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

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Theory / Practical</th>
<th>Assessment</th>
<th>Credit</th>
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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

UNIT-II 10 HOURS

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

Text Books

Reference Books
MABO-412 CHEMICAL OCEANOGRAPHY

TOTAL CREDIT: 4
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

UNIT-III 13 HOURS

UNIT-IV 14 HOURS

UNIT-V 10 HOURS

Text Books

Reference Books
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

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

UNIT-V
11 HOURS

Text Books

Reference Books
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 -

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

Reference Books
MABO-415  PRACTICAL –I

TOTAL CREDIT: 4  TOTAL HOURS: 60

15 HOURS


15 HOURS

5. Estimation of   Salinity.


7. Determination of Nitrite, Nitrate.


15 HOURS


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.


# 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**  

## 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**  

## UNIT-V  
**11 HOURS**  

**Text Books**  

**Reference Books**  
MABO- 422 MARINE BIOTECHNOLOGY

TOTAL CREDIT: 4  TOTAL HOURS: 60

UNIT-I  12 HOURS

UNIT –II  14 HOURS

UNIT-III  12 HOURS

UNIT-IV  10 HOURS

UNIT-V  12 HOURS

Text Books

Reference Books
MABO-423 CELL BIOLOGY

TOTAL CREDIT: 4
TOTAL HOURS: 60

UNIT-I 12 HOURS

UNIT-II 12 HOURS

UNIT-III 12 HOURS

UNIT-IV 11 HOURS

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


Reference Books

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

UNIT-III  13 HOURS

UNIT- IV  12 HOURS

UNIT-V  12 HOURS

Text books

Reference books
MABO-425  PRACTICAL-II

TOTAL CREDIT: 4

1. Respiratory organs of fish.

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
SEMESTER - III
MABO-511 PHYSIOLOGY AND BIOCHEMISTRY

TOTAL CREDIT: 4
TOTAL HOURS: 60

UNIT-I 10 HOURS

UNIT-II 13 HOURS

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

UNIT-V 12 HOURS
Biochemical methods - Centrifugation - Precipitation - Solvent extraction - Chromatography (Ion Exchange, size exclusion, affinity, adsorption, hydrophobic interaction, TLC, GLC, HPLC. Colorimetry - flurometry - spectrophotometry - visible, UV, IR, NMR, MASS.

Text Books

Reference Books
MABO-512 MARINE ECOLOGY

TOTAL CREDIT: 4 TOTAL HOURS: 60

UNIT-I 14 HOURS

UNIT–II 12 HOURS

UNIT-III 12 HOURS

UNIT –IV 12 HOURS

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


Reference Books

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

UNIT- III
10 HOURS

UNIT-VI
14 HOURS

UNIT –V
14 HOURS

Text Books

Reference Books
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.
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.
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.
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

UNIT –III  14 HOURS

UNIT- IV  12 HOURS

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


Reference Books

MABO- 522 COASTAL AQUACULTURE

TOTAL CREDIT: 4 TOTAL HOURS: 60

UNIT-I 12 HOURS

UNIT –II 12 HOURS

UNIT –III 12 HOURS

UNIT- IV 14 HOURS

UNIT-V 10 HOURS

Text Books

Reference Books
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

UNIT –III 13 HOURS

UNIT- IV 10 HOURS

UNIT-V 15 HOURS

Text Books

Reference Books
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 - subsampling - examination - determination of biomass.

UNIT-V  06 HOURS
Phytobenthos - sampling techniques - separation of live populations - estimation of biomass - primary productivity measurements.

Text Books:

Reference Books
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

UNIT- IV
05 HOURS
Identification of marine benthic invertebrates - polychaetes - gastropods - bivalves.

UNIT-V
08 HOURS

Text Books

Reference Books
MABO-526  MARINE ORNAMENTAL FISHES
Offered by Dr. S.Venu

TOTAL CREDIT: 2  TOTAL HOURS:30
UNIT- I  08 HOURS

UNIT - II  06 HOURS

UNIT - III  04 HOURS

UNIT- IV  08 HOURS

UNIT-V  04 HOURS

Text Books

Reference Books
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

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

Reference Books
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

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

Text Books

Reference Books
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

Text Books


References

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

UNIT –III 07 HOURS

UNIT- IV 06 HOURS

UNIT-V 06 HOURS

Text Books

Reference Books
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

UNIT –III 08 HOURS

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

Reference Books
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

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

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

Reference Books
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 - synergestic - antagonistic effects acute toxicity - chronic toxicity - subchronic toxicity - carcinogenicity.

UNIT –III 06 HOURS
Study of LC_{50} - 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

UNIT-V 06 HOURS
Methods for analyzing pesticides - heavy metals - hydrocarbon - data analysis - interpretation.

Text Books

Reference Books
MABO-534 BIOACTIVE MARINE NATURAL PRODUCTS
Offered by Dr. Jayant Kumar Mishra

TOTAL CREDIT: 2 TOTAL HOURS: 30

UNIT-I 06 HOURS

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 - brevotoxin - ciguatoxin - tetradotoxin.

UNIT- IV 06 HOURS
Nitrogen and non-nitrogen containing marine bioactive compounds - polyketides - prostanoids - polyethers - macrolides - terpenes.

UNIT-V 06 HOURS
Commercial development of marine natural products - chitosan as biomaterial - algal products - SCPs - β-carotene - vitamins.

Text Books

Reference Books
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  

## UNIT-III  
06 HOURS  

## 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  

## Text Books

## Reference Books
MABO-536 MEIOBENTHOOLOGY
Offered by Dr. P.M.Mohan

TOTAL CREDIT: 2
TOTAL HOURS: 30

UNIT-I
06 HOURS

UNIT –II
05 HOURS

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

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:

Reference Books
MABO 537 CORAL AND MANGROVE ECOSYSTEMS
Offered by Dr. P.M.Mohan

TOTAL CREDIT: 2
TOTAL HOURS: 30

UNIT-I
06 HOURS

UNIT-II
06 HOURS

UNIT-III
06 HOURS

UNIT-IV
06 HOURS

UNIT-V
06 HOURS

Text Books


Reference Books