

ALAGAPPA UNIVERSITY, KARAIKUDI
NEW SYLLABUS FOR AFFILIATED COLLEGES
UNDER CBCS PATTERN WITH EFFECT FROM 2022-23 ONWARDS

B.Sc., MARINE BIOLOGY
Programme Structure

| Sem. | Part | Course Code | Courses | Title of the Paper | T/P | Credits | Hours/ Week | Max. Marks | | |
|--------------|-------|---------------------------|--|--|-----|-----------|----------------|------------|------------|------------|
| | | | | | | | | Int. | Ext. | Total |
| I | I | 2211T | T/OL | Tamil /Other Languages -I | T | 3 | 6 | 25 | 75 | 100 |
| | II | 712CE | E | Communicative English - I | T | 3 | 6 | 25 | 75 | 100 |
| | III | 22BMB1C1 | CC | Fundamentals of Marine Biology | T | 5 | 5 | 25 | 75 | 100 |
| | | 22BMB1P1 | CC | Practical - Fundamentals of Marine Biology | P | 4 | 4 | 40 | 60 | 100 |
| | | - | AL - IA | Botany/Zoology/Microbiology/ Biotechnology | T | 3 | 3 | 25 | 75 | 100 |
| | - | AL - IA | Practical – Respective Allied Theory Course | P | 2 | 2 | 40 | 60 | 100 | |
| | IV | 22BVE1 | SEC -I | Value Education | T | 2 | 2 | 25 | 75 | 100 |
| | | - | - | Library | - | - | 2 | - | - | - |
| Total | | | | | | 22 | 30 | 205 | 495 | 700 |
| II | I | 2221T | T/OL | Tamil/Other Languages-II | T | 3 | 6 | 25 | 75 | 100 |
| | II | 722CE | E | Communicative English - II | T | 3 | 6 | 25 | 75 | 100 |
| | III | 22BMB2C1 | CC | Animal Diversity | T | 5 | 5 | 25 | 75 | 100 |
| | | 22BMB2P1 | CC | Practical- Animal Diversity | P | 4 | 4 | 40 | 60 | 100 |
| | | - | AL - IB | Botany/Zoology/Microbiology/ Biotechnology | T | 3 | 3 | 25 | 75 | 100 |
| | - | AL - IB | Practical – Respective Allied Theory Course | P | 2 | 2 | 40 | 60 | 100 | |
| | IV | 22BES2 | SEC -II | Environmental Studies | T | 2 | 2 | 25 | 75 | 100 |
| | | Naan Mudhalvan Courses | | Language Proficiency for Employability(Effective English) | - | 2 | 2 | 25 | 75 | 100 |
| Total | | | | | | 24 | 30 | 230 | 570 | 800 |
| III | I | 2231T | T/OL | Tamil/Other Languages-III | T | 3 | 6 | 25 | 75 | 100 |
| | II | 2232E | E | English for Enrichment - I | T | 3 | 6 | 25 | 75 | 100 |
| | III | 22BMB3C1 | CC | Cell and Developmental Biology | T | 3 | 3 | 25 | 75 | 100 |
| | | 22BMB3C2 | CC | Fishery Biology | T | 3 | 3 | 25 | 75 | 100 |
| | | 22BMB3P1 | CC | Practical-III- Cell and Developmental Biology | P | 3 | 3 | 40 | 60 | 100 |
| | - | AL - IIA | Botany/Zoology/Microbiology/ Biotechnology | T | 3 | 3 | 25 | 75 | 100 | |
| | - | AL - IIA | Practical – Respective Allied Theory Course | P | 2 | 2 | 40 | 60 | 100 | |
| IV | 22BE3 | SEC -III | Entrepreneurship | T | 2 | 2 | 25 | 75 | 100 | |
| | | - | NME-I | 1.Adipadai Tamil (or) 2.Advance Tamil (or) 3.IT Skills for Employment/ MOOC'S | T | 2 | 2 | 25 | 75 | 100 |
| Total | | | | | | 24 | 30 | 255 | 645 | 900 |
| IV | I | 2241T | T/OL | Tamil /Other Languages -IV | T | 3 | 6 | 25 | 75 | 100 |
| | II | 2242E | E | English for Enrichment - II | T | 3 | 3 | 25 | 75 | 100 |
| | III | 22BMB4C1 | CC | Animal Physiology and | T | 4 | 4 | 25 | 75 | 100 |

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|-----|-----------------------|-----------|--|---|-----------|-----------|------------|------------|------------|--|
| | | | Biochemistry | | | | | | | |
| | 22BMB4C2 | CC | Aquaculture | T | 4 | 4 | 25 | 75 | 100 | |
| | 22BMB4P1 | CC | Practical –IV- Animal Physiology and Biochemistry | P | 3 | 3 | 40 | 60 | 100 | |
| | - | AL – II B | Botany/Zoology/Microbiology/ Biotechnology | T | 3 | 3 | 25 | 75 | 100 | |
| | - | AL – II B | Practical – Respective Allied Theory Course | P | 2 | 2 | 40 | 60 | 100 | |
| IV | - | NME- II | 1.Adipadai Tamil 2.Advance Tamil 3. Small Business Management / MOOC'S | T | 2 | 2 | 25 | 75 | 100 | |
| | Naan Mudhalvan Course | | Digital Skills for Employability – (Microsoft-Office Fundamentals) | - | 2 | 3 | 25 | 75 | 100 | |
| | | | Total | | 26 | 30 | 255 | 645 | 900 | |
| V | 22BMB5C1 | CC | Immunology and Genetics | T | 4 | 4 | 25 | 75 | 100 | |
| | 22BMB5C2 | CC | Marine Pollution | T | 4 | 4 | 25 | 75 | 100 | |
| | 22BMB5C3 | CC | Biodiversity and Conservation | T | 4 | 4 | 25 | 75 | 100 | |
| | 22BMB5C4 | CC | Seafood Processing Technology | T | 4 | 4 | 25 | 75 | 100 | |
| | 22BMB5P1 | CC | Practical-V- Immunology and Genetics | P | 4 | 6 | 40 | 60 | 100 | |
| | 22BMB5P2 | CC | Practical-VI- Marine Pollution, Biodiversity and Conservation, Seafood Processing Technology | P | 4 | 6 | 40 | 60 | 100 | |
| | - | | Career development/employability skills | - | - | 2 | - | - | - | |
| | | | Total | | 24 | 30 | 180 | 420 | 600 | |
| III | 22BMB6I | | Internship | | 24 | 26 | 150 | 250 | 400 | |
| IV | Naan Mudhalvan Course | | Employability Readiness* (Naandi /Unnati/Quest/IBM Skills build) | - | 2 | 4 | 25 | 75 | 100 | |
| | | | Total | | 26 | 30 | 175 | 325 | 500 | |
| | | | (Or) | | | | | | | |
| III | 22BMB6E1 | DSE | Marine Resources | T | 6 | 6 | 25 | 75 | 100 | |
| | 22BMB6E2 | | Aquarium Fish Keeping | T | 6 | 6 | 25 | 75 | 100 | |
| | 22BMB6E3 | | Coastal Disaster Management | T | 6 | 6 | 25 | 75 | 100 | |
| | 22BMB6E4 | | Marine Biofouling And Management | T | 6 | 6 | 25 | 75 | 100 | |
| IV | | Others | Library / Yoga etc | | | 2 | | | | |
| IV | Naan Mudhalvan Course | | Employability Readiness* (Naandi /Unnati/Quest/IBM Skills build) | - | 2 | 4 | 25 | 75 | 100 | |
| | | | Total | | 26 | 30 | 125 | 375 | 500 | |
| | | | (Or) | | | | | | | |
| III | 22BMB6PR | DSE | Project | | 6 | 8 | 25 | 75 | 100 | |
| | 22BMB6E1 | | Marine Resources | T | 6 | 6 | 25 | 75 | 100 | |
| | 22BMB6E2 | | Aquarium Fish Keeping | T | 6 | 6 | 25 | 75 | 100 | |
| | 22BMB6E3 | | Coastal Disaster Management | T | 6 | 6 | 25 | 75 | 100 | |
| IV | Naan Mudhalvan Course | | Employability Readiness* (Naandi /Unnati/Quest/IBM Skills build) | - | 2 | 4 | 25 | 75 | 100 | |

