

DEPARTMENT OF MARINE LIVING RESOURCES

Revised Syllabus

With effect from 2021-2022



ANDHRA UNIVERSITY
Visakhapatnam

DEPARTMENT OF MARINE LIVING RESOURCES, ANDHRA UNIVERSITY
M.Sc. Marine Biotechnology-I Semester- Scheme of Examination
(With effect from 2021-2022 admitted batches)

Paper No	Paper Title	Maximum Marks			Credits		
		Theory (End exam + Mid)	Practical (Semester end)	Total marks	Theory	Practical	Total
1.1	Oceanography and Marine Biology	80+20	50	150	4	2	6
1.2	Biochemistry	80+20	50	150	4	2	6
1.3	Reproductive Physiology and Endocrinology	80+20	50	150	4	2	6
1.4	Molecular Biology	80+20	50	150	4	2	6
	Total marks	400	200	600	16	8	24
M.Sc. Marine Biotechnology -II Semester							
		Theory (End exam + Mid)	Practical (Semester end)	Total marks	Theory	Practical	Total
2.1	Coastal Aquaculture	80+20	50	150	4	2	6
2.2	Fish Genetics	80+20	50	150	4	2	6
2.3	Marine Microbiology and Microbial Technology	80+20	50	150	4	2	6
2.4	Cell & Tissue Culture	80+20	50	150	4	2	6
	Total marks	400	200	600	16	8	24
M.Sc. Marine Biotechnology -III Semester							
		Theory (End exam + Mid)	Practical (Semester end)	Total marks	Theory	Practical	Total
3.1	Health Management in Aquaculture	80+20	50	150	4	2	6
3.2	Immunology	80+20	50	150	4	2	6
3.3	Enzymology and Enzyme Technology	80+20	50	150	4	2	6
3.4	Marine Pollution and Bio-deterioration	80+20	50	150	4	2	6
3.5	MOOC-I						4
	IPR (Value added course)						
	Total marks	400	200	600	16	8	28
M.Sc. Marine Biotechnology -IV Semester							
		Theory (End exam + Mid)	Practical (Semester end)	Total marks	Theory	Practical	Total
4.1	Applications of Biotechnology in Aquaculture	80+20	50	150	4	2	6
4.2	Genetic Engineering	80+20	50	150	4	2	6
4.3	Bioactive Marine Natural Products	80+20	50	150	4	2	6
4.4	MOOC-II						4
4.5	Project	100		100	4	-	4
	Viva-voce		50	50		2	2
	Research Methodology						
	Total marks	400	200	600	16	8	28

Programme: M.Sc., Marine Biotechnology (MBT)

Programme Outcome (PO):

- PO1. Masters the concepts in oceanography, Biochemistry, Molecular Biology, Reproductive Physiology and Endocrinology of Fish
- PO2. Acquire knowledge on Coastal Aquaculture; apply the principles of genetics, Marine Microbiology and Tissue Culture on aquaculture species.
- PO3. Understand the principles of Health Management in Aquaculture, Immunology, Enzymology and Enzyme Technology and can apply them in Industry.
- PO4. Masters the concepts in Marine Pollution and Bio-deterioration.
- PO5. Understand the applications of Biotechnology and Genetic Engineering in Aquaculture, Bioactive Marine Natural Products and their applications.

Programme Specific outcome (PSO):

- PSO1. Able to practice the applications of Marine Biotechnology in Oceanography, Marine Biology and Aquaculture industries.
- PSO3. Able to establish own Aquaculture/ Marine Biotechnology related industry.

Programme Educational objectives (PEO):

- PEO1. Gets employment in Aquaculture farms, Hatcheries, Aquaculture Feed and processing industries especially in Quality assurance sections.
- PEO2. Gets employment in R&D sectors connected to health care of Aquatic animals.
- PEO3. Can crack any entrance examination leading to higher education such as doctoral program etc.

M.Sc. Marine Biotechnology
First Semester
Course 1.1: Oceanography and Marine Biology

Learning Objectives (LO):

- LO1. To impart knowledge in dimensions of oceans, physical parameters of sea, Heat budgets of the oceans, sound and its propagation in the sea.
- LO2. To understand chemical parameters of the sea, composition of seawater and brackish water
- LO3. To impart knowledge on classification of marine habitats and ecological divisions of the ocean. Ecology of coral reefs and mangrove habitats and Sea-ranching.
- LO4. To understand the Law pertaining to the sea, Remote sensing applications in oceanography and marine biology, GIS and its role in oceanography.
- LO5. To impart knowledge on National and International Institutes of marine research: NIO, CMFRI, CIFE, CIFT, CIBA, MPEDA, INCOIS and NRSA.

Course Outcome (CO):

- CO1. Obtain knowledge on dimensions of oceans, physical parameters of sea, Heat budgets of the oceans, sound and its propagation in the sea.
- CO2. Acquire knowledge on chemical parameters of the sea, composition of seawater and brackish water.
- CO3. Obtain knowledge on classification of marine habitats and ecological divisions of the ocean. Ecology of coral reefs and mangrove habitats and Sea-ranching.
- CO4. Acquire knowledge on Law pertaining to the sea, Remote sensing applications in oceanography and marine biology, GIS and its role in oceanography.
- CO5. Obtain knowledge on National and International Institutes of marine research: NIO, CMFRI, CIFE, CIFT, CIBA, MPEDA, INCOIS and NRSA.

Course Specific Outcome (CSO):

- CSO1. The student will be able to understand the reasons for climatic changes in day to day life
- CSO2. The student will be able to apply the knowledge of oceanography and marine biology to the aquaculture activities to improve yield from aqua farms.
- CSO3. The student will have an opportunity to work in the organizations such as NRSA, INCOIS, NIO, IMD as technical person.

Unit - I

Dimensions of oceans; Physical parameters of sea: Tides, waves, light, temperature, currents, density, pressure. Heat budget of the oceans. Sound and its propagation in the sea.

Unit - II

Chemical parameters of the sea: salinity, dissolved oxygen, carbon dioxide, pH, nutrients and trace elements. Composition of seawater and brackish water.

Unit - III

Classification of marine habitats and ecological divisions of the ocean. Plankton, nekton, benthos and their adaptations, methods of collection
Ecology of coral reefs and mangrove habitats; their special features.
Sea-ranching of economically important marine organisms.

Unit - IV

Law pertaining to the seas: Historical perspectives in International negotiations and settlementsover open seas. Modern law of the sea.

Remote sensing applications in oceanography and marine biology.

Elements of Geographic Information Systems (GIS) and its role in oceanography.

Unit - V

National and International Institutes of marine research: NIO, CMFRI, CIFE, CIFT, CIBA, MPEDA, INCOIS, NRSA.

their affiliation, thrust areas of research, administrative hierarchy, scientist recruitment.

Scripp's Institute of oceanography, Woods Hole Institute of Oceanography, Rosential School of Marine Sciences, Hawaiian Institute of Marine Biology, National Oceanography and atmospheric administration, Plymouth Laboratories.

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

Practical:

1. Determiation of Salinity of the sea water sample adopting Harvey's Method
2. Determiation of the Dissolved Oxygen concentration in the sea water adopting Winkler's Method
3. Determiation of Alkalinity of the sea water sample following Titrimetric Method
4. Determiation of pH of sea water sample using a digital pH meter.
5. Identification of Phytoplankton Zooplanktons Nekton, Intertidal and sub-tidal organisms, coral reefs and mangroves.

Course 1.1. Mapping of course outcome with Programme outcome

	CO1	CO2	CO3	CO4	CO5
PO1	✓	✓	✓	✓	✓
PO2					
PO3					
PO4					
PO5					

Course: 1.2: Biochemistry

Learning objectives (LO):

- LO1. To understand the basic concepts of biochemistry, bonding properties of carbon, chemical bonds, classification, structure and properties of carbohydrates and their metabolism.
- LO2. To understand the structure and properties of proteins and lipids, their metabolism and knowledge on principles of metabolic regulation and regulatory steps.
- LO3. To understand the proximate compositions of fish and shellfish and bioenergetics.
- LO4. To understand the structure and properties of vitamins and hormones, prostaglandins, leucotrienes, thromboxanes, interferons, interleukins and types of antibiotics.
- LO5. To understand the organization of membranes, transport of biomolecules and biochemical pathway of photosynthesis.

Course outcomes (CO):

- CO1. Able to gain fundamental knowledge in biochemistry, carbohydrates and understand the various metabolic pathways of carbohydrates and its regulation.
- CO2. Able to gain knowledge on amino acids, protein structure, fatty acids and metabolism of proteins and lipids and regulation of metabolic pathways.
- CO3. Able to know the composition of finfish and shellfish and basic principles of bioenergetics, equilibria, concept of free energy and coupled processes.
- CO4. Able to know the chemical nature of vitamins, hormones, prostaglandins, leucotrienes, thromboxanes, interferons, interleukins and types of antibiotics.
- CO5. Able to know about biological membranes, transport of biomolecules, cell signaling and pathways of photosynthesis.

Course Specific Outcomes (CSO):

- CSO1. Becomes competent on basic concepts of biochemistry, chemical bonds, structure and properties of biomolecules and their metabolism.
- CSO2. Attains the skill on biochemical functions of different biomolecules, their metabolism and regulation, bioenergetics, biological membranes, vitamins, hormones and antibiotics.

Unit-I

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

Structure & properties of biomolecules - Carbohydrates; Metabolism of carbohydrates - Glycolysis, Gluconeogenesis, Krebs's cycle, Oxidative phosphorylation.

Unit-II

Structure & properties of biomolecules – proteins, lipids ; Protein metabolism, lipid metabolism- Beta fatty acid oxidation. Principles of Metabolic regulation- regulatory steps

Unit-III

Proximate compositions of fish and shellfish.

Bioenergetics: Basic principles, Equilibria and concept of free energy; Coupled processes

Unit-IV

Structure and properties of Vitamins and hormones; Prostaglandins, leucotrienes, thromboxanes, interferons, interleukins . Types of antibiotics

Unit-V

Biological membranes: organization-sideness and function, transport of biomolecules and cytoskeletal organization. signals and second messengers Biochemical pathway of photosynthesis and factors affecting.

References:

Stryer H Biochemistry Freeman
Lehninger AL Principles of biochemistry CBS
Voet & Voet Biochemistry
Plummer An introduction to practical biochemistry.

Practical:

1. Estimation of moisture in fish/shrimp muscle
2. Estimation of protein in fish/shrimp muscle by Lowry's method
3. Estimation of carbohydrate in fish/shrimp muscle by Anthrone method
4. Estimation of lipid in fish/shrimp muscle by Sulpho- Phospho vanillin method
5. Separation of proteins by Acrylamide GEL Electrophoresis
6. Estimation of glycine by formal titration
7. Analytical method to detect carbohydrates
8. Analytical method to detect amino acids-
9. Analytical method to detect proteins
10. Analytical method to detect lipids
11. Equipments in Biochemistry

Course: 1.2. Mapping of course outcomes (COS) with Programme outcomes (POS):

	CO1	CO2	CO3	CO4	CO5
PO1	✓	✓	✓	✓	✓
PO2					
PO3					
PO4					
PO5					

Course 1.3: Reproductive Physiology and Endocrinology

Learning Objectives (LO):

- LO1: To understand the anatomy and histological changes in gonads of fish and shellfish.
- LO2: To understand sexual dimorphism and sex differentiation.
- LO3: To understand the factors responsible for reproduction and sexual dimorphism.
- LO4: To understand the endocrine system of finfish and shell fish and its role in reproduction.
- LO5: To understand the applications of biotechnology in accelerating reproduction and gonadal development.

Course Outcome (CO):

- CO1: Acquire knowledge on reproductive system of finfish and shell fish.
- CO2: Acquire knowledge on sex determination
- CO3: Acquire knowledge on the reproductive cycles, spawning season, gonadal development and fecundity studies of finfish and shellfish.
- CO4: Acquire knowledge on Importance and role of endocrine system.
- CO5: Acquire knowledge on applications of biotechnology in aquaculture.

Course Specific Outcome (CSO):

- CSO1: Able to differentiate the sexes of finfish and shellfish.
- CSO2: Able to identify the physiological changes of reproduction in finfish and shellfish.
- CSO3: Able to perform induced breeding in finfish and shellfish.
- CSO4: Gets employment in aquaculture farms and hatcheries.

Unit - I

Anatomy and histology of gonads in fin fish and shellfish.

Development of gonad: oogenesis; spermatogenesis, metabolic changes during oogenesis and spermatogenesis and gonadal steroidogenesis.

Unit – II

Sex determination and differentiation, factors affecting sex differentiation.

