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
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 Biochemistry Freeman
Lehninger AL Principles of biochemistry CBS
Voet & Voet Biochemistry
Plummer An introduction to practical biochemistry.
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
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: Allosteryism, covalent modification and feedback mechanisms; ATPase, glutamine synthetase; Haemoglobin and myoglobin.

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

References:

Boyer P D                      The Enzymes            Freeman
Fersht A R                    Enzyme structure & mechanism Freeman
Palmer T                      Enzymes                  Horwood
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**                 **Genes IX**            **John Wiley**
- **Watson et al**            **Molecular biology of gene**    **Benj. Cumm.**
- **Frifielder D**            **Microbial genetics**
- **Lodish et al**            **Molecular cell biology**    **Freeman**
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  Biotechnology
Reed G et al  Industrial microbiology  CBS
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
Trevan M D                Immobilized enzymes                      Wiley & Sons
Plowman K M              Enzyme kinetics                             MacGraw Hill
Rehm & Reed              Biotechnology Vol II: Bioreactors
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
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
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  Academic
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
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, brevotoxin and ciguatoxin

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

Marine prostaglandins and marine cosmetic products.

Theories 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
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
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.


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.


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 Sambroo & DW Russel Molecular cloning- Lab manual Vol. 1-3
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, Immunoflorescence, 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
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.