| | | | | | | | | | | |
|--|--|--|--|---------------|-------------|-----|----|-----|-----|----------|
| | | | | Skills build) | | | | | | |
| | | | | | Total | 26 | 30 | 125 | 375 | 500 |
| | | | | | Grand Total | 146 | -- | -- | -- | 440 0 |

*Employability Readiness -Women's Colleges Naandi course and all other Colleges IBM Skills build Course.

| Sem. | Part | Course Code | Title of the Paper | Credit | Hours/Week | Marks | | |
|------|------|-------------|--|--------|------------|-------|------|-------|
| | | | | | | Int. | Ext. | Total |
| I | III | 71BEPL - I | Professional English for Life Science -I | 4 | 5 | 25 | 75 | 100 |
| II | | 72BEPL - II | Professional English for Life Science -II | 4 | 5 | 25 | 75 | 100 |
| III | | * | Professional English for Life Science -III | 4 | 5 | 25 | 75 | 100 |
| IV | | | Professional English for Life Science -IV | 4 | 5 | 25 | 75 | 100 |

*The Syllabus of Professional English for III & IV Semester will be provided after Receiving the syllabus from TANSCHÉ.

As per TANSCHÉ, the Professional English book will be taught to all four streams apart from the existing hours of teaching/additional hours of teaching (1hour/day) as a 4 credit paper as an add on course on par with Major paper and completion of the paper is a must to continue his/her studies further.

- TOL-Tamil/Other Languages,
- E – English
- CC-Core course –Core competency, critical thinking, analytical reasoning, research skill & teamwork
- Allied -Exposure beyond the discipline
- AECC- -Ability Enhancement Compulsory Course (Professional English & Environmental Studies) - Additional academic knowledge, psychology and problem solving etc.,
- SEC-Skill Enhancement Course - Exposure beyond the discipline (Value Education , Entrepreneurship Course, Computer application for Science, etc.,
- NME -Non Major Elective – Exposure beyond the discipline
- DSE – Discipline specific elective – -Student choice – either or
 - Internship
 - If internship – Marks = Internal =150 (75+75) two midterm evaluation through Viva voce and External 250 marks (Report =150 +Viva Voce=100) =Total 400 marks
 - Theory papers or
 - Project + 3 theory papers.
- MOOCs – Massive Open Online Courses
- T- Theory, P- Practical

| SEMESTER- I | | | | |
|--|--|------------|----------|------------|
| Course Code: 22BMB1C1 | Core Course - I | T/P | C | H/W |
| | FUNDAMENTALS OF MARINE BIOLOGY | T | 5 | 5 |
| Objectives | <ul style="list-style-type: none"> ➤ To study the History of Marine Biology and physical and chemical properties of sea water. ➤ To understand the primary and secondary productivity and community ecology. | | | |
| Unit - I | History of Marine Biology - Definition, historical and modern developments in Marine Biology and Oceanography – National and International Ocean expeditions, Topography of the oceans; Zonation and its significance. | | | |
| Unit – II | Physical properties of seawater –Concept note on temperature, density, viscosity, surface tension, hydrostatic pressure. Waves: types of waves and its dynamics. Tides: Definition, types, generating force. Wind and Ocean circulation, Currents and its types. | | | |
| Unit – III | Chemical properties of seawater: Concept of chlorinity and salinity of seawater; Dissolved gases in seawater: non-reactive gases, minor reactive gases; Elements-major and minor elements. Organic matter: Dissolved and Particulate organic matter-sources and types; Biogeochemical cycle - carbon, nitrogen, phosphorus, silicate and their significance. | | | |
| Unit – IV | Biological properties of sea: Primary and Secondary Productivity of the coastal environment; Phytoplankton and Zooplankton: Classification, distribution, inter-relationship. Measurement of primary and Secondary productivity. | | | |
| Unit – V | Community ecology – Pelagic, benthic, coral reef, estuaries, seagrass, mangrove, intertidal and Deep-Sea Ecology-Animal association and their assemblages. | | | |
| References and Textbooks | | | | |
| Naskar, K., & Mandal, R. (1999). <i>Ecology and Biodiversity of Indian Mangroves</i> (Vols. 1-2). Daya Publishing House. | | | | |
| Nybakken, J. W., & Mark, D. Bertness. (2004). <i>Marine Biology an Ecological Approach</i> (6 th ed.). Benjamin-Cummings Pub Co. | | | | |
| Peter McRoy, C., & Helterich, G. (1977). <i>Seagrass Ecosystem: A Scientific Perspective</i> . New York: Marcel Dekker Inc. | | | | |
| Peter, C., & Michel, E. H. (2013). <i>Marine Biology</i> (9 th ed.). McGraw-Hill Education. | | | | |
| Spoel. S. Vander, & Heyman, R. P. (1983). <i>Comparative atlas of Zooplankton biological patterns in the oceans</i> . Springer-Verlag Berlin. | | | | |
| Sumich, J. L. (1999). <i>Introduction to the biology of Marine Life</i> (7 th ed.). The Mc Graw Hill Companies Inc. | | | | |
| Sverdrup, H. U., Honson, M. W., & Fleming, R. H. (1959). <i>The oceans their physics, chemistry and general biology</i> . New Jersey: Prentice-Hall Inc. | | | | |
| Outcomes | <ul style="list-style-type: none"> ➤ The students gain knowledge in history of Marine biology and Oceanography features. ➤ The students able to know about the productivity of oceans with community ecology. | | | |

