- Microscopes: Types and basic principles
- Microbes in the sea: Viruses, bacteria, fungi, micro algae and protozoans distribution in the marine environment.
- Sterilization techniques employed in microbiological studies.
- Viruses: Morphology, enumeration, isolation, culture, classification
- Bacteria: Morphology, enumeration, isolation, culture, classification, identification and preservation.
- Marine Microalgae, fungi and protozoans: Classification and culture.
- Role of microbes in the marine environment.
- Methods of controlling microbial organisms: Physical, chemical and chemotherapeutic methods.
- Microbial decomposition of carbohydrates, proteins and lipids.
- Mangrove microbiology: Mangrove microbial processes and the organisms involved.

Books:

References:
**Paper 3.2 : Principles of Biochemistry**

- Biomolecules, carbohydrates, lipids, proteins, vitamins and minerals –structure , biological significance, role in metabolism, bioenergetics
- Moulting and growth, regulating factors.
- Analytical techniques, Biomolecular separation, isolation and purification. Chromatography-paper, thin layer, GLC, HPLC, affinity chromatography
- Centrifugation, spectroscopy, fluorescence, nanometry and microtomy.
- Microscopy: Light, bright field, phase contrast fluorescence and electron microscopy.
- Enzymes- classification, enzyme action, factors affecting enzyme catalysis, control of enzymatic action, immobilization of enzymes, coenzymes, activators and inhibitors, allosteric enzymes, ribozymes and abyzymes.
- Digestive physiology of finfishes and shellfishes.

**Books:**

**References:**
Paper 3.3: Bioactive Marine Natural Products – I

Bioactivities of Marine Natural Products. An introduction to the of marine natural products; Antibiotic-tumor, repellent, anti-parasitic, Microbial, antifouling.

Commercial potential and development of marine natural products.

Chitosan as a biomaterial.

Algae products: carrageenan, algin, B-carotene and vitamins.

Marine microorganisms as a new biomaterial resources (marine microalgae, fungi and bacteria).

Dinoflagellates as a source of bioactive compounds: A brief introduction of isolation, chemistry and pharmacology of saxitoxin, brevitoxin and cigatoxin Tunicromes.

Isolation techniques: Liquid – Liquid extraction, membrane separation methods and Chromatography (TLC, HPLC) and conventional techniques.

Characterization techniques: IR, UV, NMR, and mass spectra.

Books:

References:
**Paper 3.4: Marine Pollution**

Marine Pollution: Definition by GESAMP, major sources of pollution, dynamics, transport paths and agents.

Toxicology: Lethal and sub lethal effects of pollutants on marine organisms, evaluation of toxicity tolerance, bioassay.

Enzymatic removal of hazardous organic substances from aqueous effluents.

Sewage: Domestic, Industrial, agricultural and aquacultural discharges, their composition and fate in the marine environment, toxicity and treatment methods, sewage disposal system.

Environmental Impact Assessment Methods of aquaculture activities.

Oil pollution: Sources and fate of oil, composition and toxicity of oil, biological effects treatment procedures.

Thermal and radioactive pollutants: Source and characteristics, strategies for disposal of RNA and Heated effluents, biological effects and alternative uses of waste dumping, mining and dredging operations, their effects on the organisms and marine environment.

**Text Books/References:**

2. A.M.Chakravarthy Biodegradation and detoxification of Environmental pollutants, CRC Press, 1928.
COASTAL AQUACULTURE AND MARINE BIOTECHNOLOGY
FOURTH SEMESTER
Paper 4.1: Pathology and Immunology

- Disease causing agents: Physical, Chemical and Biological
- Disease diagnostics: Epidemiology, Laboratory studies, microbiological and histopathological studies.
- Viral, bacterial, fungal and protozoan diseases in marine organisms and their control methods.
- Chemotherapeutic agents: Types and modes of action.
- Applications of biotechnology in the diagnosis and control of diseases.
- Antigens and their general properties.
- Immunoglobulins: Structure and properties
- Immunity: natural and acquired; Immunogenetics
- Cytotoxicity mechanisms.
- Immunology of invertebrate marine organisms
- Techniques in immunology, precipitation reactions, agglutination reactions.
- ELISA, RIA, Immuno-electrophoresis, vaccine production and immunization. Immunotherapy, production of monoclonal antibodies, hybridoma technology.

Reference Books:
2. I.M.Riott Essential of Immunology Blackwell Pub.
Paper 4.2 : Molecular Biology

- Cell- Structure, organization, function
- Molecular basis of nucleic acids- DNA, RNA, mitochondria, plastids. Ribosomes
- Regulation of gene expression in pro and eukaryotes, attenuation and antitermination.
- Operon concept, DNA methylation, Heterochromatinization, regulatory sequences and transacting factors, Environmental regulation of gene expression
- Mechanism of transcription of prokaryotes and eukaryotes. RNA processing ribonucleoproteins, Genetic code, protein synthesis, Bacteriophage Genetics, Transduction, Complementation, Molecular recombination, DNA ligases, topoisomerases, gyrases, methylases, nucleases, restriction endonucleases.

Books:
4. De Robertis : Cell and Molecular Biology
Paper 4.3: Marine Biotechnology

- Microbial fermentation, microbes in decomposition and recycling processes, application of biofermenter and biofertilizer. Microbial transformation process, the structure of fermentation process.

- Genetic engineering, gene targeting, approaches in biotechnology, isolation in nuclear and extra nuclear DNA, Gene modification and introduction southern, northern and south-western blots, hybridization, colony hybridization and sequencing of proteins, and nucleic acids, polymerase chain reaction.


- Cell and tissue culture primary culture, cell line, cell clones, callus culture, somaclonal culture, micropropagation, somatic embryogenesis, haploidy, protoplast fusion and somatic hybridization, cybrids.


Text Books:


References:
**Paper 4.4. Bioactive Marine Natural Products - II**

Bioactive marine natural products: Anti-tumour, tumour promoting, anti-inflammatory, cytotoxic, anti-neoplastic and analgesic compounds.

Nitrogen containing marine natural products: Amides, (Symbioramide, mycolamide – A), Tyrosin based metabolites (Aeroplisinin – 1), diagoamides – A and B, Indoles (Herbindoles – A - C) Imadezoles (Girolline), Pyridines (Theonelladines), Peptides (didemnins, Dolastatins), ara – A, nucleosides (toyocamnins), swinholide and macrolides.

Non Nitrogenous Bioactive Compounds: polyketides (Dysidazirine, ficulinic acids-A and B, Duryne, Aliphatic esters, peroxides), prostanoides (clavulone –II punaglandin-1, chloro, bromo and iodo vulones).

Polyethers (hemibrevitoxin B, lokadaicacid), macrolides (amphidinilide .A. swinholide A, bryostatins) Terpenes, laplysiterpenoid, geranyl hydroquinone.


Books:

References: