

**Department of Marine Living Resources
Andhra University**

**M.Sc. Marine Biotechnology – I Semester Syllabus
Paper 1.1 : Oceanography & Marine biology**

Physical parameters of sea: tides, waves, light, temperature, currents, density & pressure.

Chemical parameters of sea: salinity, dissolved oxygen, carbondioxide, pH, nutrients and trace elements

Composition seawater and brackishwater..

Classification of marine habitats and ecological divisions of ocean.

Plankton, nekton and benthos and their adaptations.

Ecology of coral reefs and mangrove habitats; their special features.

Law pertaining to the seas.

Remote sensing applications in oceanography and marine biology.

References

Svedrup et al	The Oceans	Prentice Hall
Tait RV	Elements of marine ecology	Butterworths
Riley & Skirrow	Chemical Oceanography	Academic Press
Newell RC	Biology of intertidal animals	Logos Press
Kinne O (Ed)	Marine ecology	John Wiley & Sons
Mann KH	Ecology of coastal waters	
King CAH	Introd. Phys. & Biol. Oceang.	ELBS

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**M.Sc. Marine Biotechnology – I Semester Syllabus
Paper 1.2 : Biochemistry**

Basic concepts of biochemistry: an overview, types of chemical bonds.

**Structure & chemistry of biomolecules: Carbohydrates, lipids, proteins
and nucleic acids.**

Carbohydrates, lipids, proteins and nucleic acids of fish and shellfish..

**Metabolism and synthesis of carbohydrates, proteins and lipids and its
regulation.**

Chemistry and properties of Vitamins and hormones.

**Prostaglandins, leucotrienes, thromboxanes, interferons, interleukins,
antibiotics: structure and general properties.**

**Biological membranes and cytoskeletal organization and transport of
biomolecules and elements.**

References:

**Stryer H
Lehninger AL
Voet & Voet
Plummer**

**Biochemistry
Principles of biochemistry
Biochemistry
An introduction to practical biochemistry.**

**Freeman
CBS**

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**M.Sc. Marine Biotechnology – I Semester Syllabus
Paper 1. 3: Marine Microbiology**

**Classification and taxonomy of micro-organisms: viruses, bacteria, microalgae,
Fungi and protozoans.**

Distribution of micro-organisms in the marine environment.

Viruses: Ultrastructure, growth, life cycle and culture.

Bacteria: Ultrastructure, growth, life cycle and culture.

Microalgae and fungi: Culture techniques.

Protozoans and microscopic metazoans: Culture techniques.

References:

Pelczar et al	Microbiology	McGraw Hill
Cappuccino & Sherman	Microbiology- Lab manual	
Stainer RT et al	General Microbiology	MacMillan
Luria et al	General Virology	Wiley

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**M.Sc. Marine Biotechnology – I Semester Syllabus
Paper 1.4 : Enzymology**

Nomenclature & classification of Enzymes.

Enzyme structure and properties.

Enzyme specificity; factors affecting enzyme action.

Mechanism of enzyme action: activation energy; characterization of active site; activators and inhibitors.

Multi-enzyme complex; single and multi-substrate systems.

Regulatory enzymes: Allosterism, covalent modification and feedback mechanisms; ATPase, glutamine synthetase; Haemoglobin and myoglobin.

Membrane-bound enzymes: extraction, purification, assay and enzyme storage

References:

**Boyer P D
Fersht A R
Palmer T**

**The Enzymes
Enzyme structure & mechanism
Enzymes**

**Freeman
Freeman
Horwood**

**Department of Marine Living Resources
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**M.Sc. Marine Biotechnology – II Semester Syllabus
Paper 2.1 : Molecular Biology & Genetics**

Cell nucleus: chromosomes, nucleic acids, heterochromatin; Molecular components packing & organization.

Mendelian principles of inheritance; cytogenetics

Mutations: types, molecular basis, consequences and utilization.

Prokaryotic and eukaryotic cells: Ultrastructure and membrane transport; Signal transduction, cytoskeleton organization.

Cell division: chromosomal and extra-chromosomal; molecular basis of inheritance.

Gene structure & function: transduction, conjugation; DNA as genetic material. Genetic recombinations.

DNA replication and repair; DNA transcription; RNA processing; Ribozyme.

Regulation systems: *lac* and *tryp* operons.

Genetic code and Protein synthesis.

References:

**Lewin B
Watson et al
Friedlander D
Lodish et al**

**Genes IX
Molecular biology of gene
Microbial genetics
Molecular cell biology**

**John Wiley
Benj. Cum. J.
Freeman**

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**M.Sc. Marine Biotechnology – II Semester Syllabus
Paper 2.2 : Microbial technology**

Role of microbes in the sea: recycling of nutrients.

Estuarine and mangrove microbiology.