| SEMESTER -I | | | | |
|---|---------------------------|------------|----------|------------|
| Course Code: 22BMB1P1 | CORE PRACTICAL - I | T/P | C | H/W |
| | | P | 4 | 4 |
| FUNDAMENTALS OF MARINE BIOLOGY | | | | |
| <ol style="list-style-type: none"> 1. Marine sampling devices: Water sampling devices- Knudsen water sampler, Light measuring devices - Secchi disc - Turbidity meter, Sediment sampler -- Peterson's grab. 2. Chemical parameters- Salinity, Total alkalinity, Dissolved oxygen, Nitrite, Nitrate, Phosphate and silicate. 3. Identification of phytoplankton, zooplankton, seaweeds, seagrass, benthic fauna. 4. Field visit to nearby fish landing centers and different ecosystems. | | | | |

| SEMESTER II | | | | |
|---|---|------------|----------|------------|
| Course Code | Core Course - II | T/P | C | H/W |
| 22BMB2C1 | ANIMAL DIVERSITY | T | 5 | 5 |
| Objectives | <ul style="list-style-type: none"> ➤ To know the variety of invertebrate and vertebrate organisms and their evolutionary origin and diversification. ➤ To investigate invertebrates and vertebrates in laboratory and field conditions and identify major taxonomy. | | | |
| Unit - I | Principles and classification; origin, evolution and interrelationships of invertebrate's Phyla. – interrelationship among the classes with in each invertebrate phylum | | | |
| Unit – II | Marine invertebrates and their biology -Classification and biology: Physiology, locomotion, nutrition and reproduction of marine invertebrates - Phylum Porifera, Phylum Cnidaria, Phylum Ctenophora, Phylum Echinodermata. Minor phyla: chaetognatha, brachiopoda, phoronida and pogonophora | | | |
| Unit – III | Prochordata, Hemichordata, Urochordata - Principles and classification; origin, evolution and phylogenetic relationships. Comparative morphology, reproductive and early development and larval. | | | |
| Unit – IV | General characteristics and outline classification of Phylum Chordata. Origin, evolution and comparative anatomy of vertebrates through geological time scale. Classification of cyclostomes and pisces. Accessory respiratory organ, Classification of Amphibia and reptilia. Metamorphosis, Paedomorphosis, Parental care in Amphibia. Classification of Aves and Mammals. Exoskeleton, and migration in Birds; Principles and aerodynamics of flight. Adaptive radiation in mammals. | | | |
| Unit – V | Structure, function and derivatives of integument in amphibian, birds and mammals. Comparative anatomy of stomach; dentition in mammals. Respiratory organs in fish, birds and mammals. General plan of circulation, Comparative account of heart and aortic arches. Succession of kidney in different vertebrate groups. Comparative account of brain in vertebrates; cranial nerves; olfactory and auditory receptors in Vertebrates. | | | |
| References and Textbooks | | | | |
| Barnes, R. D. (1982). <i>Invertebrate Zoology</i> (4 th ed.). Holt Saunders International Edn. | | | | |
| Bliss, D. (Ed.). (1983). <i>Biology of Crustacea</i> (Vols. 1-10). London: Academic Press. | | | | |
| Ekambaranatha Ayyar, M., & Ananthakrishnan, T. N. (1992). <i>Manual of Zoology</i> (Vol. 1, part I & II). Chennai: S. Viswanathan Pvt. Ltd. | | | | |
| Gurdarshan Singh & Bhaskar, H. (2002). <i>Advanced Chordate Zoology</i> . Campus Books. | | | | |
| Jordan, E. L. & Verma, P.S. (1998). <i>Chordate Zoology</i> . S. Chand & Co. | | | | |
| Janakiraman, N., & PatchiRajan, G. <i>Biodiversity of Invertebrates</i> . Devakottai: Seetha Lakshmi Ganesan Publishers. | | | | |
| Jordan, E. L. & Verma, P.S. (2009). <i>Invertebrate Zoology</i> (Revised edition). New Delhi: S. Chand & Co. | | | | |
| Jordan, E. L. & Verma, P.S. (2010). <i>Vertebrate Zoology</i> . S. Chand & Company Ltd. | | | | |

Kotpal, R. L., (2000). *Modern Textbook of Zoology (Vertebrates)*. Global Media Publications.
Sandhu, G.S. & Bhaskar, H. (2004). *Textbook of Chordate Zoology* (Vols. 1-2). Campus Books
Sandhu, G.S. (2005). *Objective Chordate Zoology*. Campus Books.

Outcomes

- The students will learn about the diversity of invertebrates and vertebrates.
- The students will explore the adaptations of the invertebrate and vertebrate groups to the environment in terms of comparative physiology and body structure.