Sexual dimorphism, primary and secondary sex characters, bisexual reproduction, inter-sexes, hermaphroditism. Sex reversal in fish and shellfish, factors affecting sex reversal.

Unit - III

Breeding biology: Annual reproductive cycles and breeding patterns in fin fish and shell Fish, artificial insemination

Role of environment - photoperiod, temperature, rainfall, nutrition

Pheromones and reproductive behaviour.

Unit - IV

Role of hypothalamo-hypophyseal system and pineal gland

Neuro-endocrine systems in fish and shell fish and its role in the regulation of reproduction.

Unit - V

Cryopreservation of gametes

Application of biotechnology for accelerating gonadal growth

In vitro fertilization.

References:

- Adiyodi KG & Adiyodi RG. 1971.** Endocrine Control of Reproduction in Decapod Crustacea. Biology Reviews.
- Agarwal NK. 2008.** Fish Reproduction. APH Publ.
- Bell TA & Lightner TA. 1988.** A Handbook of Normal Penaeid Shrimp Histology. World Aquaculture Society.
- Ghosh R. 2007.** Fish Genetics and Endocrinology. Swastik Publ. & Distr.
- Hoar WS, Randall DJ & Donaldson EM. 1983.** Fish Physiology. Vol. IX. Academic Press.
- Maria RJ, Augustine A & Kapoor BG. 2008.** Fish Reproduction. Science Publ.
- Matty AJ. 1985.** Fish Endocrinology. Croom Helm.
- Mente E. 2003.** Nutrition, Physiology and Metabolism in Crustaceans. Science Publ.
- Nikolsky GV. 2008.** The Ecology of Fishes. Academic Press.
- Thomas PC, Rath SC & Mohapatra KD. 2003.** Breeding and Seed Production of Finfish and Shellfish. Daya Publ. House.

Practical:

1. Dissection of reproductive system - fish, shrimp, Celina
2. Estimation of spawning season
3. Estimation of fecundity
4. Gonadal maturity stages in fish, shrimp, mollusca
5. Dissection and display of pituitary gland from fish
6. Preparation of pituitary gland extract
7. Estimation of GSI
8. Dissection and display of various endocrine organs of fish/shrimp

Course 1.3. Mapping of Course outcome with Programme outcome

	CO1	CO2	CO3	CO4	CO5
PO1	✓	✓	✓	✓	✓
PO2					
PO3					
PO4					
PO5					

Course 1.4: Molecular Biology

Learning Objectives (LO):

- LO1. To understand Cell structure and function in prokaryotes and eukaryotes, Cell cycle and its regulation.
- LO2. To understand structure, function and plethora of crucial metabolic activities and mechanisms followed by nucleic acids.
- LO3. To understand Transcription, Translation, Protein turn over and degradation, Post- translational modifications.
- LO4. To understand regulation of gene expression; DNA methylation, and Environmental regulation of gene expression.
- LO5. To understand types and causes of Mutations and Oncogenes

Course outcomes (CO):

- CO1. Able to understand cell structure and cell division mechanisms.
- CO2. Able to gain knowledge on structure and major functions of nucleic acids.
- CO3. Get to know transcription, translation and post translational modifications.
- CO4. Able to gain knowledge on Operon concept and environmental regulation of gene expression
- CO5. Gain knowledge on types and causes of mutations, oncogenes, tumour suppressor genes

Course Specific Outcomes (CSO):

- CSO1. Attains the skill in isolation, purification and quantification of nucleic acids
- CSO2. Able to gain hands on experience on restriction digestion of DNA, bacterial transformation.
- CSO3. Become competent to understand and apply principles molecular biology in fisheries as well as aquaculture right from disease prevention and treatment to generation of new protein products and manipulation of marine organisms for desired phenotypic traits. These principles form basis for developing strategies for conservation and sustainable exploitation of marine resources.

Unit-I

Cell structure and function in prokaryotes and eukaryotes with reference to nucleus, mitochondria, chromosomes and ribosomes. Cell cycle and its regulation.

Unit-II

Nucleic Acids: Structures of DNA and RNA; DNA replication, damage and repair in prokaryotes and eukaryotes; DNA recombination: homologous, non-homologous and site-specific recombination

Unit-III

Transcription in Prokaryotes and eukaryotes; Regulatory elements, processing of tRNA and rRNA; Genetic code, Translation and Translational machinery: Ribosomes, composition and assembly; Transport of proteins and molecular chaperones, Protein stability, Protein turnover and degradation; Post-translational modifications

Unit-IV

Regulation of gene expression in prokaryotes and eukaryotes - Operon concept – Lac, Tryp, Ara, Gal and His; DNA methylation, regulatory sequences and transacting factors

Unit-V

Environmental regulation of gene expression

Mutations: Types, Physical, chemical and biological mutagens, Role of transposons in mutations. Oncogenes and tumor suppressor genes.

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

Practical:

1. Qualitative analysis of Nucleic acids.
2. Quantitative analysis of nucleic acids.
3. Plasmid DNA and Genomic DNA isolation & quantitation: Plasmid mini preparations
4. Isolation of RNA from yeast cells/ fish
5. Purification of DNA from an agarose gel
6. Restriction digestion of DNA
7. Bacterial transformation

Course 1.4 mapping of course outcomes(COS) with Programme outcomes(POS):

	CO1	CO2	CO3	CO4	CO5
PO1	✓	✓	✓	✓	✓
PO2					
PO3					
PO4					
PO5		✓			

M.Sc. Marine Biotechnology
Second Semester
Course: 2.1: Coastal Aquaculture

Learning Objectives (LO):

- LO1. To understand the importance and present status of coastal aquaculture.
- LO2. To understand the various technical aspects of site selection, design and construction of fish/shrimp culture systems and hatcheries.
- LO3. To understand the various culture practices.
- LO4. To understand the biology and life cycles of finfish and shellfish and sea weeds.
- LO5. To understand the criteria for species selection and culture of fishes, molluscs, crustaceans and sea weeds.

Course Outcome (CO):

- CO1. Acquire knowledge on present status of coastal aquaculture.
- CO2. Obtain knowledge on site selection and design of fish/shrimp ponds, cages, pens, race-ways and hatcheries.
- CO3. Acquire knowledge on types of culture practices, i.e. traditional, extensive, semi-intensive, intensive, super-intensive, integrated and organic farming.
- CO4. Obtain knowledge on biology and life cycles of finfish, shellfish and sea weeds.
- CO5. Acquire knowledge on culture of finfish, shellfish and sea weeds.

Course Specific Outcome (CSO):

- CSO1. Able to culture fishes, shrimps, molluscs and sea weeds in coastal waters.
- CSO2. Able to get employment in coastal aquaculture and its subsidiary industries.

Unit-I

Definition and importance of aquaculture. Overview and status of aquaculture in India. Global aquaculture scenario, production, consumption and emerging trends.

Unit-II

Engineering aspects of aquaculture: Design and construction of pond and hatchery. Types of culture systems: Ponds, cages, pens, race ways. Types of culture practices: Traditional, extensive, semi-intensive, intensive, super intensive, ultra-intensive, mono- and poly culture, integrated and organic farming.

Unit-III

Biology and life cycles of *Penaeus monodon*, *Penaeus vannamei*, *Macrobrachium rosenbergii*, *Panulirus homarus*, *Scylla serrata*, *Crassostrea madrasensis*, *Pinctada fucata*, *Loligo sps.*, *Chanos chanos* and *Lates calcarifer*.

Unit-IV

Criteria for selection of species for coastal aquaculture.
Finfish culture: Milk fish, mullets, Asian sea bass.
Shell fish culture: Shrimps, prawns, crabs, lobsters, oysters, mussels and cephalopods.

Unit-V

Life cycles of seaweeds: *Ulva fasciata*, *Gracilaria corticata* and *Sargassum tenerrimum*.
Culture practices of seaweeds in India and Abroad. Farming of Agar, Algin and Carrageenan yielding seaweeds. Breed improvement in Sea weeds.

References:

Bardach JE et al. Aquaculture Wiley interscience
Pillay TVR Aquaculture: principles and practices FNB
Bardach, John.E. 1997 Sustainable Aquaculture. John Wiley and Sons.
Chapman, V.J., 1980. Seaweeds and theirs uses Chapman and Hall London.
Wheaton, F.W. 1977. Aquaculture Engineering. John Wiley and Sons, New York.
Stickney, 1995. Principles of Aquaculture, John Wiley & Sons.
Santhanam R et al Coastal aquaculture CBS

Practical:

1. Identification of fish based on morphometric and meristic data.
2. Identification of shrimp based on morphological characters.
3. Dissect and display the digestive system of fish, shrimp, molluscs
4. Identification of cultivable organisms: Seaweeds, Crustaceans, Molluscs and Finfish
5. Identification of larval forms of cultivable organisms: Crustaceans, Molluscs and Finfish.
6. Aquaculture equipment.
7. Design and describe shrimp hatchery and fish farm.

Course 2.1 mapping of course outcomes (COS) with Programme outcomes (POS):

	CO1	CO2	CO3	CO4	CO5
PO1					
PO2	✓	✓	✓	✓	✓
PO3					
PO4					
PO5					

Course: 2.2 Fish Genetics

Learning objectives (LO):

- LO1. To understand applications of genetics in fisheries and aquaculture; Chromosomal polymorphism, Genetic improvement in fish.
- LO2. To understand concepts of Population genetics; Genetic variability and differentiation.
- LO3. To understand the concepts of genetic similarity; adaptive variation in trait-related genes
- LO4. To understand uses of Allozyme and DNA markers and their applications; genetic diversity and conservation.
- LO5. To understand concepts of Parentage, Linkage, Karyotyping; Transgenics, GMO; Genotoxicity assays.

Course Outcome (CO):

- CO1. Gains knowledge on principles and applications of genetics in fisheries and aquaculture.
- CO2. Gets insight into various parameters to study Population genetics.
- CO3. Acquires knowledge on various aspects of genetic variation.
- CO4. Gains knowledge on applications of protein and DNA markers in fisheries.
- CO5. Able to get knowledge on concepts of QLT mapping; Karyotyping and laboratory assays for DNA damage

Course Specific Outcome (CSO):

- CSO1. Become competent to apply principles and concepts of genetics in estimating genetic diversity existing in fish and shellfish populations.
- CSO2. Able to regenerate fish stocks and conserve fish germplasm by chromosomal manipulations.
- CSO3. Able to employ/develop various allozyme and DNA markers for species/stock identification, hybridization and characterization of finfish and shellfish species.
- CSO4. The knowledge gained can be used for development of increasingly sensitive population discriminators, yielding information that can be valuable for both sustainable exploitation and the conservation of marine organisms.

Unit-I

Scope and Importance of fish genetics. Mendelian inheritance, Non- chromosomal & Mitochondrial inheritance, genetic variation, chromosome theory, genetic basis for sex determination and sex linked genes in fish, linkage and crossing over.

Unit-II

Chromosomal polymorphism, Gynogenesis, androgenesis, production of super males. Genetic improvement in fish. Population genetics: Changes in allelic and genotypic frequency, effective population size, inbreeding and coefficients, Fitness, qualitative and quantitative traits, Components of variance- additive and non-additive variance.

Unit-III

Genetic variability and differentiation, Genetic similarity and Nei's genetic distance, Genetic bottle neck and mutation drift equilibrium null alleles, population genomics, outlier loci and adaptive variation in trait-related genes.

Unit-IV

DNA markers in stock identification: Allozymes, RFLP, RAPD, AFLP, Microsatellites, ESTs, SNPs, Type I and Type II markers, mt DNA and nuclear DNA markers, Laboratory assay of markers, Hybridization, genetic diversity and conservation, Parentage, Linkage, QLT mapping and microarray genes.

Unit-V

Karyotyping and chromosome banding- C-banding, G-banding, NOR banding. Fluorescence In-situ Hybridization (FISH), Transgenics, GMO and biosafety regulations, designer ornamental fish. Comet assay, Sister chromatid exchange, MNT (Max's Next Tango).

References:

Pandian TJ, Strussmann CA & Marian MP Fish Genetics & Aquaculture SciencePub
Biotechnology
Lakra/Singh Fish genetic resources
Mirza Akbar Khan Genetic Embryology and fishes

Practical:

1. Exercises on Mendelian laws
2. Estimation of gene and genotypic frequencies
3. Estimation of effective population size
4. Building of pedigree size
5. Protein, mt DNA and nuclear DNA extraction.
6. ANOVA in genetic variance
7. Estimation of heritability by half-sib, full-sib and mid-parent analysis.
8. Procedures for estimating breeding values/coefficient of inbreeding.
9. Estimation of genetic diversity and relatedness using molecular information.
10. Preparation of chromosome spreads; karyotyping, banding techniques, comet assay.