General principles of bioreactors

Fermentation and bioconversion by microbial organisms.

Microbial degradation of carbohydrates, proteins and lipids.

Single cell proteins : *Spirulina*

References:

**Rehm & Reed
Reed G et al**

**Biotechnology
Industrial microbiology**

CBS

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**M.Sc. Marine Biotechnology – II Semester Syllabus
Paper 2.3 : Enzyme Technology**

Cell & enzyme reactors.

Enzymes involved in nucleic acid modification: DNAses, RNAses, methylases, gyrases, topoisomerases, polymerases.

Enzyme kinetics: steady state kinetics; single and multi-substrate interactions, Competitive, non-competitive and uncompetitive enzyme-substrate kinetics.

Immobilization of enzymes: methods of enzyme immobilization; applications ; Merits and demerits of immobilized enzymes.

Biosensors and modifications; Biological energy transducers.

Synthetic enzymes, co-enzymes; oxidases and oxygenases; isozymes and their importance.

Enzymes of industrial and diagnostic importance.

References:

Siseman A	Handbook of Enzyme technology	Wiley & Sons
Trevan M D	Immobilized enzymes	MacGraw Hill
Plowman K M	Enzyme kinetics	
Rehm & Reed	Biotechnology Vol II: Bioreactors	

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**M.Sc. Marine Biotechnology – II Semester Syllabus
Paper 2.4 : Marine Living Resources**

Plant resources: phytoplankton, seaweeds, seagrasses and mangroves – their distribution and utilization.

Animal resources: Zooplankton, corals, crustaceans, mollusks, echinoderms, and finfish – their distribution and utilization.

Culture of live feed: Phytoplankton (*Chaetoceros*, *Skeletonema*, *Isochrysis*) and zooplankton (rotifers, cladocerans, *Artemia* sp.).

Culture of commercially important fishery resources: seaweeds, crustaceans, mollusks and finfish.

Sea- ranching of economically important marine organisms.

References:

Raymont JEG	Plankton & productivity of oceans	Pergamon
Bardach JE et al	Aquaculture	Wiley interscience
Pillay TVR	Aquaculture: principles and practices	FNB
Santhanam R et al	Coastal aquaculture	CBS

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**M.Sc. Marine Biotechnology – II Semester Syllabus
Paper 3.1 : Aquaculture & Health Management**

Aquaculture : history, status and types.

Selection of site and species for culture.

Culture of shrimps, crab, oysters and sea-cucumbers.

Culture of milkfish, mullets and seabass.

Culture of seaweeds: *Porphyra* culture

Viral, bacterial, fungal, nutritional and environmental diseases in culture systems & their prevention & control.

Ecofriendly aquaculture practices; probiotics in aquaculture.

References

Bardach JE et al	Aquaculture	Wiley- Interscience
Pillay TVR	Aquaculture: principles & practices	FNB
Santhanam R et al	Coastal aquaculture	CBS
Stickney RR	Principles of aquaculture	Wiley & Sons

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**M.Sc. Marine Biotechnology – III Semester Syllabus
Paper 3.2 : Cell and Tissue culture**

**Cell & tissue culture: an overview, equipments and materials for
Cell culture technology.**

Culture media: types and preparation

Cell lines; development of cell lines of shrimp and fish.

Tissue cultures: primary, secondary cultures and their maintenance;

Cloning of cell lines; large scale cultures.

Organ cultures.

**Stem cells: Stem cell cultures, embryonic stem cells and their applications;
Three dimensional culture and tissue engineering.**

**Culture techniques of marine macroalgae, mangroves, crustaceans, mollusks &
fishes.**

Preservation of germplasms.

Industrial applications of tissue culture.

References:

Gupta PK	Biotechnology	
Barnes D & Mathur PJ	Animal cell culture methods	Academic
Basega R	Cell growth & division: a a Practical approach	IRL
Clynes	Animal cell culture techniques	Springer
Freshney I	Culture of animal cells: a manual Of basic techniques	Wiley-Liss
Harrison et al	General techniques of cell culture	Cambrid. U.
Lan FR	Culture of animal cells	Wiley-Liss
Masters RW	Animal cell culture: practical approach	Oxford
Hoar & Randall	Fish Physiology Vol V	

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**M.Sc. Marine Biotechnology – III Semester syllabus
Paper 3.3 : Bioactive Marine Natural products**

Introduction: Significance of marine natural products.

**Isolation techniques: liquid-liquid extraction, membrane separation methods,
Chromatography (paper, TLC, HPLC) techniques.**

Characterisation techniques: IR, UV, NMR and Massspectra

**Types of important products: Antibiotic, anti-tumour, tumour-promotor,
anti-inflammatory, analgesic, cytotoxic, anti-viral anti-fouling
compounds of marine origin.**

Marine toxins: Saxitoxin, brevitoxin and ciguatoxin

**Marine peptides & alkaloids: pyridoacridine, pyrrolocridine indole,
pyrrole, isoquinoline alkaloids.**

Marine prostaglandins and marine cosmetic products.