| SEMESTER II | | | | |
|---|--------------------------|------------|----------|------------|
| Course Code 22BMB2P1 | Core Practical II | T/P | C | H/W |
| | | P | 4 | 4 |
| ANIMAL DIVERSITY | | | | |
| <ol style="list-style-type: none"> 1. Identification selective larval forms through slides 2. Identification of selective protozoan and helminthes of medical importance 3. Dissection and mounting of digestive system, reproductive system of selected invertebrate 4. Comparative anatomy of vertebrates (Fish, Amphibia, Reptiles, birds and mammals) Skeletal system – Girdles only; Digestive system; Respiratory system 5. Comparative anatomy of vertebrates (Fish, Amphibia, Reptiles, birds and mammals) Circulatory system – heart and Aortic arches; Nervous system – Brain; Urinogenital system 6. Dissection of the locally available cultivable fish- Digestive system; Reproductive system; nervous system. | | | | |

| SEMESTER III | | | | |
|---|---|-----|---|-----|
| Course Code | Core Course III | T/P | C | H/W |
| 22BMB3C1 | CELL AND DEVELOPMENTAL BIOLOGY | T | 3 | 3 |
| Objectives | <ul style="list-style-type: none"> ➤ To understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles. ➤ To provide a comprehensive understanding of the concepts of early animal development. | | | |
| Unit - I | Prokaryotic and Eukaryotic cell structure, Ultra-structure and composition of Plasma membrane. Structure and Functions: Endoplasmic Reticulum, Golgi Apparatus, Lysosomes, Mitochondria, Peroxisomes, Centrosome. Nuclear envelope, Nuclear pore complex, Nucleolus; Chromatin: Euchromatin and Heterochromatin | | | |
| Unit – II | Cell division; mitosis, meiosis. Cell cycle and control in prokaryotes and eukaryotes. Cell death apoptosis. Cell signalling – signal molecules – receptors – signal transduction | | | |
| Unit – III | Gametogenesis: Spermatogenesis, Oogenesis. Types of eggs, Egg membranes; Fertilization. Planes and patterns of cleavage; Types of Blastula. Fate map. Gastrulation, organogenesis. Embryonic induction and organizers | | | |
| Unit – IV | Extra-embryonic membranes in Chick; Implantation of embryo in humans, Placenta (Structure, types and functions of placenta). Development of brain and Eye in Chick. Molecular Induction in Brain and Eye development. Organizer concept Amphibian metamorphosis. Hormonal control of Amphibian metamorphosis. Nuclear Transplantation in Acetabularia - Regeneration – types – regeneration in Amphibians and planaria. | | | |
| Unit – V | <i>In vitro</i> fertilization (IVF), Stem cell: Concept of potency, types, markers and applications of stem cell therapy in bone marrow transplantation and cartilage regeneration | | | |
| References and Textbooks | | | | |
| Alberts, B., Bray, D., Lavis, J., Raff, M., Roberts, K., & Watson, J. (1989). <i>Molecular biology of the cell</i> (2 nd ed.). New York: Garland publishing Inc. | | | | |
| DeRobertis & DeRobertis (1999). <i>Cell and Molecular Biology</i> . Philadelphia: W.B. Saunders Co. | | | | |
| Geoffrey Cooper, M. (2000). <i>The cell – A molecular approach</i> (2 nd ed.). ASM Press. | | | | |
| Hopper, A. F., & Hart, N. H. (1985). <i>Foundations of Animal Development</i> . Oxford: Oxford University Press. | | | | |
| Lewis Wolpert. (2007). <i>Principles of Development</i> . Oxford: Oxford University Press. | | | | |
| Rastogi, V.B. (2010). <i>Introductory Cytology</i> (9 th ed.). New Delhi: Kedarnath Ramnath Publications. | | | | |
| Saunders, J. W. (1982). <i>Developmental Biology - Patterns, Principles and Problems</i> . New York: Macmillan Publishing Co. | | | | |
| Scott F. Gilbert. (2006). <i>Developmental Biology</i> (8 th ed.). INC Publishers | | | | |

Subramanian, T. (2002). *Developmental Biology*. New Delhi: Alpha Science International Ltd.

Wolpert, L., & Tickle, C. (2011). *Principles of Development* (4th ed.). Oxford: Oxford University Press.

Outcomes:

- The students will learn about the basics of cell biology and developmental biology

| SEMESTER III | | | | | |
|--|--|--|-----|---|-----|
| Course Code 22BMB3C2 | Core Course IV | | T/P | C | H/W |
| | FISHERY BIOLOGY | | T | 3 | 3 |
| Objectives | <ul style="list-style-type: none"> ➤ To know the basic classification, anatomy age and growth of marine fishes. ➤ To understand the different stages of fishes and fisheries conservation | | | | |
| Unit - I | Introduction: Brief outline of the classification of fin fish and shell fishes. Major fish group of the world and their characteristics- Distribution of commercially important fishes in Indian waters. | | | | |
| Unit – II | Morphometric and meristic characters of fishes. Key characters in identification of fishes. Basic anatomy of fish: digestive, respiratory, nervous and reproductive system. Food and feeding habits. | | | | |
| Unit – III | Age and growth–Length weight relationship. Maturity and fecundity- Reproduction–Embryonic, larval development. Concepts of Maximum Sustainable Yield and Maximum Economic Yield. Under fishing and overfishing. | | | | |
| Unit – IV | Juvenile stages of fin fishes and shell fishes. Biotic and abiotic factors affecting spawning in fishes. Migration in fishes; Parental care in fishes. | | | | |
| Unit – V | Fisheries conservation: Definition, Principles of conservation and management – Fishery regulation - Organizations involved in fisheries conservation. | | | | |
| References and Textbooks | | | | | |
| Aravind, N. S. (2013). <i>Fish and Fisheries</i> . Discovery Publishing House Pvt. Ltd. | | | | | |
| Agarwal, S. C. (2006). <i>History of Indian Fishery</i> . Daya Publishing House. | | | | | |
| Desai, R. K. (2009). <i>Fish Management and Aquatic Environment</i> . A.K. Publications. | | | | | |
| Harnell, J. (1995). <i>Marine Fish Farming for India</i> . Asiatic Publishing House. | | | | | |
| Nelson, J. A. (1992). <i>Fishes of the world</i> . John Wiley & Sons, Inc. | | | | | |
| Yadav, B. (1997). <i>Fish & Fisheries</i> . Daya Publishing House. | | | | | |
| Outcomes | <ul style="list-style-type: none"> ➤ The students able to aware the morphology and anatomy of marine fishes. ➤ The students will be able to understand about the age, growth and juvenile stages and fisheries conservation. | | | | |

| SEMESTER III | | | | |
|---|---------------------------|------------|----------|------------|
| Course Code | Core Practical III | T/P | C | H/W |
| 22BMB3P1 | | P | 3 | 3 |
| CELL AND DEVELOPMENTAL BIOLOGY | | | | |
| <ol style="list-style-type: none"> 1. Principle, working mechanism and care of compound microscope. 2. Mounting of Mitotic stages in the onion root tip 3. Mounting of Meiotic stages from the testis of grasshopper. 4. Mounting of Giant Chromosomes in Chironomus larva 5. Mounting of Squamous epithelial cells from the oral mucosa 6. Mounting of live sperms of a vertebrate 7. Observation of different types of eggs 8. Slides – Cleavage, Blastula, Gastrula stages of Frog 9. Whole mounting of Chick blastoderm 10. Slides – 18, 24, 33, 48, 72, 96 hours chick embryo. 11. Placenta of Mammals – Pig, sheep, Man & Rabbit | | | | |
| FISHERY BIOLOGY | | | | |
| <ol style="list-style-type: none"> 1. Classical identification of locally available fin and shell fishes. 2. Analysis of food and feeding habits of fishes. 3. Observation of fish maturation cycle, larval, juveniles and adult development. 4. Identification of fish parasites. 5. Methods of eggs and larvae-collection. | | | | |