Course 2.2 mapping of course outcomes (COS) with Programme outcomes (POS):

	CO1	CO2	CO3	CO4	CO5
PO1					
PO2	✓	✓	✓	✓	✓
PO3					
PO4					
PO5				✓	

Course: 2.3: Marine Microbiology and Microbial Technology

Learning objectives (LO):

- LO1. To understand the general principles of microscopy, microbiology including the morphology, taxonomy and culture methods of Virus, Bacteria, Microalgae and Marine Protozoans.
- LO2. To understand techniques of sterilization, enumeration and preservation of Bacteria.
- LO3. To understand the general principles and design of bioreactors used for fermentation .
- LO4. To understand the role of pathogenic microorganisms in fish preservation and concepts of quality management in fish processing.
- LO5. To understand the principal aspects of planning and implementation of HACCPs in Marine Food processing industries.

Course outcomes (CO):

- CO1. Able to isolate and identify various microbes.
- CO2. Able to understand and apply the principles of microscopy, microbiology and Microbial technology in fish processing and beverage industries.
- CO3. Able to detect pathogenic microbes and antibiotic residues in fish and shrimp.
- CO4. Able to plan the total management of Sea food processing industries.
- CO5. Able to assess the hazards and risks in sea food and monitor National and International standards.

Course Specific Outcomes (CSO):

- COS1. Attains the skill in Microbial taxonomy.
- COS2. Becomes competent to undertake Microbiological works in Sea food processing, Aquaculture and Beverage industries.

Unit-I

Microscopy: Principles and Working mechanisms of Light, Phase contrast, Transmission and Scanning electron microscopes. Virus, bacteria, fungi, protozoans and their classification. Microbes in extreme environments and their significance- thermophiles, psychrophiles, halophiles and barophiles.

Unit-II

Physical and chemical methods of Sterilization. Viruses: morphology, isolation and culture methods. Bacteria: Morphology, Enumeration, culture, classification and preservation. Culture of Fungi and protozoans.

Unit-III

Bioreactors: Design and types. Fermentation and bioconversion by microorganisms. Water borne pathogens of public health importance: Protozoan, Bacteria, Enteroviruses, microbial toxins. Microbial standards for different water uses.

Unit-IV

Role of bacteria and moulds in fish preservation. Microorganisms in frozen, canned and dried products and their control. Fish quality, evaluation and different indices of quality, total quality management in sea food processing.

Unit-V

HACCP: Practical aspects of planning and implementing HACCP systems. Hazards in sea foods, risk assessment. National and international standards – ISO 9000, ISO 22000. Role of Bureau of Indian Standards, Export Inspection Agency, EIC and FSSAI. Traceability issues in international trade.

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
Rehm & Reed	Biotechnology	
Reed G et al	Industrial microbiology	CBS

Practical:

1. Sterilization Techniques
2. Preparation of Different Bacterial, Fungal and Protozoal culture media,
3. Isolation, identification of Bacteria.
4. Estimation of total heterophilic Bacterial counts in water and soil sediments,
5. Estimation of total Vibrio counts in water and soil sediments,
6. Isolation, Culture and identification of fungi
7. Antibiotic sensitivity tests.
8. MPN of coliforms and confirmation
7. Detection of food borne pathogens – Salmonella, Listeria and schizella
8. Detection of antibiotic residues in Fish/Shrimp.
9. Measurement of bacterial growth.

Course 2.3. Mapping of course outcomes with Programme outcomes:

Course Outcomes(CO)	CO1	CO2	CO3	CO4
Programme outcomes(PO)	PO2,	PO2	PO2	PO2, PO5

Course 2.4: Cell and Tissue culture

Learning objectives (LO):

- LO1. To impart knowledge on materials, equipment, culture media for tissue culture.
- LO2. To understand the methods of cell culture and establishment of cell lines.
- LO3. To impart knowledge on isolation, characterization, maintenance and preservation of cell lines.
- LO4. To understand the importance of stemcells, cancerous cells and role of proto-oncogenes.
- LO5. To understand the techniques of cell culture of marine macroalgae and mangrove plants.

Course outcomes (CO):

- CO1. Obtain knowledge on culture medias for cell and tissue culture.
- CO2. Acquire knowledge on techniques of cell culture and cell lines.
- CO3. Acquire knowledge on techniques of isolation, characterization, maintenance of preservation of cell lines.
- CO4. Obtain knowledge on stem culture, organ culture and large scale culture.
- CO5. Gets knowledge on techniques of cell culture in marine macroalgae & mangroves and industrial application of tissue culture.

Course Specific Outcomes (CSO):

- CSO1. Able to culture cells, cell lines and stem cells.
- CSO2. Able to apply tissue culture techniques in biotechnological industries for large scale cell culture.
- CSO3. Chance to get employment in tissue culture industries.

Unit- I

An overview of tissue culture, equipments and materials for tissue culture.

Culture media: Types and preparation.

Unit- II

Cell cultures: Primary, secondary cultures and their maintenance.

Cell lines: Primary and secondary cell lines establishment. Measurement of viability and cytotoxicity assay, measuring parameters of growth.

Unit- III

Pure culture: isolation, separation, characterization, identification, maintenance and preservation, Cloning of cell lines.

Development of cell lines of shrimp and fish.

Unit- IV

Organ cultures, large scale cultures.

Stem cells: Stem cell differentiation, Blood cell formation, Fibroblasts and their differentiation,

Differentiation of cancerous cells and role of proto-oncogenes.

Unit- V

Stem cell cultures, embryonic stem cells and their applications; Measurement of cell death & apoptosis, Three dimensional culture and tissue engineering.

Cell culture techniques of marine macroalgae, mangrove plants and molluscan mantle.

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 IRL

Practical approach

Clynes Animal cell culture techniques Springer

Freshney I Culture of animal cells: a manual Wiley-Liss

Of basic techniques

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

Practical:

1. Preparation of tissue culture media.
2. Preparation of Balanced Salt Solutions: DPBSA and Eagle's BSS.
3. Preparation of F2 and Convey's medium for microalgal culture.
4. Isolation of protoplast from seaweeds.
5. Tissue degradation by trypsinization- Warm/cold.
6. Cell count using Haemocytometer.
7. Spore culture of seaweeds.
8. Detection of dead and live cells using calcofluor white stain

Course 2.4 mapping outcomes (COS) with Programme outcomes (POS):

	CO1	CO2	CO3	CO4	CO5
PO1					
PO2	✓	✓	✓	✓	✓
PO3					
PO4					
PO5					

M.Sc. Marine Biotechnology
Third Semester
Course: 3.1: Health management in Aquaculture

Learning objectives (LO):

- LO1. To understand causative factors of disease outbreak, relationship between pathogen, host and environment besides stress and inflammation response in fishes.
- LO2. To understand the aetiology of various Bacterial, viral, mycotic, parasitic and environmental and nutritionally induced diseases of cultured shrimp and fish.
- LO3. To understand various disease diagnostic techniques of shrimp and fish.
- LO4. To understand various disease management strategies including prophylactic, therapeutic methods.
- LO5. To understand the role of probiotics and antibiotics in Aquaculture health management.
- LO6. To become aware of Fish/ shrimp quarantine systems and seed certifications.

Course outcomes (CO):

- CO1. Able to analyse factors responsible for disease outbreak and gains knowledge on stress and inflammation response in fishes.
- CO2. Gains knowledge on the aetiology of various diseases encountered in shrimp/ fish culture.
- CO3. Can diagnose diseases of fish and shrimp and implement various disease management strategies
- CO4. Gains knowledge on the role of probiotics and antibiotics in aquaculture.
- CO5. Able to design quarantine and seed certification systems.

Course Specific Outcomes (CSO):

- CSO1. Gains skill in health management of fish and shrimp.
- CSO2. Becomes an aquaculture pathologist and can undertake consultancy independently.

Unit-I

Disease: Definition, Host-pathogen- environment relationship, environmental stress, Inflammation response to diseases.

Unit-II

Infectious bacterial, viral and mycotic diseases in fish and shrimp: Epizootiology, Diagnosis, Life Cycle, Prevention and treatment.

Non-infectious Diseases: Nutritionally induced diseases, water, soil, environmental parameters and their effect on fish health.

Unit-III

Diagnostic techniques in aquaculture: Microbiological, haematological, histopathological, immunological and molecular techniques, Disease surveillance and reporting.

Unit-IV

Disease control and management: Environment management, chemotherapeutic agents, host management, prophylaxis-vaccines, adjuvants, immunostimulants .

Unit-V

Probiotics. Use and abuse of antibiotics and chemicals in health management.
Fish health and quarantine systems. Seed certification, SPF and SPR stocks- development and applications.

References:

- Bardach JE et al.,** Aquaculture Wiley- Interscience
Pillay TVR Aquaculture: Principles & practices FNB
Santhanam R et al ., Coastal aquaculture CBS
Inglis V, Roberts RJ and Bromage NR. Bacterial diseases of fish . Blackwell
Iwami G & Nakanishi T (Eds.). The fish immune system- organism, pathogen and environment. Academic Press.
Roberts RJ. Fish Pathology 3rd Ed. WB Saunders
Schaperclaus W. Fish diseases. Vols. I, II. Oxonian Press.
Shankar KM and Mohan CV. 2002. Fish and Shellfish Health Management. UNESCO Publ.
Sindermann CJ. Principal diseases of marine fish and shellfish. Vols. I, II. 2nd Ed. Academic Press.
Stickney RR. Principles of aquaculture Wiley & Sons

Practical:

1. Procedure of disease diagnosis.
2. Tissue fixation, Microtomy and histology of various fish/shrimp tissues.
3. Isolation of pathogenic bacteria/fungi and their identification.
4. Disease diagnostic methods: Necroscopy, Agglutination tests.
5. Identification of various parasites
6. Diseases of fin fish and shell fishes.
7. PCR for disease diagnosis, serological techniques in disease diagnosis.
8. Diseased fish/shrimp specimens.
9. Fish/Shrimp haematological parameters- TEC, DLC, TLC, Hb, Total protein, lipid profile, creatine Urea and enzymes in blood.

Course 3.1. Mapping of course outcomes with Programme outcomes:

Course Outcomes(CO)	CO-1	CO-2	CO-3	CO-4	CO-5
Programme outcomes(PO)	PO-3	PO-3	PO-3	PO-2, PO-3	PO-3

Course: 3.2: Immunology

Learning objectives (LO):

- LO1. To understand the basic concepts of immune system and its components.
- LO2. To understand properties of antigens, and Major histocompatibility complex
- LO3. To understand the structure, diversity of antibodies.
- LO4. To understand auto immunity, immune deficiencies and immunotherapy.
- LO5. To understand the concepts of hybridoma technology, tumor immunology and immunological techniques.

Course outcomes (CO):

- CO1. Gains knowledge on types of immune systems including the cellular and non-cellular components.
- CO2. Gains knowledge on antigens, histocompatibility and immune responsiveness.
- CO3. Gains knowledge on structure and diversity of immunoglobulins including complement proteins.
- CO4. Gains knowledge on autoimmunity, immune deficiency, and immunotherapeutic methods.
- CO5. Gains knowledge on hybridoma technology, tumor immunology and various immunodiagnostic techniques.

Course Specific Outcomes (CSO):

- CSO1. Gains overall knowledge on immune systems .
- CSO2. Can use immunodiagnostic methods.

Unit-I

Immunity and types of immunity. Fundamental concepts and anatomy of the immune system, components of innate and acquired immunity, Phagocytosis, Complement and inflammatory responses, Organs and Cells of the immune system-primary and secondary lymphoid organs, Lymphatic system, Lymphocyte circulation, Lymphocyte homing, Mucosal and Cutaneous associated Lymphoid tissue (MALT & CALT); Mucosal immunity.

Unit-II

Antigens: Types and properties. Major Histocompatibility Complex(MHC) - MHC genes, Immune responsiveness and disease susceptibility and HLA typing.

Unit-III

Immunoglobulins: Structure, types and functions. Immunogenetics: Genetic basis of antibody diversity. Molecular biology of B and T cells. Complement proteins and cytokines.

Unit-IV

Disorders of immune system: autoimmunity- types of autoimmune diseases.

Immunodeficiency- Primary immune deficiencies, Acquired or secondary immune deficiencies, hypersensitivity.

Immunotherapy, Immunostimulants-beta glucagons; Active and passive immunization; vaccines-Live, killed, attenuated, sub unit vaccines and antibodies. Non-specific immunity of shellfish.

