT –II 12 HOURS

UNIT- III 13 HOURS

UNIT-VI 10 HOURS

UNIT –V 20 HOURS
Collection and analysis of biological data – mean, median, mode, standard deviation, standard error, coefficient of variation, student ‘t’ test, skewness, kurtosis, chi – square, correlation regression and analysis of variance.

Text Books


Reference Books

MABO-551  PRACTICAL - III

1. Isolation and purification of DNA/RNA.
2. Isolation of mutant using chemical and UV radiation.
3. Interstitial fauna and meiofauna - Methods of collection and sorting.
4. Rocky shore fauna - Methods of collection and sorting.
5. Sandy shore fauna - Methods of collection and sorting.
7. Pelagic and Benthic fauna identifications.
8. Field trip to study animal communities in different biotopes - mudflat, sandy and rocky shore, mangrove, oyster bed, fouling organisms, symbionts, parasites, commensals, phytal fauna.
9. Identification of common fin and shell fishes of Andaman waters
10. Study on the external morphology of fishes.
12. Collection of data on fishery resources.
SEMESTER - IV
MABO-515 POLLUTION & TOXICOLOGY

UNIT-I 10 HOURS
Marine Pollution-definition- role of GESAMP- major pollutant- sources, transport path, dynamics. Toxicology- lethal and sub lethal effects of pollutants to marine organisms-bioconcentration, bioaccumulation and biomagnifications- methods of toxicity testing-factors influencing toxicity- synergistic and antagonistic effects- role of microcosms and mesocosms.

UNIT -II 12 HOURS

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

UNIT-V 12 HOURS
Environmental monitoring methods for critical pollutants-objectives status limitations-biological indicators - natural bioaccumulations (mussel watch – water quality assessment. Use of analytical instruments AAS, ICP, GLC, Spectrofluorometer for analyzing Petroleum hydrocarbon, Pesticides, Heavy metals etc.

Text Books


Reference Books

MBAO- 516 COASTAL AQUACULTURE

UNIT-I
Overview – importance of aquaculture, global scenario, present status in India - prospects and scope.

UNIT –II
Aqua-farming systems traditional, extensive, semi-intensive and intensive; selection of site: topography, water availability and supply, soil conditions, design and layout, structure and construction.

UNIT –III
Cultivable Species- Seaweeds- (Gracilaria, Gelidiella, Kappaphycus) Finfishes – (Asian sea bass, groupers, pearl spot, mullets, milkfish and ornamental fishes). Shellfishes – (shrimps, crabs, lobsters, mussels, edible oysters, pearl oysters, clams).

UNIT- IV
Culture techniques - monoculture, polyculture - pond, raceway, cages, pens, raft and rope culture. Hatchery seed production techniques- breeding, hatchery and nursery phases.

UNIT-V

Text Books


Reference Books

MBAO- 517  MARINE BIOTECHNOLOGY

UNIT-I  12 HOURS
Biotechnology in marine science- history of marine biotechnology – application in aquaculture, pharmaceutical, environment remediation, biofouling and biocorrosion.

UNIT -II  14 HOURS

UNIT-III  12 HOURS
Bioactive marine natural products – membrane receptors, anti tumor compounds, anti inflammatory / analgesic compounds, anti viral agents, isolation and identification of marine bioactive compounds such as labile proteins, toxins, carotenoids – biotermillator – Commercial development of marine natural products- chitosan, chitin.

UNIT-IV  11 HOURS

UNIT-V  11 HOURS
Bioinformatics –introduction to computers, Internet and bioinformatics, Bioinformatics servers- (European Bioinformatics Institute, National Centre for Biotechnological Information, DNA Data Bank of Japan), DNA sequence & structural analyses, Basic Logical Alignment Tool, DNA sequence alignment and phylogeny, protein structural analysis, 3D Molecular Visualiser, drug designing.

Text Books


Reference Books

MBAO- 530   PROJECT

Each student will be under a Faculty member and the students will put in 80 hours of field oriented research work which mainly consists of visiting to the field for sample collection and analyzing in the laboratory. Data collected is complied and submitted as a dissertation to the Department. During Viva Voce the student has to present his work to the panel of examiners. The dissertation is sent to experts for evaluation.