| SEMESTER IV | | | | |
|---|---|------------|----------|------------|
| Course Code | Core Course - V | T/P | C | H/W |
| 22BMB4C1 | ANIMAL PHYSIOLOGY AND BIOCHEMISTRY | T | 4 | 4 |
| Objectives | <ul style="list-style-type: none"> ➤ To provide students with a basic understanding of the fundamental processes and mechanisms that serve and control the various functions of the body. ➤ Students will understand the structures and purposes of basics of macromolecules, membranes, and organelles. | | | |
| Unit - I | Nutrition: Types of food, general mechanisms of feeding, transport of food through gut; digestion and digestive enzymes in marine organisms. Food and feeding mechanisms of marine crustaceans, molluscs and fishes. | | | |
| Unit – II | Mechanism of Respiration, Respiratory volumes and capacities, transport of Oxygen and Carbon dioxide in blood, Dissociation curves and the factors influencing it, respiratory pigments. Physiology of sense organs in marine fishes: types of organs and functions. Physiology of nervous system: structure and functions. Physiology of endocrine system: hormones; neuro-hormones-controlled, Functions; Growth hormones –moulting process. | | | |
| Unit – III | Osmotic regulation and ion regulation: mechanisms and general account. General survey of pigments and colour in marine animals; Colour changes— Chromatophores; Bioluminescence and its biological significance. Endogenous rhythms: Biological clocks; Lunar periodicity. Excretion: Nitrogen excretion, mode of nitrogen excretion and elimination of nitrogenous wastes. Structure of Kidney and its functional unit, Mechanism of urine formation, Regulation of acid base balance. | | | |
| Unit – IV | Bio - Macromolecules as an energy source – Handerson and Hasselbalch equation – Acid base maintenance and their significance. Chemical bonds and their significance. Thermodynamics – laws and their significance. Carbohydrates- classification, structure, properties and biological importance of Monosaccharides, Disaccharides and Polysaccharides Proteins- Classification and function of Proteins, structural levels of organization. Denaturation and isoelectric point of Proteins. Amino acids: Classification of amino acids, essential amino acids, reactions of amino and carboxyl groups of amino acids. | | | |
| Unit – V | Lipids- Classification and properties of lipids. Types of fatty acids – saturated, unsaturated and essential fatty acids. Significance of lipoproteins and phospholipids. Structure, synthesis and biological significance of cholesterol, HDL and LDL | | | |
| References and Textbooks | | | | |
| Hoar, S. (1975). <i>General and Comparative Physiology</i> (2 nd ed.). Printice Hall. | | | | |
| Hoar, W. S. (1983). <i>General and Comparative Physiology</i> . Prentice Hall. | | | | |
| Prosser, C. L. (1991). <i>Comparative Animal Physiology</i> (4 th Ed.). Philadelphia: Saunders Co. | | | | |

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|---|---|
| <p>Nagabhushanam, R., Kadarkar, M. S., Sarojini, R. (2002). <i>Text book of Animal Physiology</i> (2nd ed.). New Delhi: Oxford and IBH publishing Co. Pvt. Ltd.</p> <p>Murray R. K., Granner, D.K., & Rodwell, V. M. (2006). <i>Harpers Illustrated Biochemistry</i> (28th ed.). The McGraw-Hill companies, Inc.</p> <p>Donald Voet & Judith Voet, G. (2004). <i>Biochemistry</i> (3rd ed.). USA: John Wiley and Sons.</p> <p>Eckert, R. (2005). <i>Animal Physiology</i>. CBS publishers.</p> <p>Nelson, D.L., & Cox, M.M. (2006). <i>Lehninger Principles of Biochemistry</i> (4th ed.). Macmillan worth Publishers.</p> <p>Mohan P. Arora (2013). <i>Animal Physiology</i>. Himalaya Publishing House.</p> | |
| Outcomes | <ul style="list-style-type: none"> ➤ Students will understand the functions of important physiological systems and how these separate systems interact to yield integrated physiological responses. ➤ The students will learn about the basics of biochemistry. |

| SEMESTER IV | | | | | |
|---|--|--|-----|---|-----|
| Course Code 22BMB4C2 | Core Course VI | | T/P | C | H/W |
| | AQUACULTURE | | T | 4 | 4 |
| Objectives | <ul style="list-style-type: none"> ➤ To study about the status of aquaculture and aquafarm design construction and management. ➤ To understand about the fish hatchery and feed formulation. | | | | |
| Unit - I | Introduction: Definition, Importance of Coastal Aquaculture -Status of inland and marine aquaculture in India and world. Socio-economic issues. | | | | |
| Unit – II | Farm design: Site Selection-Topography-Soil Characteristics - water source – Structures and type and drainage canals, Sluice, construction, operation- Seepage, evaporation and their control-Open Sea farming - cage, pen, raft, IMTA. | | | | |
| Unit – III | Fish farm management: nursery and grow out pond management-stocking, feeds, water quality management- Shore based aquaculture system: traditional, semi-intensive, intensive aquaculture practice of commercially important species of fishes - bioflocs and raceways. Fish disease, diagnosis, treatment, management and control - economics of farming. Seaweed culture-Types-economic importance. | | | | |
| Unit – IV | Hatchery Management: Fin and shell fish hatchery, Types of hatcheries, Present Status-Hatchery production: Collection & maintenance of brood stock-induced breeding-mass production of seeds-Types and components of hatchery. Live feed culture. | | | | |
| Unit – V | Feed Formulation - Feed ingredients and nutritive value, feed formulation procedure, microdiets. Fisheries extension: Principles, types and Role-Fish Farmers Development Agency -Brackish Water fish Farmers Development Agency &Role of Non- Governmental Agencies in fisheries development. | | | | |
| References and Textbooks | | | | | |
| Pillay, T.V.R. (1990). <i>Aquaculture Principles & Practices</i> . London: Fishing News (Books) Limited | | | | | |
| Santhanam R., Ramanathan, N., & Jegatheesan, G. (1990). <i>Coastal Aquaculture in India</i> . CBS publishers and Distributors. | | | | | |
| Dash, M. C., & Patnaik, P. N. (1994). <i>Brackish Water Prawn Culture</i> . Palani Paramount Publications. | | | | | |
| Hertrampf, J. W., & Pascal, F. P. (2000). <i>Handbook on Ingredients for Aquaculture feeds</i> . London: Kluwer Academic Publishers. | | | | | |
| Gupta, S., Mohapatra, B., & Routray, P. (2008). <i>Textbook of Breeding and Hatchery Management of Carps</i> . Narendra Publishing House. | | | | | |
| Thomas, P. C., Rath, S., & Mohapatra, K. D. (2013). <i>Breeding and Seed Production of Finfish and Shellfish</i> . Daya Publishing House. | | | | | |
| Outcomes | | | | | |
| <ul style="list-style-type: none"> ➤ The students will learn the status, potentials and construction and management of aqua farms. ➤ The students will be able to understand the Hatchery management and feed formulation in aquaculture. | | | | | |