Unit-V

Hybridoma technology- mono and polyclonal antibodies. ELISA, RIA and Immuno electrophoresis applications. Transplantation- Immunological basis of graft rejection.

Tumor immunology- Tumor antigens; immune response to tumors and tumors evasion of the immune system, Cancer immunotherapy.

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

Practical:

1. Preparation of antigens, Immunization and methods of bleeding, serum separation and storage.
2. Antibody titre by ELISA method.
3. Isolation and purification of Ig G from serum or Ig Y from chicken egg.
4. Blood smear identification of leucocytes by Giemsa stain.
5. Separation of leucocytes by dextran method.
6. Demonstration of phagocytosis.
7. Immuno electrophoresis, Isolation of antibody from serum, Nonspecific immune response (NBT and Prophenol oxidase tests).

Course 3.2. Mapping of course outcomes with Programme outcomes:

Course Outcomes(CO)	CO-1	CO-2	CO-3	CO-4	CO-5
Programme outcomes(PO)	PO-3	PO-3	PO-3	PO-3	PO-3, PO-5

Course: 3.3: Enzymology and Enzyme Technology

Learning objectives (LO):

- LO1. To understand the concepts of nomenclature and classification of enzymes, structure, properties, specificity and the factors effecting enzymatic reaction.
- LO2. To understand the mechanism of enzyme action, enzyme kinetics, competitive, non-competitive and uncompetitive enzyme substrate kinetics.
- LO3. To understand the concepts of multi-enzyme complex, single and multi-substrate systems, mechanisms of enzyme regulation.
- LO4. To acquire knowledge on extraction, isolation and purification of enzymes and also on concept of Immobilized enzymes.
- LO5. To impart knowledge on biosensors, synthetic enzymes, isozymes and importance of enzymes in disease diagnosis and industrial use.

Course outcomes (CO):

- CO1. Able to classify, name the enzymes and explain how enzyme activity is affected by concentration of enzyme, substrate, temperature, pH etc.,
- CO2. Able to understand the mechanism of enzyme action and their kinetics.
- CO3. Able to understand the feedback regulation, allosteric regulation, covalent modification, multi enzyme complexes and single & multi-substrate systems.
- CO4. Able to extract, isolate, purify the membrane bound enzymes and have an idea about methods of immobilized enzymes and their uses.
- CO5. Able to list the enzymes used in industry, disease diagnosis, importance of isozymes and synthetic enzymes.

Course Specific Outcomes (CSO):

- CSO1. Attains the knowledge about enzymes, enzyme kinetics, regulation and their importance.
- CSO2. Becomes competent to use biosensors, synthetic enzymes, isozymes and enzymes in disease diagnosis and industrial use.

UNIT -I

Nomenclature & classification of Enzymes.
Enzyme structure and properties, co-enzymes, co-factors.
Enzyme specificity; factors affecting enzyme action.

UNIT -II

Mechanism of enzyme action: activation energy; characterization of active site; activators and inhibitors, Enzyme kinetics: Michaelis- Menten Kinetics, steady state kinetics; single and multi-substrate interactions, Competitive, non-competitive and uncompetitive enzyme substrate kinetics.

UNIT -III

Multi-enzyme complex; single and multi-substrate systems.
Regulatory enzymes: Allosterism, covalent modification and feedback mechanisms; ATPase, glutamine synthetase. Haemoglobin and myoglobin.

UNIT -IV

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

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

UNIT -V

Biosensors and modifications.

Synthetic enzymes, isozymes and their importance.

Enzymes of industrial and diagnostic importance.

References:

Boyer P D	The Enzymes	Freeman
Fersht A R	Enzyme structure & mechanism	Freeman
Palmer T	Enzymes	Horwood
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	

Practical:

- 1) Preparation of maltose standard curve using 3, 5- Dinitrosalicylate reagent.
- 2) Assay of amylase in saliva.
- 3) Preparation of ammonia standard curve using Nessler's Reagent
- 4) Assay of urease activity.
- 5) Time course of enzyme activity.
- 6) Effect of temperature on enzyme activity.
- 7) Effect of pH on enzyme activity.
- 8) Common instruments used in enzymology.

Course: 3.3. Mapping of course outcomes (COS) with Programme outcomes (POS):

	CO1	CO2	CO3	CO4	CO5
PO1					
PO2					
PO3	✓	✓	✓	✓	✓
PO4					
PO5					

Course 3.4: Marine Pollution and Bio-deterioration

Learning Objectives:

- LO1. To understand the sources of marine pollution. Toxicity and treatment methods.
- LO2. To impart knowledge on oil pollution, thermal and radioactive pollution, solid dumping, mining and dredging operations and their effects on marine ecosystem. Treatment methods
- LO3. To study the fouling and boring activities of marine organisms on marine structures, controlling of boring and fouling activities of marine organisms.
- LO4. To study the strategies of global environmental methods, the role of biotechnology in mitigating the pollution and management.
- LO5. To offer the students opportunity to study the environmental impact assessment-methods; enzymatic removal of hazardous organic substances biological treatment of waste water.

Course Outcome:

- CO1. The students will get knowledge about the various types of pollutants, their sources, transport paths, transport agents, their fate in the environment; controlling, monitoring and management methods of all those pollutants.
- CO2. The students will get commendable knowledge on the recent topics such as application of biotechnology to mitigate the pollutants generated by industrial activities, to treat the pollutants; EIA methods and enzymatic removal of hazardous substances.
- CO3. The knowledge acquired by the students on marine pollution may encourage them to develop, conduct and participate in the programmes against release of pollutants into the coastal environment.
- CO4. The student will be aware of the hazardous effects of various pollutants released into the environment and take precautions to keep up his and his family health, which contribute to the health of the society.
- CO5. The student may get appointment in the waste water management boards, pollution control boards and also teaching jobs in the higher education institutes.

Course Specific Outcome (CSO):

- CSO1. The students will get jobs in the pollution control board, NGOs working on coastal ocean protection and conservation activities.
- CSO2. The student will have a thorough understanding about pollutants which are hazardous to the health of humans and can keep up their health, contribute to mitigate the pollution.
- CSO3. The student will be motivated to take up higher studies on pollution.

Unit - I

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

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

Unit - II

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

Thermal and radioactive pollution: sources, disposal systems of heated effluents, effects and treatment.

Solid dumping, mining and dredging operations: their effects on marine ecosystem, management of solid waste.

Unit - III

Bio-fouling and bio-deterioration: Biofilm formation-primary, secondary, tertiary colonizers. Effects of bio-fouling and control measures: manual, mechanical, chemical and biotechnological.

Borers: Effects and control measures.

Corrosion- definition, reactions, classification. Factors and preventive measures.

Unit - IV

Global environmental monitoring methods: status, objectives and limitations.

Monitoring strategies of marine pollution: critical pathway approach and mass balancing.

Environment Impact Assessment: Assessment of damage and problems of measuring the impact

Unit - V

Role of biotechnology in marine pollution control.. Enzymatic removal of hazardous organic substances. Wastes from fish processing units and their treatment- removal of nitrogen and phosphorus. Aquatic macrophytes in treatment of waste water.

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
Goldberg, E. D. 1974. The Health of the oceans, UNESCO Press. Paris.
Park, P .K, Kester D.R., J.W. Deudall and B.H Ketchum, 1983. Wastes in the Ocean.
 Vols. 1 to 3. Wiley Interscience Publishers, New York.
Eckenfelder WW. 2000. *Industrial Water Pollution Control.* McGraw Hill.
Gray NF. 2004. *Biology of Wastewater Treatment.* Oxford University Press.
Trivedy RK. 1998. *Advances in Wastewater Treatment Technologies.* Global Science.

Practical:

1. Determination of BOD in the polluted sea water sample.
2. Determination of nutrients in the polluted sea water sample: nitrites, nitrates, silicates, phosphates
3. Determination of toxic elements in the polluted sea water sample: ammonia, sulphide
4. Estimation of particulate organic matter in the polluted sea water sample
5. Spotters: Foulers- primary, secondary and tertiary colonizers; Borers

Course 3.4. Mapping of Course outcome with Programme outcome

	CO1	CO2	CO3	CO4	CO5
PO1					
PO2					
PO3					
PO4	✓	✓	✓	✓	✓
PO5					

M.Sc. Marine Biotechnology
Fourth Semester
Course: 4.1: Applications of Biotechnology in Aquaculture

Learning Objectives (LO):

- LO1. To understand the natural, supplementary feeds, probiotics, nutraceuticals and growth promoters in aquaculture.
- LO2. To impart knowledge on culture of live feeds.
- LO3. To understand the applications of genetics in aquaculture.
- LO4. To know the various hormones and their uses in induced breeding of finfish and shellfish.
- LO5. To understand the applications of biotechnology in aquaculture.

Course outcome (CO):

- CO1. Obtain knowledge on uses of natural and supplementary feeds, probiotics and nutraceuticals in aquaculture.
- CO2. Acquire knowledge on culture of live feeds.
- CO3. Obtain knowledge on application of genetics in aquaculture for production of quality cultivable species.
- CO4. Acquire knowledge on induced breeding in finfish and shellfish.
- CO5. Acquire knowledge on biotechnology in aquaculture.

Course Specific Outcome (CSO):

- CSO1. Able to produce seed through induced breeding.
- CSO2. Able to formulate nutritionally balanced supplementary feed for aquaculture species.
- CSO3. Able to culture live feeds for aquaculture species.
- CSO4. Gets employment in aquaculture industry.

UNIT-I

Role of biotechnology in aquaculture. Natural and artificial feeds, probiotics, nutraceuticals, Growth promoters, Energetics of food conversion.

UNIT- II

Plant live feeds (*Chaetoceros*, *Isochrysis*, *Nannochloropsis* & *Tetraselmis*)- collection, isolation, culture and enumeration. Animal live feeds (*Artemia*, Rotifers, Copepods): Collection, isolation and culture. supplementary feeds: feed formulations, methods & strategies. Importance and use of anti-oxidants and antibiotics in feeds.

UNIT- III

Application of genetics in aquaculture: genetic selection, inbreeding, and cross-breeding, sex control, polyploidy and transgenesis, methods of gene transfer in fishes. Development of high quality strains.

UNIT- IV

Synthetic hormones for induced breeding - molecular endocrinology with emphasis on use of analogues for breeding like GnRH, pheromones, growth hormone signal peptide for secretion, biotechnological approaches for peptide synthesis, Antimicrobial peptides and their applications.

UNIT- V

Biotechnological approaches for the identification and production of commercially important compounds, single cell protein from *Spirulina*, Microalgae for nutrition and cosmetics. Applications of nanotechnology in aquaculture.

References:

Colwell RR Biotechnology in Marine Science

Felix S. 2007. Molecular Diagnostic Biotechnology in Aquaculture. Daya Publ. House.

Fingerman M, Nagabhushanam R & Thompson MF. 1997. Recent Advances in Marine Biotechnology, Vols. I-III. Oxford & IBH.

Pandian TJ, Strusmann CA & Marian MP. 2005. Fish Genetics and Aquaculture Biotechnology, Science Publ.

Reddy PVGK, Ayyappan S, Thampy DM & Gopalakrishna. 2005. Text book of fish Genetics and Biotechnology, ICAR

Nair PR. 2008. Biotechnology and Genetics in Aquatic Biotechnology. Science Publ.

Practical:

1. Hatching and production of Artemia nauplii for shrimp feed.
2. Dissection and display of various endocrine glands of fin fishes & shell fishes.
4. Isolation of pituitary gland from fish, and preparation of extract,
5. Types of various artificial fish and shrimp feed.
5. PCR for diagnosis of viral diseases (WSV, EHP, MBV)
6. Synthetic GnRH for induced breeding, in fish-preparation and dose determination.
7. Induced breeding in shrimp- Eyestalk ablation, cauterization, squeezing.
7. Induced breeding in bivalves and sea urchin.
8. Live feed organisms: animal & plant live feed.
9. Quantification of protein in *Spirulina* dry biomass.
10. Extraction of lipid from micro algae dry biomass.
11. Quantification and characterization of lipid by GCMS.