Theries of drug action and factors affecting drug action.

References:

David HA et al	Marine Biotechnology	Plenum
Scheur PJ	Marine Natural Products	Academic
DS Bhakuni DS Rawat	Bioactive marine natural products	Springer& Anamaya

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**M.Sc. Marine Biotechnology – III Semester Syllabus
Paper 3.4 : Marine Pollution and Biodeterioration**

Sources of marine pollution, its dynamics, transport paths and agents.

Composition of domestic, industrial and agricultural discharges. Their fate in the marine environment. Toxicity and treatment methods.

Oil pollution: Sources, composition and its fate in marine habitats. Toxicity and treatment methods.

Thermal and radioactive pollution: sources, effects and remedial measures.

Solid dumping, mining and dredging operations: their effects on marine ecosystem.

Role of biotechnology in marine pollution control.

Biofouling and biodeterioration: Agents and protection methods.

Global environmental monitoring methods: status, objectives and limitations.

References:

Nielsen SE	Tropical pollution	
Kinne O	Marine Ecology Vol. V	John Wiley
Johnson R (Ed)	Marine pollution	Academic Press
Patin SA	Pollution and boil. Resources of oceans	Butterworths

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**M.Sc. Marine Biotechnology – IV Semester Syllabus
Paper 4.1 : Genetic Engineering**

Basic concepts: Restriction enzymes, DNA ligases, Klenov fragment, T4 DNA polymerase, cohesive & blunt ends ligation, autoradiography, Radio-active and non-radioactive probes, hybridization techniques (Southern, Northern, Western and colony hybridization), DNA finger printing and DNA foot printing, transposons.

Cloning vectors: Plasmids, bacteriophages (lambda, M 13), cosmids, Yeast vectors, shuttle vectors.

Cloning methodologies: Insertion of foreign DNA into the host cells, Transfection techniques. Construction of Genomic and C-DNA libraries, Jumping and hopping libraries. Southwestern and farwestern Cloning. Analysis of cloned genes.

PCR and its applications: Basic principles of PCR; types of PCR (Multiple, Nested, reverse transcriptase, real time, touch down, hot start, colony). Site specific mutagenesis, PCR based mutagenesis.

Sequencing and Gene-therapy methods: DNA sequencing (chemical, Enzymatic, automated). RNA sequencing. Gene silencing techniques (Si RNA, Si RNA technology, Micro RNA, Construction of RNA vectors). Gene Knock-outs and gene therapy (suicide gene therapy, gene replacement and gene targeting.)

References:

RW Old & SB Primrose	Principles of Gene manipulation	Blackwell
H Lodish et al	Molecular cell biology	Scientific American
RF Weaver & PW Hedrick	Genetics	WCB
S. Mitra	Genetic Engineering	
J Sambrook & DW Russel	Molecular cloning- Lab manual Vol. 1-3	

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**M.Sc. Marine Biotechnology – IV Semester Syllabus
Paper 4.2 : Immunology**

Introduction to immune system: types of immunity.

Antigens: types and properties.

Immunoglobulins: structure, types and functions.

Immunogenetics: Major histocompatibility gene complex.

Genetic basis of antibody diversity.

Molecular biology of B and T cells.

Complement proteins and cytokines.

**Immunological techniques: immunodiffusion, immunoelectrophoresis,
Immunofluorescence, ELISA and RIA.**

Production of monoclonal antibodies.

**Disorders of immune system: hypersensitivity, autoimmunity and
Immunodeficiency.**

Transplantation immunology and tumour immunology.

Immunotherapy: immunostimulants, vaccines and antibodies.

Immunology fish and shellfish.

References:

Eli Benjamini	Immunology – a short course	
I. Riott	Essentials of immunology	Blackwell
I Riott et al	Immunology	Molsby
Aruna B	Manual of practical immunology	Palani-paramount

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**M.Sc. Marine Biotechnology – IV Semester Syllabus
Paper 4.3 : Applications of Biotechnology**

**Biotechnology applications in Aquaculture: chromosomal manipulations:
Gynogenesis, androgenesis, polyploidy and transgenesis**

Cryopreservation, in-breeding, cross-breeding, hybridization & sex control

Reproduction: Hormonal control and induced breeding.

Synthetic feeds: composition, formulation and processing.

Gene manipulations to improve strains.

**Diseases in marine organisms: application of biotechnology in disease
diagnosis; prevention and control; Gene probes.**

References:

**Colwell RR Biotechnology in Marine Science
Colwell RR et al Biotechnology of marine polysaccharides.**