| SEMESTER IV | | | | |
|--|--------------------------|------------|----------|------------|
| Course Code 22BMB4P1 | Core Practical IV | T/P | C | H/W |
| | | P | 3 | 3 |
| ANIMAL PHYSIOLOGY AND BIOCHEMISTRY | | | | |
| <ol style="list-style-type: none"> 1. Oxygen consumption by a fish. 2. Study of ciliary activity / heart beat of Mussel in relation to the temperature 3. Determination of Blood bleeding time and clotting time 4. Preparation of haemin crystals 5. Osmoregulation – Salt loss & gain in fish 6. Determination of R_f values of amino acid – Paper Chromatography 7. Qualitative analysis of carbohydrates 8. Qualitative analysis of Proteins 9. Qualitative analysis of lipids | | | | |
| AQUACULTURE | | | | |
| <ol style="list-style-type: none"> 1. Soil and water quality analysis. 2. Identification of plankton and locally available seaweeds. 3. Field visit to aquaculture farms, Hatchery and seaweed culture sites. 4. Feed formulation, stocking density, FCR | | | | |

| SEMESTER V | | | | | | |
|--|--|--|--|------------|----------|------------|
| Course Code 22BMB5C1 | Core Course VII | | | T/P | C | H/W |
| | IMMUNOLOGY AND GENETICS | | | T | 4 | 4 |
| Objectives | <ul style="list-style-type: none"> ➤ To identify the cellular and molecular basis of immune responsiveness ➤ To develop and demonstrate an understanding of the structure and function of genes. | | | | | |
| Unit - I | History and scope of Immunology - Immunity -Types of Immunity - Innate and acquired, Passive and Active- Lymphoid organs - Primary and secondary lymphoid organs - Thymus, Bone marrow, Bursa of fabricus, Spleen, Tonsil, Lymph node. | | | | | |
| Unit – II | Immunoglobulin and Immune Diseases-Immunoglobulin - Structure, function and biological properties of Immunoglobulin classes. Interaction of antigen and antibody- Auto immune diseases – Causes, Classification, Diagnosis & Treatment- Hypersensitivity & its types, Tumour Immunology. | | | | | |
| Unit – III | Mendelian Genetics: Monohybrid – laws of dominance & segregation; Dihybrid cross – law of independent assortment – simple mendelian traits in man. Interaction of Genes: Complementary, Epistasis – Dominant & Recessive Polygenic Inheritance - Skin colour in man. | | | | | |
| Unit – IV | Multiple Alleles - Blood groups in man Linkage & Crossing over in Drosophila. Chromosome mapping, Sex-linked inheritance in man – Colour blindness and Haemophilia. Sex Determination – Types, intersexes, Gynandromorph and sex-mosaics. | | | | | |
| Unit – V | Inborn Errors of metabolism, Non-disjunction – Syndromes – Klinefelter, Turner, Down. Pedigree analysis, Inbreeding and Out-breeding, Eugenics, Euthenics and Genetic Counselling. | | | | | |
| References and Textbooks | | | | | | |
| Tizard, R. I. (1983). <i>Immunology: An introduction</i> . Philadelphia: Saunders college Publishing. | | | | | | |
| Roitt, I. (1984). <i>Essential Immunology</i> (5 th ed.). Blackwell Scientific publications. | | | | | | |
| Tramarin, R. H. (1996). <i>Principles of Genetics</i> (5 th ed.). WCB publishers. | | | | | | |
| Klug, W. S., & Cummings, M.R. (2000). <i>Concepts of Genetics</i> (6 th ed.). Prentice Hall. | | | | | | |
| Fingerman, M., & Nagabhusanam, R. (Eds.). (2001). <i>Recent advances in marine biotechnology</i> (Vol. 5: <i>Immunobiology and Pathology</i>). Enfield: Science Publishers Inc. | | | | | | |
| Gardner, E. J., Simmons, M. J., Snustad D. P. (2006). <i>Principles of Genetics</i> . New Delhi: Wiley Eastern Private Limited. | | | | | | |
| Outcomes | <ul style="list-style-type: none"> ➤ The students know about the principles of Mendelism. Be able to understand multiple allelic inheritance and to describe different types Gene Interactions. Learn the significance of Mitosis and Meiosis, etc. ➤ Student will learn the basic knowledge of immunological processes at a cellular and molecular level. | | | | | |