Course 4.1 Mapping of course outcomes (COS) with Programme outcomes (POS):

	CO1	CO2	CO3	CO4	CO5
PO1					
PO2					
PO3					
PO4					
PO5	✓	✓	✓	✓	✓

Course: 4.2: Genetic Engineering

Learning objectives (LO):

- LO1. To understand the role, use and types of different DNA modifying enzymes (Polymerases, Nucleases, Restriction endonuclease, ligases) and probes. To understand various hybridization techniques and autoradiography.
- LO2. To understand the various techniques like DNA finger printing and DNA foot printing, concept of transposons, vectors, their types, sources and their roles in genetic engineering and also learn about the various cloning methodologies and techniques used in gene transfer.
- LO3. To understand the steps involved in construction of genomic and cDNA library. To attain knowledge on protein –DNA, protein-protein interactions. To provide knowledge on PCR, types and applications of PCR and transgenic fish.
- LO4. To understand the basic principles of DNA and RNA sequencing, next generation sequencing technology and to provide knowledge on gene silencing and gene therapy.
- LO5. To introduce the students to basics bioinformatics, DNA and protein databases, sequence retrieval and phylogenetic analysis and their applications.

Course outcomes (CO):

- LO1. Able to use different enzymes used in recombinant DNA technology and have sound knowledge on hybridization techniques.
- CO2. Will attain knowledge on the types of vectors, cloning methodologies and gene transfer techniques.
- CO3. Able to construct genomic and cDNA libraries, perform different types of PCR techniques and produce transgenic fish.
- CO4. Able to sequence DNA, RNA and apply gene silencing and gene therapy techniques to cure diseases.
- CO5. Able to describe the contents and properties of the bioinformatics databases, explain the pairwise and multiple sequence alignment and able to construct physical map of genomes

Course Specific Outcomes (CSO):

- CSO1. Attains the skill in basic concepts in Genetic engineering and Bioinformatics and have in-depth knowledge on the techniques available for genetic engineering.
- CSO2. Becomes competent to produce transgenic fish.

UNIT -I

Basic concepts: Restriction enzymes, DNA ligases, Klenow fragment, T4 DNA polymerase, autoradiography, Radio-active and non-radioactive probes, hybridization techniques (Southern, Northern, Western and colony hybridization).

UNIT -II

DNA finger printing and DNA foot printing, Methyl interference assay, transposons. Cloning vectors: Plasmids, bacteriophages-Lambda, M 13, cosmids, Yeast vectors, shuttle vectors, cohesive & blunt ends ligation, Cloning methodologies: Insertion of foreign DNA into the host cells, Transfection techniques.

UNIT -III

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, touchdown, hot start, colony. Loop Mediated Isothermal Amplification (LAMP) Site specific mutagenesis, PCR based mutagenesis. DNA-micro arrays. Transgenic fish.

UNIT -IV

Sequencing and Gene-therapy methods: DNA sequencing- chemical, Enzymatic, automated. RNA sequencing. Next Generation Sequencing, CRISPER technology.

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.

UNIT -V

Bioinformatics: History, definition, scope and applications, Data base: mining tools; database searching, similarity search, FASTA, BLAST.

Information networks: Gene bank sequence database, EBI-net; NCBI, Genome net, Protein database.

Phylogenetic analysis; Comparative genome analysis; Microarray analysis.

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

Practical:

1. Quantitative isolation of DNA
2. PCR and Agarose Gel Electrophoresis
3. Restriction digestion, Ligation
4. Primer Designing
5. Generating Fasta Sequence from an Autoradiogram
6. Usage of various bioinformatic tools, software packages, web portals
7. Pair-wise Alignment (FASTA/BLAST)
8. Multiple Sequence Alignment (Clustal W)
9. Phylogenetic Tree Construction and Phylogenetic Analysis
10. Protein Structure Prediction
11. Amplification of viral/bacterial DNA

Course 4.2 Mapping of course outcomes (COS) with Programme outcomes (POS):

	CO1	CO2	CO3	CO4	CO5
PO1					
PO2					
PO3					
PO4					
PO5	✓	✓	✓	✓	✓

Course 4.3: Bioactive Marine Natural products

Learning objectives (LO):

- LO1. To understand principles and working mechanisms of various types of spectrophotometers.
- LO2. To understand various separation and characterization techniques.
- LO3. To understand antibiotic, antitumor, anti-viral, antifouling anti-inflammatory compounds of marine origin.
- LO4. To gain knowledge on marine toxins and alkaloids.
- LO5. To understand basic principles of pharmacology.

Course outcomes (CO):

- CO1. Gains knowledge on working mechanisms of various spectrophotometers.
- CO2. Gains knowledge on various extraction and separation techniques.
- CO3. Gains knowledge on Various bio active compounds of marine origin.
- CO4. Gains knowledge on marine toxins.
- CO5. Gains knowledge on principles of pharmacology.

Course Specific Outcomes (CSO):

- CSO1. Gains complete knowledge on bioactive marine natural products
- CSO2. Gains knowledge on various extraction, separation and characterization techniques.

UNIT- I

Introduction: Significance of marine natural products. Principle and applications of colorimeter, Flame photometer; Atomic absorption spectrophotometer, Inductively Coupled plasma Spectrophotometer (ICP) in quantification of compounds.

UNIT- II

Isolation techniques: Liquid - liquid extraction, membrane separation methods, chromatography techniques- Paper, Thin layer, Gas and liquid chromatography, HPLC, Ion-Exchange chromatography. Characterization techniques: IR, UV, NMR, Mass Spectroscopy.

UNIT- III

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

UNIT- IV

Marine toxins: Saxitoxin, brevetoxin and ciguatoxin. Marine peptides & alkaloids: pyridoacridine, pyrrolocridine indole, pyrrole, isoquinoline, alkaloids.

UNIT-V

Basic principles of pharmacology: Classification and action of antibiotics and other antimicrobials. Green fluorescent protein from jelly fish and its applications. Pharmaceutical values and 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

Practical:

1. Separation of amino acids by paper chromatography
2. Identification of amino acids by paper chromatography
3. Preparation of crude extract by methanol: hexane solvent from molluscs, sponges, mangrove plants
4. Separation of crude extract fractions by column chromatography
5. Separation of fractions/compounds by TLC
6. Testing of Anti-bacterial activity by crude extract
7. Bio-autography testing

Course 4.3 mapping of course outcomes (COS) with Programme outcomes (POS):

	CO1	CO2	CO3	CO4	CO5
PO1					
PO2					
PO3					
PO4					
PO5	✓	✓	✓	✓	✓

**DEPT. OF MARINE LIVING RESOURCES, ANDHRA UNIVERSITY
MODEL QUESTION PAPERS WITH EFFECT FROM 2021-2022**

M.SC. DEGREE EXAMINATION
Marine Biology and Fisheries
First Semester
Physical and Chemical Oceanography
(Effective from the admitted batch 2021-2022)

Answer all questions.
All questions carry equal marks.

Time: 3hours

Max. Marks: 80

Unit – 1

1. Give an account of the physical properties of sea water.
or
2. a. the sea is a suitable chemical environment. Explain.
b. Gulf stream

Unit – II

3. Define salinity. Draw the relationship between salinity and chlorinity.
or
4. a. Describe the conservative behavior of major elements,
b. Describe the factors affecting the distribution of gases in the sea water.

Unit – III

5. Describe the distribution of dissolved oxygen in the sea water column and factors affecting the distribution.

Or

6. a. Describe the buffer action of the sea water.
b. Give an account of the biological significance of the calcium carbonate precipitation in the marine environment.

Unit – IV

7. write an essay on the sea surface micro layer.
or
8. a. Describe the nitrogen cycle in the marine environment.
b. Regeneration of nutrient elements.

Unit – V

9. Name any two National Institutes of marine research and their contribution to the development of marine biology and fisheries in India.

Or

10. a. Scripp's institute of oceanography
b. INCOIS

M.SC. DEGREE EXAMINATION
Marine Biology and Fisheries
First Semester
Biological Oceanography
(Effective from the admitted batch 2021-2022)

Time: 3 hrs

Max. Marks: 80

Answer all the questions.
All questions carry equal marks

Unit I

1. Give an account on general classification and composition of plankton.
(Or)
2. a) Plankton net
b) Floating mechanisms

Unit II

3. Explain in detail about fixation and preservation of plankton.
(Or)
4. a) Standing crop
b) Bongo Net

Unit III

5. Write about the phytoplankton and Zooplankton relationship.
(Or)
6. a) Vertical migration
b) Oceanic plankton

Unit IV

7. Give a detail account of primary production of oceans.
(Or)
8. a) Particulate organic matter,
b) Factors affecting secondary production

Unit V

9. Give an account of Red tide phenomena in oceans.
(Or)
10. a) Pelagic food chain
b) Food pyramids in oceans

M.SC. DEGREE EXAMINATION
Marine Biology and Fisheries
First Semester
Marine Ecology
(Effective from the admitted batch 2021-2022)

Time: 3 hrs

Max. Marks: 80

Answer all the questions.
All questions carry equal marks

Unit – 1

1. Classify the marine environment, explaining the general characteristic features of each zone.

or

2. a. Describe the features and organisms that represent the shallow water benthic region.
b. Give an account of adaptations of deep sea organisms

Unit – II

3. Describe the effect of temperature, insolation and desiccation in the intertidal region.

or

4. a. Describe the distribution of life on rocky shore in relation to tides.
b. Give an account of adaptations of muddy shore organisms.

Unit – III

5. Discuss the role of environmental parameters in supporting the rich and specific biodiversity of Indo-west Pacific region.

Or

6. a. Illustrate and explain the special features of food web of mangrove ecosystem .
b. Describe zonation in coral reefs.

Unit – IV

7. Define ecological modelling. Give an account of the different components for constructing an ecological model.

or

8. a. Draw neat labelled diagrams of all invertebrate larval forms.
b. Describe the ecological importance of marine thalloid algae.

Unit – V

9. What is meiobenthos. Write the methods adopted for collection and enumeration of meiobenthic organisms

Or

10. a. Give an account of chemical composition of marine sediments.
b. Explain the animal- sediment relations

M.SC. DEGREE EXAMINATION
Marine Biology and Fisheries
First Semester
Biostatistics
(Effective from the admitted batch 2021-2022)

Time: 3 hrs

Max. Marks: 80

Answer all the questions.
All questions carry equal marks.

Unit I

1. Give an account on classification of data.
(Or)
2. a) Tabulation of data
b) Secondary data

Unit II

3. Explain in detail about Measures of central tendency.
(Or)
4. a) Histograms
b) Cumulative frequency curve

Unit III

5. Write about the regression analysis.
(Or)
6. a) Standard error
b) Moments

Unit IV

7. Give a detail account of probability and distributions.
(Or)
8. a) Multivariate analysis
b) ANCOVA

Unit V

9. Explain about computer applications in stock assessment.
(Or)
10. a) Predictive models
b) Pedigree analysis

M.SC. DEGREE EXAMINATION
Marine Biology and Fisheries
Second Semester
Estuaries and Coastal Zone Management
(Effective from the admitted batch 2021-2022)

Answer all questions.
All questions carry equal marks.

Time: 3 hrs

Max. Marks: 80

Unit - 1

1. Discuss the physical parameters operating in the estuarine ecosystem
- Or
2. a. H₂ S in estuaries
b. positive estuary

Unit - II

3. Give an account of the distribution of mangroves in India. Describe the special features of mangroves.
- Or
4. a. Conservation measures of estuarine birds
b. Estuarine food web

Unit - III

5. Explain the Coastal Zone Management strategies with reference to living resources of the oceans.
- Or
6. a. applications of remote sensing to oceanography
b. Discuss the threats to shellfish resources and suggest management strategies

Unit - IV

7. Discuss the IUCN Criteria for keeping wild life in the Red-list. Give an account of wildlife protection act.
- Or
8. a. *In-Situ and Ex-Situ* conservation methods.
b. Marine Protected Areas in India and abroad

Unit – V

9. What are the elements present in the Geographic Information System and GPS. Add a note on their applications in the Coastal Zone Management.
- or
10. a. Write an essay on the Law of the Seas.
b. Conflict management in implementation of conservation activities

M.SC. DEGREE EXAMINATION
Marine Biology and Fisheries
Second Semester
Biology of Marine Organisms
(Effective from the admitted batch 2021-2022)

Answer all questions.
All questions carry equal marks.

Time: 3 hrs

Max. Marks: 80

Unit – 1

1. Give an account of feeding mechanisms in the marine gastropods quoting suitable examples. or
2. a. Prey and predator relationships
b. Excretion in Polychaetes

Unit - II

3. Describe the factors affecting respiration in marine animals
or
4. a. Describe the respiratory organs in bivalves
b. Give an account on osmoregulatory mechanism.

Unit - III

5. Write an essay on bioluminescence in marine organisms, discussing its biological significance. or
6. a. Describe the various pigments present in plants in the marine ecosystem.
b. Give an account of chromatophores in the colour changes of marine organisms.

Unit - IV

7. Write an essay on the endogenous rhythms in marine organisms giving examples of species of organisms. or
8. a. Give an account of the structure of nerve cell and its function.
b. Describe the sense organs and their functions in marine organisms.

Unit - V

9. Give an account of the factors effecting the reproduction in marine organisms.
or
10. a. Describe semelparity and iteroparity giving suitable examples.
b. Describe different gonadal stages in shrimp

M.SC. DEGREE EXAMINATION
Marine Biology and Fisheries
Second Semester
Fish Physiology
(Effective from the admitted batch 2021-2022)

Time: 3 hrs.

Max. Marks: 80

Answer all the questions.
All questions carry equal marks

Unit I

1. Give an account on digestion of carbohydrates, proteins and lipids in fish.
(Or)
- 2 a) Digestive enzymes
b) Digestive system of fish

Unit II

3. Explain in detail about respiration in fish.
(Or)
4. a) Chloride cells
b) Respiratory pigments

Unit III

5. Write about the cardiovascular system in fish.
(Or)
6. a) Blood circulation
b) Hemolymph pigments

Unit IV

7. Give a detail account of the physiology of reproduction.
(Or)
8. a) Oogenesis,
b) Spermatogenesis

Unit V

9. Give an account of neuro-secretions in shell fish.
(Or)
10. a) Pineal gland
b) Growth in shrimps

M.Sc. Degree Examination
Marine Biology and Fisheries
Second Semester
Fishery Science
(Effective from the admitted batch of 2021-2022)

Time: 3 Hrs.

Max Marks: 80

Answer all questions.
All questions carry equal marks.

Unit – 1

1. Describe the classification of fishes based on zonation.

(Or)

2. a) Elasmobranchs
b) Molluscs

Unit – 1I

3. Describe the various factors limiting abundance of stocks

(Or)

4. a) pre and post stock management
b) Stock enhancement

Unit – 1II

5. Describe length weight relationship.

(Or)

6. a) Growth
b) Recruitment

Unit – 1V

7. Describe the life history of Malabar sole.

(Or)

8. a) Oil sardines
b) Food and feeding habits

Unit – V

9. Write notes on age determination in fishes.

(Or)

10. a) Migration in fishes
b) Marking

M.Sc. Degree Examination
Marine Biology and Fisheries
Third Semester
Fishing Technology and Fishery Management
(Effective from the admitted batch of 2021-2022)

Time: 3 Hrs.

Max Marks: 80

Answer all questions.
All questions carry equal marks.

Unit – 1

1. Describe the classification of boats.

(Or)

2. a) Purse seines
b) Trawl nets

Unit – 1I

3. Write notes on demersal fishing

(Or)

4. a) Turtle extruder device
b) Stock size

Unit – 1II

5. Write notes on potential fishing zones.

(Or)

6. a) Code of conduct
b) Control measures of fishing output

Unit – 1V

7. Write an essay on mesh size regulation

(Or)

8. a) Catch quota
b) Closed fishing areas

Unit – V

9. Describe the various management techniques to regulate over fishing.

(Or)

10. a) SCUBA
b) Buoy

M.Sc. Degree Examination
Marine Biology and Fisheries
Third Semester
Aquaculture
(Effective from the admitted batch of 2021-2022)

Time: 3 Hrs.

Max Marks: 80

Answer all questions.
All questions carry equal marks.

Unit-I

1. Define the aquaculture and write notes on its importance.

Or

2. a) Present status of aquaculture
b) Emerging trends in aquaculture

Unit-II

3. Describe various type pens and its operations in aquaculture.

Or

4. a) Ponds
b) Soil characteristics and suitability

Unit-III

5. Give a detail account of Integrate multi trophic aquaculture.

Or

6. a) Mono-species culture
b) Aquaculture equipment

Unit-IV

7. Describe the various culture practices of mussels.

Or

8. a) Milkfish
b) Seed production in shrimp

Unit-V

9. Give a detail account of Agar yielding sea weed.

Or

10. a) Life cycle of *Ulva fasciata*
b) Breed improvement in sea weeds

M.Sc. Degree Examination
Marine Biology and Fisheries
Third Semester
Fish Nutrition and Feed Technology
(Effective from the admitted batch of 2021-2022)

Time: 3 Hrs.

Max Marks: 80

Answer all questions. All questions carry equal marks

Unit – 1

1. Describe the nutritional requirements of finfish and shell fish.
(Or)
2. a) Vitamins
b) Classification of carbohydrates

Unit – 1I

3. Write notes on energy requirements of fishes.
(Or)
4. a) Protein sparing effect
b) Optimal forage theory

Unit – 1II

5. Describe the nutritional deficiency diseases of finfish and shell fish.
(Or)
6. a) Microbial toxins
b) Anti metabolites

Unit – 1V

7. Write notes on high energy feeds.
(Or)
8. a) Probiotics
b) Feed storage

Unit – V

9. Write notes on supplementary feed theory.
(Or)
10. a) Ration size
b) Feeding methods

M.Sc. Degree Examination
Marine Biology and Fisheries
Third Semester
Marine Pollution and Bio-deterioration
(Effective from the admitted batch of 2021-2022)

Time: 3 Hrs.

Max Marks: 80

Answer all questions.
All questions carry equal marks.

Unit – 1

1. Describe the major transport paths and agents of pollutants into the coastal ocean.
or
2. a. Describe the fate of DDT in the marine environment.
b. Give an account of composition of domestic sewage.

Unit – II

3. Describe the methods adopted to treat the oil pollution.
or
4. a. Explain the disposal systems of heated effluents with illustration.
b. Give an account of the effects of dredging and mining activities on the marine environment.

Unit – III

5. Describe biofilm formation on the man-made marine structures and its role in settlement of bio-foulers.

Or

6. a. What are the factors effecting corrosion, suggest controlling measures
b. Suggest methods to control biofouling.

Unit – IV

7. Discuss the status, objectives and limitations of global environmental monitoring methods.
or
8. a. Emphasize the role of critical pathway approach in the marine pollution monitoring strategy.
b. Mass balance models.

Unit – V

9. Give an account of the various industries which are adopting biotechnological methods to reduce or control pollution.

Or

10. a. Suggest methods to remove nitrogenous wastes from fish processing units.
b. Describe the use of aquatic plants in the treatment of waste water.

M.Sc. Degree Examination
Marine Biology and Fisheries
Fourth Semester
Fish Processing Technology
(Effective from the admitted batch of 2021-2022)

Time: 3 Hrs.

Max Marks: 80

Answer all questions.
All questions carry equal marks.

Unit – 1

1. Describe the different methods of isolation of bacteria.

(Or)

2. a) Bacteria of sanitary importance
b) Morphology of bacteria

Unit – II

3. Write notes on different types of containers for transportation of fish.

(Or)

4. a) Chemical preservatives
b) Handling of fish

Unit – III

5. Describe the different methods of curing of fish.

(Or)

6. a) Process value calculation
b) Microwave vacuum drying

Unit – IV

7. Describe the different types of freezers used for freezing of fish.

(Or)

8. a) Wrapping
b) Double freezing

Unit – V

9. Write notes on different by products of shell fish.

(Or)

10. a) Preparation of fish oils
b) Food laws in India

M.SC. DEGREE EXAMINATION
Marine Biology and Fisheries
Fourth Semester
Fishery Economics and Extension
(Effective from the admitted batch 2021-2022)

Time: 3 hrs

Max. Marks: 80

Answer all the questions.
All questions carry equal marks.

Unit-I

1. Importance of Fisheries to Indian Economy? How does technological and political factors effect the growth of Fishery sector?

Or

- 2 (a). Explain Law of variable proportions with graph.
(b). Discuss Product-product relationship?

Unit-II

3. Focus on different strategies for development of Fisheries. Explain the different costs effecting the fishery production?

Or

- 4(a) State the different demand determinants.
(b). Fishery market system

Unit-III

5. What is a fishery co-operative? Major activities undertaken by fishery cooperatives for promotion of commercial fishing?

Or

- 6 (a) What are the different risks associated in Fisheries?
(b). Role of NABARD in promotion of fisheries.

Unit-IV

7. What are the different factors effecting the economics of aquaculture? Also focus on socio-economic issues?

Or

- 8 (a). WTO role in promoting global trade of fisheries.
(b). MPEDA

Unit-V

9. What is Extension? Describe its role in fisheries development? Name different organizations associated with fisheries extension?

Or

- 10 (a) Natural disasters effecting fisheries
(b) Coping mechanism for disasters in fisheries.

M.Sc. Degree Examination
Marine Biology and Fisheries
Fourth Semester
Aquaculture Biotechnology
(Effective from the admitted batch of 2021-2022)

Time: 3 Hrs.

Max Marks: 80

Answer all questions.
All questions carry equal marks.

Unit-I

1. Describe various techniques of In-Vitro fertilization.

Or

2. a) Cryopreservation
b) Shrimp larval rearing

Unit-II

3. Give a detail account on production of hybrid species and their importance in aquaculture.

Or

4. a) Sex control
b) Polyploidy

Unit-III

5. Give an account on culture of spirulina and its importance in aquaculture.

Or

6. a) Cladocera
b) *Skeletonema*

Unit-IV

7. Write an essay on nutritional diseases in finfish.

Or

8. a) RAPD
b) Fungal diseases in shellfish

Unit-V

9. Give an account of therapeutic proteins in aquaculture.

Or

10. a) Antioxidants
b) Immunostimulants

M.Sc. Degree Examination
Coastal Aquaculture and Marine Biotechnology
First Semester
Oceanography and Marine Biology
(Effective from the admitted batch of 2021-2022)

Time: 3 Hrs.

Max Marks: 80

Answer all questions.
All questions carry equal marks.

Unit – 1

1. Give an account of the heat budget of the oceans,
- Or
2. a. Tides
b. Density of sea water

Unit – II

3. Describe the carbon di- oxide system in the sea water.
- Or
4. a. trace elements
b. salinity

Unit – III

5. Describe the characteristic features of the various ecological divisions of the water column giving suitable examples.
- Or
6. a. define plankton, give an account of the various types of nets used to collect zooplankton.
b. sea ranching

Unit – IV

7. define remote sensing. Give an account of the applications of remote sensing in marine biology and fisheries.
- Or
8. a. law of the seas
b. GIS

Unit – V

9. Name any two National marine research institutes and their contribution to the marine research in India.
- Or
10. a. Woods Hole Institute of Oceanography
b. National Oceanography and Atmospheric Administration

M.Sc. Degree Examination
Coastal Aquaculture and Marine Biotechnology
First Semester
Finfish Culture
(Effective from the admitted batch of 2021-2022)

Time: 3 Hrs.

Max Marks: 80

Answer all questions.
All questions carry equal marks.

Unit-I

1. Give an account of Global Aquaculture Scenario.

Or

2. a) Importance of Aquaculture
b) Emerging trends in aquaculture

Unit-2

3. Describe the biology and life cycle of cobia.

Or

4. a) Salmons
b) Tilapia

Unit-III

5. Describe various methods of eradication of weed and predatory finfishes.

Or

6. a) Pens
b) Cages

Unit-IV

7. Give an account on culture practices of yellow tail.

Or

8. a) Organic farming
b) Polyculture

Unit-V

9. Give an account of marketing and economics of cultured finfish.

Or

10. a) Harvesting
b) Coastal aquaculture Authority

M.SC. DEGREE EXAMINATION
Coastal Aquaculture and Marine Biotechnology
First Semester
Crustacean Farming
(Effective from the admitted batch 2021-2022)

Time: 3 hrs.

Max. Marks: 80

Answer all the questions.
All questions carry equal marks.

Unit I

1. Give an account on scope and importance of crustacean farming in India.
(Or)
2. a) Production and utilization
b) Emerging trends

Unit II

3. Explain in detail about the biology of *Penaeus vannamei*.
(Or)
4. a) *Scylla serrata*
b) *Panilurus homarus*

Unit III

5. Write about the different types of feeds used in aquaculture.
(Or)
6. a) Feed ingredients
b) Nutrition quality

Unit IV

7. Write about the different types of farming practices.
(Or)
8. a) Intensive culture
b) Ultra-intensive

Unit V

9. Write about re-circulatory system (RAS).
(Or)
10. a) Cage culture
b) Rice fields

M.SC. DEGREE EXAMINATION
Coastal Aquaculture and Marine Biotechnology
First Semester
Aquaculture Engineering
(Effective from the admitted batch 2021-2022)

Time: 3 hrs

Max. Marks: 80

Answer all the questions.
All questions carry equal marks.