| SEMESTER V | | | | |
|--|--|------------|----------|------------|
| Course Code 22BMB5C2 | Core Course VIII | T/P | C | H/W |
| | MARINE POLLUTION | T | 4 | 4 |
| Objectives | <ul style="list-style-type: none"> ➤ To understand about the marine pollution and their classification and origin. ➤ To know thermal, pesticide and heavy metal pollution. | | | |
| Unit - I | Marine Pollution - Definition, categories of additions, Pollutant and its classification. Organic wastes – BOD and COD. Origin and transport of organic pollutants to the oceans. Physical, chemical and biological effect on marine organisms- bioaccumulation, biomagnification and biodepuration. | | | |
| Unit – II | Sewage Pollution - Definition, sources, nature and their treatment processes with reference to wastes from river run off, agricultural, paper, fertilizer, pulp and soap manufacturing industries. Microplastic pollution: source and effects. | | | |
| Unit – III | Thermal Pollution- The status of Indian and Pacific Ocean and seas in the world in relation to pollution. Oil Pollution – types and properties of oil, oil spills, fate of spilled oil on the marine environment - consequences of oil spills and treatment of oil spills. | | | |
| Unit – IV | Pesticide pollution - inputs, fate in the sea, factors affecting the bioaccumulation of pesticides - DDT the most widespread molecule - Impact of pesticides on the Environment - Mode of poisoning of pesticides - Methods to minimize pesticide pollution. | | | |
| Unit – V | Heavy metal Pollution - Sources, Classification and effects of marine and coastal waters (Hg, Pb, Cd and Fe). Distribution- toxicity and disease -Minamata and Itai itai and their toxic effect – Red tide and ecological significance. Indicator organism - Macro algae, crustaceans and mollusks as indicator organisms. GESAMP. | | | |
| References and Textbooks | | | | |
| Andres, H. A., & Jorge, E. (2017). <i>Marine Pollution and Climate Change</i> . Taylor & Francis Group. | | | | |
| Aaradhana, S. (2018). <i>Marine, Nuclear and Thermal Pollution</i> . Jnanada Prakashan (P&D). | | | | |
| Clark, R. B. (1989). <i>Marine pollution</i> . Oxford, New York: Clarendon Press. | | | | |
| Coffield, R. L. (2019). <i>Saving Our Oceans</i> . Moonlight Mesa Associates. | | | | |
| Judith S. Weis (2015). <i>Marine Pollution</i> . Oxward University Press. | | | | |
| Park, P. K., Kester, D. R., Deudall, J. W. & Ketchum, B. H. (1983). <i>Wastes in the Ocean</i> . (Vols. 1-3). New York: Wiley Interscience Publishers. | | | | |
| Ricardo, B. (2018). <i>Marine Pollution: Sources, Fate and Effects of Pollutants in Coastal Ecosystem</i> . Elsevier. | | | | |
| Singh, P. (1995). <i>Environmental Pollution and Management</i> . Chugh Publications. | | | | |
| Outcomes | <ul style="list-style-type: none"> ➤ Students acquire knowledge about marine pollution and their types and effects. ➤ The students will be able to understand about major types of pollutions such as Thermal, Pesticide and heavy metal pollution. | | | |

| SEMESTER V | | | | | | |
|--|--|--|--|-----|---|-----|
| Course Code 22BMB5C3 | Core Course IX | | | T/P | C | H/W |
| | BIODIVERSITY AND CONSERVATION | | | T | 4 | 4 |
| Objectives | <ul style="list-style-type: none"> ➤ To understand about the biodiversity of marine organisms and marine protected areas ➤ To acquire knowledge in issues in marine biodiversity conservation and sustainable development. | | | | | |
| Unit - I | Introduction – Definition to Marine Biodiversity - significance - biodiversity indices. Definition of extinction of marine bio-resources – causes and rate of extinction. | | | | | |
| Unit – II | Conservation – Definition, essential concepts for small populations - problems of small population - establishment of new populations - conservation categories of species - legal protection of species. | | | | | |
| Unit – III | Marine protected areas – Establishment of protected areas – management-restoration. | | | | | |
| Unit – IV | Challenges in marine biodiversity conservation – Lack of scientific data and barriers in transfer of information - cultural and biological diversity - differing benefits and costs harming aquatic life - jurisdictional gaps and overlaps - use of marine environment. | | | | | |
| Unit – V | Conservation and sustainable development - traditional societies - Government action local legislation - national laws - National Biodiversity Act and National Biodiversity Authority. | | | | | |
| References and Textbooks | | | | | | |
| Bertness, M. D., Bruno, J. F., Silliman, B. R., & Stachowicz, J. J. (Eds.). (2014). <i>Marine community ecology and conservation</i> . Sinauer Associates, Inc. | | | | | | |
| Heywood, V., & Watson, R. (1995). <i>Global Biodiversity Assessment</i> . Cambridge University Press. | | | | | | |
| Krishnamurthy, K.V. (2004). <i>An Advanced Text Book of Biodiversity - Principles and Practices</i> . New Delhi: Oxford and IBH Publications Co. Pvt. Ltd. | | | | | | |
| Kumar, S. (2009). <i>Biodiversity, Environment and Sustainable Management</i> (1 st ed.). A. K. Publications. | | | | | | |
| Kannaiyan, S., & Venkatraman, K. (2011). <i>Marine Biodiversity in India</i> . Associated Publishing Company. | | | | | | |
| Naskar, K., & Mandal, R. (1999). <i>Ecology and Biodiversity of Indian Mangroves</i> . Daya Publications. | | | | | | |
| Sinha, P. (1998). <i>Biodiversity Depletion</i> . Anmol Publications Pvt. Ltd. | | | | | | |
| Outcomes | | | | | | |
| <ul style="list-style-type: none"> ➤ The students understand about importance of marine biodiversity and conservation. ➤ The students gain knowledge about marine protected areas and sustainable development. | | | | | | |

| SEMESTER V | | | | |
|---|---|-----|---|-----|
| Course Code | Core Course X | T/P | C | H/W |
| 22BMB5C4 | SEA FOOD PROCESSING TECHNOLOGY | T | 4 | 4 |
| Objectives | <ul style="list-style-type: none"> ➤ To understand about handling processing and storage of seafoods. ➤ To learn about the export and quality control in seafoods. | | | |
| Unit - I | Fish Handling transportation - on board and on shore – manufacture and quality of ice for fish storage. Transportation of fish - Refrigerated Sea water - Insulated containers for fresh fish transportation. | | | |
| Unit – II | Fish processing –Post mortem changes - rigor mortis- autolysis- autooxidation and their role.- Chemical changes (Lipid, protein and nucleotide)-Bacterial load, sensory changes, texture, taste and odour. Factors affecting quality of fish - salting, sun drying, smoking, marinading and fermentation. | | | |
| Unit – III | Freezing - Processing and packaging, antibiotics and chemicals usage and cryoprotectants. Duration of Storage period -quality and shelf life. Hygienic practice in processing plants. HACCP. Packaging and packaging materials - vacuum packaging, MAP - Packing of fresh and frozen fish – transportation and cold chain-packaging for local consumption and export. | | | |
| Unit – IV | Canning of fish-general steps in canning-principles-can materials-preparation of raw materials, packing, precooking, exhausting, seaming, retorting, labelling, cooling, labelling and storage. Spoilage of canned foods and preventive measures. Irradiation-Radiation sources and units, dose level-effects of irradiation on protein, vitamin and lipids. | | | |
| Unit – V | Fish by products and value-added products-fish meal, oil, chitin, chitosan and gelatin etc. Seaweed uses: agar agar, algin, carrageenan. Seafood quality: Quality assessment in fish and fishery products - Quality standards - good manufacturing practices-Codex alimentaris, USFDA and EU regulation for export trade. Role of MPEDA. | | | |
| References and Textbooks | | | | |
| Balachandran. (2002). <i>Post - Harvest Technology of Fish and Fish Products</i> . Daya Publishing House. | | | | |
| Nowak, W. S. W. (1970). <i>The marketing of shell fish</i> . London: Fishing News (Books) Ltd. | | | | |
| Sinha, P. (2011). <i>Fish Processing and Preservation</i> . APHA Publishing Corporation. | | | | |
| Outcomes | <ul style="list-style-type: none"> ➤ The students will acquire knowledge on seafood handling and processing. ➤ The students will understand about seafood storage, export and quality control. | | | |