Unit-I

1. Write an essay on Soil water relationships

Or

2. A) Soil profile
B) Soil texture

Unit-II

3. Describe the method of site measurement by chain

Or

4. A) Earth work estimations
B) Magnetic prism compass

Unit-III

5. Write an essay on the properties of fluids

Or

6. A) Engineering properties of materials
B) Types of tides

Unit-IV

7. What are the requirements for establishment of a fish hatchery of 40 million production capacity

Or

8. A) Raceways B) Aerators

Unit-V

9. Write an essay on different equipment used in water recirculatory systems

Or

10. A) Ozoniser
B) DO meter

M.SC. DEGREE EXAMINATION
Coastal Aquaculture and Marine Biotechnology
Second Semester
Molluscan and Seaweed Farming
(Effective from the admitted batch 2021-2022)

Time: 3 hrs.

Max. Marks: 80

Answer all the questions.
All questions carry equal marks.

Unit-I

1. Give an account of present status of molluscan farming.
Or
2. a) Life cycle of clams
b) Life cycle of mussel

Unit-II

3. Describe the life cycle of *Ulva* sps.
Or
4. a) Present status of sea weeds
b) *Sargassum tenerrimum*

Unit-III

5. Describe the various culture practices of Clams and cockles.
Or
6. a) Cephalopods
b) Pearl production

Unit-IV

7. Describe the various methods of integration of sea weed culture with other farming.
Or
8. a) Agar yielding sea weeds
b) Green sea weeds

Unit-V

9. Give a detail account of production and economics of molluscs.
Or
10. a) Harvesting
b) By-products of sea weeds

M.Sc. Degree Examination
Coastal Aquaculture and Marine Biotechnology
Second Semester
Soil and water quality management in Aquaculture
(Effective from the admitted batch of 2021-2022)

Time: 3 Hrs.

Max Marks: 80

Answer all questions.
All questions carry equal marks.

Unit – 1

1. Describe the physic-chemical properties of soil.

(Or)

2. a) Physical properties of water
b) Importance of soil and water

Unit – 1I

3. Describe sulfur cycle and its importance in aquaculture.

(Or)

4. a) Soil standards in culture systems
b) Role of micro organisms in carbon cycle

Unit – 1II

5. Write notes on bio- fertilizers.

(Or)

6. a) Primary production
b) Use of treated sewage

Unit – IV

7. Describe the process of sludge disposal.

(Or)

8. a) Aeration and aerators
b) Ozonization

Unit – V

9. Describe the various methods to control aquatic weeds.

(Or)

10. a) Eutrophication
b) Dinoflagellates

M.SC. DEGREE EXAMINATION
Coastal Aquaculture and Marine Biotechnology
Second Semester
Seed Production and Hatchery Management
(Effective from the admitted batch 2021-2022)

Time: 3 hrs.

Max. Marks: 80

Answer all the questions.
All questions carry equal marks.

Unit I

1. Give an account on brood stock management of shrimp.
(Or)
2. a) SPR brood stock certification
b) Maturation

Unit II

3. Explain in detail about wild seed collection of fin fish.
(Or)
4. a) Sea weeds
b) Pearl oyster

Unit III

5. Write about hatchery management of sea bass.
(Or)
6. a) Crabs
b) Mussels

Unit IV

7. Give a detail account of nutritional requirements of shrimp larvae.
(Or)
8. a) Micro encapsulated feed
b) Artemia

Unit V

9. Explain about harvesting, packing and transport of fish larvae.
(Or)
10. a) Seed quality management
b) Marketing and economics

M.SC. DEGREE EXAMINATION
Coastal Aquaculture and Marine Biotechnology
Second Semester
Marine Microbiology
(Effective from the admitted batch 2021-2022)

Time: 3 hrs.

Max. Marks: 80

Answer all the questions.
All questions carry equal marks.

Unit-I

1. Describe the principle and working mechanism of Scanning Electron Microscope

Or

2. A) Magnification B) Resolving power

Unit-II

3. Classify Marine microalgae up to classes with examples

Or

4. A) Halophiles B) Barophiles

Unit-III

5. Give an account of Classification of animal viruses

Or

6. A) Bacterial growth curve B) Culture media of Protozoans

Unit-IV

7. Write an essay on sterilization techniques used in microbiology

Or

8. A) Microbes in frozen fish B) Quality indices

Unit-V

9. Write an essay on the planning and implementation of HACCP systems

Or

10. A) ISO 22000 B) Traceability issues

M.SC. DEGREE EXAMINATION
Coastal Aquaculture and Marine Biotechnology
Third Semester
Biochemistry and Fish Nutrition
(Effective from the admitted batch 2021-2022)

Time: 3 hrs

Max. Marks: 80

Answer all the questions.
All questions carry equal marks.

Unit I

1. Give an account on metabolism of carbohydrates.

(Or)

2. a) Enzyme immobilization
b) Factors affecting enzyme action

Unit II

3. Explain in detail about the nutritional requirements of cultivable finfish.

(Or)

4. a) Feed formulations
b) Feed additives

Unit III

5. Write about various types of feeds.

(Or)

6. a) Compact pellet feed
b) Floating and slow sinking pellet feeds

Unit IV

7. Discuss about the equipment used in feed manufacturing.

(Or)

8. a) Drying
b) Crumbling

Unit V

9. Write about feed storage.

(Or)

10. a) Feed economics and evaluation
b) FCR & FCE

M.SC. DEGREE EXAMINATION
Coastal Aquaculture and Marine Biotechnology
Third Semester
Genetics in Aquaculture
(Effective from the admitted batch 2021-2022)

Time: 3 Hrs.

Max. Marks: 80

Answer all the questions.
All questions carry equal marks.

Unit-I

1. Write an essay on the chromosome theory of inheritance

Or

2. A) Dihybrid cross B) Non- Mendelian inheritance

Unit-II

3. Write an essay on the sex determination in fin fish

Or

4. A) Sex reversal B) Transgenesis

Unit-III

5. Write an essay on fish genomics

Or

6. A) Cryopreservation B) In-vitro fertilization

Unit-IV

7. Give an account of inbreeding and cross breeding of fishes

Or

8. A) Heterosis B) Introgression

Unit-V

9. Write an account of Allozymes and Microsatellites

Or

10. A) ESTs and SNPs B) Mitochondrial DNA

M.Sc. DEGREE EXAMINATION
Coastal Aquaculture and Marine Biotechnology
Third Semester
Molecular Biology
(Effective from the admitted batch 2021-2022)

Time: 3 hrs.

Max. Marks: 80

Answer all the questions.
All questions carry equal marks.

Unit-I

1. Write a detailed account of Meiosis with suitable illustrations

Or

2. A) Write about structure of biological membranes
B) Explain active transport mechanism that occurs in cell membranes

Unit-II

3. Describe Watson and Crick model of DNA and write the differences between structures of DNA and RNA

Or

4. A) What are the various types of DNA damage? Give a brief account of repair mechanisms.
B) Explain the terms T_m , hyperchromicity of DNA

Unit-III

5. Explain the process of Post transcriptional modifications in eukaryotes

Or

6. A) What is genetic code
B) Explain the structure and types of ribosomes

Unit-IV

7. What is DNA recombination? Explain the molecular models of homologous and site-specific recombination.

Or

8. A) What are mutations?
B) Write an account on various mutagens responsible for mutations

Unit-V

9. Write an essay on Operon concept with at least two examples in prokaryotes

Or

10. A) What are various transacting factors
B).Give a detailed account of environmental regulation of gene expression

M.Sc. Degree Examination
Coastal Aquaculture and Marine Biotechnology
Third Semester
Marine Pollution and Bio-deterioration
(Effective from the admitted batch of 2021-2022)

Time: 3 Hrs.

Max Marks: 80

Answer all questions.
All questions carry equal marks.

Unit – 1

1. Describe the major transport paths and agents of pollutants into the coastal ocean.
or
2. a. Describe the fate of DDT in the marine environment.
b. Give an account of composition of domestic sewage.

Unit – II

3. Describe the methods adopted to treat the oil pollution.
or
4. a. Explain the disposal systems of heated effluents with illustration.
b. Give an account of the effects of dredging and mining activities on the marine environment.

Unit – III

5. Describe biofilm formation on the man-made marine structures and its role in settlement of bio-foulers.

Or

6. a. What are the factors effecting corrosion, suggest controlling measures
b. Suggest methods to control biofouling.

Unit – IV

7. Discuss the status, objectives and limitations of global environmental monitoring methods.
or
8. a. Emphasize the role of critical pathway approach in the marine pollution monitoring strategy.
b. Mass balance models.

Unit – V

9. Give an account of the various industries which are adopting biotechnological methods to reduce or control pollution.

Or

10. a. Suggest methods to remove nitrogenous wastes from fish processing units.
b. Describe the use of aquatic plants in the treatment of waste water.

M.Sc. DEGREE EXAMINATION
Coastal Aquaculture and Marine Biotechnology
Fourth Semester
Fish Pathology and Immunology
(Effective from the admitted batch 2021-2022)

Time: 3 hrs.

Max. Marks: 80

Answer all the questions.
All questions carry equal marks.

1. Write an essay on the viral diseases of cultured fish

Or
2. A) Histopathology
B) Nutritionally induced diseases in fish
3. Write an essay on Various types of vaccines

Or
4. A) RNAi technology
B) Biosecurity measures in Aquaculture

Or
5. Write an essay on the phylogeny of immune system

Or
6. A) Non specific immune system B) Complement system
7. Write an essay on the immunological tolerance

Or
8. A) Antigen processing B) Haptens
9. Write an essay on Hypersensitivity reactions of Type I and II

Or
10. A) Immune genes
B) Auto immune disorders

M.Sc. DEGREE EXAMINATION
Coastal Aquaculture and Marine Biotechnology
Fourth Semester
Marine Biotechnology
(Effective from the admitted batch 2021-2022)

Time: 3 hrs.

Max. Marks: 80

Answer all the questions.
All questions carry equal marks.

Unit – 1

1. Describe the design and features of bioreactor and the types of bioreactors used in the industry.

or

2. a. Biofertilizers.
b. Isolation of extra nuclear DNA.

Unit – II

3. Give an account of gene modification techniques.

or

4. a. Explain Southern blotting technique and its application.
b. What is colony hybridization. Describe the technique.

Unit – III

5. Describe Sanger's method of DNA sequencing. Discuss its merits and demerits.

Or

6. a. PCR technique
b. Allopheny.

Unit – IV

7. Define stemness. Describe culture procedure of stem cells and their application in animal health.

or

8. a. Somatic Hybridization
b. Protoplast Fusion

Unit – V

9. Give an account of information networks and their role in the bioinformatic studies.

Or

10. a. FASTA and BLAST.
b. Phylogenetic Analysis.

M.Sc. DEGREE EXAMINATION
Coastal Aquaculture and Marine Biotechnology
Fourth Semester
Bioactive Marine Natural Products
(Effective from the admitted batch 2021-2022)

Time: 3 hrs.

Max. Marks: 80

Answer all the questions.
All questions carry equal marks.

Unit-I

1. Describe the principle and working mechanism of Inductively Coupled plasma Spectrophotometer

Or

2. A) Flame photometer B) Colorimeter

Unit-II

3. Describe the principle and working mechanism of NMR

Or

4. A) Paper chromatography B) Ion exchange chromatography

Unit-III

5. Write an essay on the antibiotic compounds of marine origin

Or

6. A) Cytotoxic compounds B) Analgesic compounds of marine origin

Unit-IV

7. Write an essay on marine peptides and their applications

Or

8. A) Marine toxins B) Green fluorescent protein

Unit-V

9. Write an essay on the classification of antibiotics with examples

Or

10. A) Biotransformation B) Excretion of drugs

M.Sc. Degree Examination
Marine Biotechnology
First Semester
Oceanography and Marine Biology
(Effective from the admitted batch of 2021-2022)

Time: 3 Hrs.

Max Marks: 80

Answer all questions.
All questions carry equal marks.

Unit – 1

1. Give an account of the heat budget of the oceans,
Or
2. a. Tides
b. Density of sea water

Unit – II

3. Describe the carbon di- oxide system in the sea water.
Or
4. a. trace elements
b. salinity

Unit – III

5. Describe the characteristic features of the various ecological divisions of the water column giving suitable examples.
Or
6. a. define plankton, give an account of the various types of nets used to collect zooplankton.
b. sea ranching

Unit – IV

7. define remote sensing. Give an account of the applications of remote sensing in marine biology and fisheries.
Or
8. a. law of the seas
b. GIS

Unit – V

9. Name any two National marine research institutes and their contribution to the marine research in India.
Or
10. a. Woods Hole Institute of Oceanography
b. National Oceanography and Atmospheric Administration

M.Sc. DEGREE EXAMINATION
Marine Biotechnology
First Semester
Biochemistry
(Effective from the admitted batch 2021-2022)

Time: 3 hrs.

Max. Marks: 80

Answer all the questions.
All questions carry equal marks

1. Describe the process of Glycolysis in detail with a note on key regulatory steps of the Process

Or

2. A) Chemical bonds in biochemistry
B) Gluconeogenesis

3. Give a detailed account of beta oxidation of fatty acids

Or

4. A) Structure and properties of proteins
B) Properties of lipids

5. Write an essay on proximate composition of fish and shellfish

Or

6. A) Non protein nitrogenous compounds in fish
and shell fish
B) Equilibria and coupled processes in bioenergetics

7. What are Vitamins? Write an account on various types of Vitamins and their properties.

Or

8. A) Prostaglandins B) Interferons

9. Describe the structure of biological membranes and their functions.

Or

10. A) Transport of biomolecules across cell membranes
B) Biochemical pathway of photosynthesis

M.Sc. Degree Examination
Marine Biotechnology
First Semester
Reproductive Physiology and Endocrinology
(Effective from the admitted batch of 2021-2022)

Time: 3 Hrs.

Max Marks: 80

Answer all questions.
All questions carry equal marks.

Unit – 1

1. Describe the anatomy and histology of gonads of shellfish.

(Or)

2. a) Oogenesis
b) Gonadal steroidogenesis

Unit – 1I

3. Describe sex differentiation and write notes on factors affecting sex differentiation.

(Or)

4. a) Hermaphroditism
b) Secondary sex characters

Unit – 1II

5. Describe the process of artificial insemination in finfish.

(Or)

6. a) Fertilization in finfish and shellfish
b) Pheromones

Unit – 1V

7. Describe the role of pineal gland in regulating reproduction.

(Or)

8. a) hypothalamo – hypophyseal system
b) Pituitary gland

Unit – V

9. Cryopreservation of gametes.

(Or)

10. a) Applications of biotechnology for gonad development
b) Invitro fertilization

M.Sc. Degree Examination
Marine Biotechnology
First Semester
Molecular Biology
(Effect from the admitted batch of 2021-2022)

Time: 3hrs

Max.Marks (5X16):80

Answer all the questions
All questions carry equal marks.

Unit-I

1. Write a detailed account of Mitosis with suitable illustrations

Or

2. A) Describe the cell structure of eukaryotes
B) Describe the structure of chromosome

Unit-II

3. Explain the mechanism of DNA replication in eukaryotes

Or

4. A) Give a brief account of DNA repair mechanisms.
B) Explain homologous and site specific DNA recombination methods

Unit-III

5. Explain the process of transcription in prokaryotes with a note on regulatory elements

Or

6. A) Describe the structure of tRNA
B) What are molecular chaperones?

Unit-IV

7. Write an essay on Lac operon

Or

8. A) Give a detailed account of DNA methylation.
C) What are transacting factors?

Unit-V

9. Give a detailed account of environmental regulation of gene expression

Or

10. A) What are mutations? Give an account of physical and chemical mutagens
B) Give a brief account of tumour suppressor genes

M.Sc. Degree Examination
Marine Biotechnology
Second Semester
Coastal Aquaculture
(Effective from the admitted batch of 2021-2022)

Time: 3 Hrs.

Max Marks: 80

Answer all questions.
All questions carry equal marks.

Unit-I

1. Write a detail notes on importance of Aquaculture.
- OR
2. a) Overview of aquaculture
b) Global aquaculture production

Unit-II

3. Describe the design and construction of ponds.
- Or
4. a) Semi-intensive culture
b) Race-ways

Unit-III

5. Give an account of biology and life cycle of *Penaeus monodon*.
- Or
6. a) *Scylla serrate*
b) *Crossostrea madrasensis*

Unit-IV

7. Describe the various culture practices of mulltes.
- Or
8. a) Culture of Cephalopods
b) Culture of fresh water prawn

Unit-V

9. Describe the importance of Sea weeds.
- Or
10. a) Algin yielding sea weeds
b) Life cycle of *Gracilaria carticata*

M.Sc. DEGREE EXAMINATION
Marine Biotechnology
Second Semester
Fish Genetics
(Effective from the admitted batch 2021-2022)

Time: 3 hrs.

Max. Marks: 80

Answer all the questions.
All questions carry equal marks.

Unit-I

1. Write an essay on the chromosomal theory of inheritance

Or

2. A) Mitochondrial inheritance B) Sex linked genes in fish

Unit-II

3. Write an essay on chromosomal polymorphism

Or

4. A) Gynogenesis B) Super males

Unit-III

5. Write an essay on population genomics

Or

6. A) Nei's genetic distance B) Genetic drift
- 7.

Unit-IV

8. Write an essay on genetic diversity and conservation

Or

9. A) Allozymes B) QLT mapping

Unit-V

10. Write an essay on Fluorescence In situ hybridization(FISH)

Or

11. A) Sister chromatid exchange B) MNT

M.Sc. DEGREE EXAMINATION
Marine Biotechnology
Second Semester
Marine Microbiology and Microbial Technology
(Effective from the admitted batch 2021-2022)

Time: 3 hrs.

Max. Marks: 80

Answer all the questions.
All questions carry equal marks.

Unit-I

1. Write an essay on the principle and working mechanism of phase contrast microscope

Or

2. A) Classification of fungi B) Thermophiles and Psychrophiles

Unit-II

3. Write an essay on preservation methods of Bacterial cultures

Or

4. A) Chemical methods of sterilization B) Culture methods of fungi

Unit-III

5. Write an essay on waterborne pathogens of public health importance

Or

6. A) Salient features of Bioreactors B) Fermentation

Unit-IV

7. Write an essay on the role of microbes in fish preservation

Or

8. A) Indices of fish quality B) Total quality management in Sea food processing

Unit-V

9. Write an essay on planning and control of HACCP systems

Or

10. A) EIA B) FSSAI

M.Sc. DEGREE EXAMINATION
Marine Biotechnology
Second Semester
Cell and Tissue Culture
(Effective from the admitted batch 2021-2022)

Time: 3 hrs.

Max. Marks: 80

Answer all the questions.
All questions carry equal marks.

Unit I

1. Give an account on overview of tissue culture.

(Or)

2. a) Culture media
b) Equipments and materials for tissue culture

Unit II

3. Explain in detail about the cell lines.

(Or)

4. a) Cytotoxic assay
b) Measuring parameters of growth

Unit III

5. Write about the development of cell lines of shrimp.

(Or)

6. a) Organ culture
b) Pure cultures

Unit IV

7. Discuss about the stem cells.

(Or)

8. a) Fibroblasts
b) Role of proto-oncogenes

Unit V

9. Write about the industrial applications of tissue culture.

(Or)

10. a) Apoptosis
b) Marine micro algae

M.Ss. DEGREE EXAMINATION
Marine Biotechnology
Third Semester
Health Management in Aquaculture
(Effective from the admitted batch 2021-2022)

Time: 3 hrs

Max. Marks: 80

Answer all the questions.
All questions carry equal marks

Unit-I

1. Describe the Host-Pathogen – Environment relationship

Or

2. A) Environmental Stress B) Inflammation

Unit-II

3. Write an essay on Bacterial diseases of shrimp

Or

4. A) Epizootiology B) Nutritionally induced diseases

Unit-III

5. Write an essay on histopathological techniques employed in disease diagnosis

Or

6. A) Disease surveillance B) Molecular diagnostic techniques

Unit-IV

7. Write an essay on the chemotherapeutic agents used in disease management

Or

8. A) Adjuvants B) Immunostimulants

Unit-V

9. Write an essay on the abuse of antibiotics in aquaculture

Or

10. A) Fish quarantine system B) SPF and SPR stocks

M.SC. DEGREE EXAMINATION
Marine Biotechnology
Third Semester
Enzymology and Enzyme Technology
(Effective from the admitted batch 2021-2022)

Time: 3 hrs.

Max. Marks: 80

Answer all the questions.
All questions carry equal marks.

Unit I

11. Give an account on classification of enzymes.

(Or)

12. a) Enzyme specificity
b) Factors affecting enzyme action

Unit II

13. Explain in detail about the reversible and irreversible inhibition of enzymes.

(Or)

14. a) Mechanism of enzyme action
b) Activation energy & Active site

Unit III

15. Write about the regulation of enzyme activity.

(Or)

16. a) Glutamine synthetase
b) Haemoglobin

Unit IV

17. Discuss about the extraction and purification of enzymes.

(Or)

18. a) Membrane bound enzymes
b) Enzyme storage

Unit V

19. Write about biosensors and their applications.

(Or)

20. a) Synthetic enzymes
b) Isozymes

M.Sc. Degree Examination
Marine Biotechnology
Third Semester
Marine Pollution and Bio-deterioration
(Effective from the admitted batch of 2021-2022)

Time: 3 Hrs.

Max Marks: 80

Answer all questions.
All questions carry equal marks.

Unit – 1

1. Describe the major transport paths and agents of pollutants into the coastal ocean.
or
2. a. Describe the fate of DDT in the marine environment.
b. Give an account of composition of domestic sewage.

Unit – II

3. Describe the methods adopted to treat the oil pollution.
or
4. a. Explain the disposal systems of heated effluents with illustration.
b. Give an account of the effects of dredging and mining activities on the marine environment.

Unit – III

5. Describe biofilm formation on the man-made marine structures and its role in settlement of bio-foulers.

Or

6. a. What are the factors effecting corrosion, suggest controlling measures
b. Suggest methods to control biofouling.

Unit – IV

7. Discuss the status, objectives and limitations of global environmental monitoring methods.
or
8. a. Emphasize the role of critical pathway approach in the marine pollution monitoring strategy.
b. Mass balance models.

Unit – V

9. Give an account of the various industries which are adopting biotechnological methods to reduce or control pollution.

Or

10. a. Suggest methods to remove nitrogenous wastes from fish processing units.
b. Describe the use of aquatic plants in the treatment of waste water.

M.SC. DEGREE EXAMINATION
Marine Biotechnology
Fourth Semester
Applications of Biotechnology in Aquaculture
(Effective from the admitted batch 2021-2022)

Time: 3 hrs.

Max. Marks: 80

Answer all the questions.
All questions carry equal marks.

Unit I

1. Give an account on role of biotechnology in aquaculture.
(Or)
2. a) Probiotics
b) Growth promoters

Unit II

3. Explain in detail about plant live feeds.
(Or)
4. a) Artemia
b) Artificial feeds

Unit III

5. Write about transgenesis in fish.
(Or)
6. a) Polyploidy
b) In-breeding

Unit IV

7. Discuss about synthetic hormones.
(Or)
8. a) GnRH
b) Antimicrobial peptides

Unit V

9. Write an essay on application nanotechnology in aquaculture.
(Or)
10. a) Single cell proteins
b) Dot-Blot technique

M.Sc. DEGREE EXAMINATION
Marine Biotechnology
Fourth Semester
Genetic Engineering
(Effective from the admitted batch 2021-2022)

Time: 3 hrs.

Max. Marks: 80

Answer all the questions.
All questions carry equal marks

Unit I

1. Give an account on probes used in genetic engineering.
(Or)
2. a) Autoradiography
b) DNA ligases

Unit II

3. Explain in detail about vectors.
(Or)
4. a) DNA foot printing
b) Transposons

Unit III

5. Write about jumping and hopping libraries.
(Or)
6. a) Loop Mediated Isothermal Amplification (LAMP)
b) Transgenic fish

Unit IV

7. Discuss about Next Generation Sequencing.
(Or)
8. a) CRISPER technology
b) Si RNA technology

Unit V

9. Write an essay on BLAST and FASTA.
(Or)
10. a) Microarray analysis
b) Gene bank sequence database

M.Sc. DEGREE EXAMINATION
Marine Biotechnology
Fourth Semester
Bioactive Marine Natural Products
(Effective from the admitted batch 2021-2022)

Time: 3 hrs.

Max. Marks: 80

Answer all the questions.
All questions carry equal marks.

Unit-I

1. Describe the principle and working mechanism of Inductively Coupled plasma Spectrophotometer

Or

2. A) Flame photometer B) Colorimeter

Unit-II

3. Describe the principle and working mechanism of NMR

Or

4. A) Paper chromatography B) Ion exchange chromatography

Unit-III

5. Write an essay on the antibiotic compounds of marine origin

Or

6. A) Cytotoxic compounds B) Analgesic compounds of marine origin

Unit-IV

7. Write an essay on marine peptides and their applications

Or

8. A) Marine toxins B) Green fluorescent protein

Unit-V

9. Write an essay on the classification of antibiotics with examples

Or

10. A) Biotransformation B) Excretion of drugs