| SEMESTER V | | | | |
|---|-------------------------|------------|----------|------------|
| Course Code 22BMB5P1 | Core Practical V | T/P | C | H/W |
| | | P | 4 | 6 |
| Immunology and Genetics | | | | |
| <ol style="list-style-type: none"> 1. Lymphoid organs in Rat Demonstration only – Model/ chart/ CD Students have to draw the diagram 2. Observation of Blood group 3. Double immunodiffusion and radial immunodiffusion (demonstration only). 4. Experiments to study Mendel’s law using beads. 5. Observation of Mendelian characters for self & class students. 6. Spotters - Drosophila types, Gynandromorph Syndromes –Down, Turner, Klinefelter. | | | | |

| SEMESTER V | | | | |
|---|--------------------------|------------|----------|------------|
| Course Code 22BMB5P2 | Core Practical VI | T/P | C | H/W |
| | | P | 4 | 6 |
| MARINE POLLUTION | | | | |
| <ol style="list-style-type: none"> 1. BOD, TOC, TDS and TSS 2. Analysis of heavy metals 3. Identification of pollution indicator organisms. | | | | |
| BIODIVERSITY AND CONSERVATION | | | | |
| <ol style="list-style-type: none"> 1. Qualitative and quantitative estimation of Phytoplankton and zooplankton. 2. Structural morphology and physiology of marine fauna and flora. 3. Biodiversity indices-diversity, richness and evenness. | | | | |
| SEA FOOD PROCESSING TECHNOLOGY | | | | |
| <ol style="list-style-type: none"> 1. Freezing and storage of fish 2. Estimation of salt content in dried fish 3. Sensory evaluation of fish freshness 4. Microbial load in fish samples 5. Proximate compositional analysis of fish 6. Visit to nearby seafood processing unit | | | | |

| Semester - VI | | | | | |
|---|---|--|-----|---|-----|
| Course Code 22BMB6E1 | DSE-I | | T/P | C | H/W |
| | MARINE RESOURCES | | T | 6 | 6 |
| Objectives | <ul style="list-style-type: none"> ➤ To understand the marine non-living resources including minerals. ➤ To learn about marine fisheries resources, drug sources and toxin and venoms. | | | | |
| Unit - I | Marine Non-living resources: Distribution of different kinds of resources-Indian ocean. Integrated resource management-Preservation and conservation of non-living resources-Renewable and non - renewable resources and their origin. | | | | |
| Unit – II | Marine minerals: Minerals-phosphorites-Placer Minerals-Sulfides-Manganese nodules and cobalt crusts-Methods in the exploration of seafloor minerals deposits. | | | | |
| Unit – III | Fisheries resources management and deep-sea fisheries. Resource potential-Fish resources of Indian EEZ-Fishery resource depletion. Profitable vessel management. Capture fisheries: Crab, shrimp and fin fishes capture in India. Molluscan fishery and algal resources. | | | | |
| Unit – IV | Marine drugs: Definition,- Classification based on their pharmacologic actions- Marine bioactive compounds from Seaweeds, Actinomycetes, Sponges, Sea whip, Corals, Tunicates, Molluscs and Fishes: Source organism name and their pharmacologic actions | | | | |
| Unit – V | <p>Marine biotoxin: Harmful algal bloom Definition- Biotoxin Classification based on their chemical structure- Source and impact.</p> <p>Marine venome: Definition- Stingray, Stonefish, Scorpion fish, Lionfish, Sea urchins, Cone shells and Sea snakes: Venome source organism and their pharmacological effects in brief.</p> | | | | |
| References and Textbooks | | | | | |
| Gautam, A. (1998). <i>Conservation & Management of Aquatic Resources</i> . Daya Publishing House. | | | | | |
| Madhu, M., Jakhar, P., & Adhikary, P. (2013). <i>Natural Resource Conservation</i> . Satish Serial Publishing House. | | | | | |
| Singh, R. (2013). <i>Fishery Resources</i> . Pearl Books Publishing. | | | | | |
| Teleki, P., Dobson, M., & Moore, R. (1987). <i>Marine Minerals</i> . Reidel Publishing Company. | | | | | |
| Thompson, M., Sarojini, R., & Nagabushanam, R. (1991). <i>Bioactive Compounds from Marine Organisms</i> . Oxford & IBH Publishing Co. Pvt. Ltd. | | | | | |
| Yaday, B. N. (1997). <i>Fish & Fisheries</i> . Daya Publishing House. | | | | | |
| Outcomes | <ul style="list-style-type: none"> ➤ The students able to understand the marine minerals and non-living resources. ➤ The students acquire knowledge about marine living resources and drugs from the ocean. | | | | |

| Semester - VI | | | | | |
|---|---|--|------------|----------|------------|
| Course Code 22BMB6E2 | DSE-II | | T/P | C | H/W |
| | AQUARIUM FISH KEEPING | | T | 6 | 6 |
| Objectives | <ul style="list-style-type: none"> ➤ To elaborate about the importance of aquarium fishes and plants. ➤ To understand the aquarium design and construction and management and hatchery production. | | | | |
| Unit - I | Introduction to aquarium – types of aquaria – importance of aquarium – exotic and indigenous fishes-Identification of ornamental fishes, crustaceans, molluscs and ornamental aquatic plants and their propagation methods. Aquarium fish culture and trade in India and world. | | | | |
| Unit – II | Design and construction aquarium– construction of marine and fresh water aquarium-construction materials, Equipment: pumps, filters, aerator and lights. | | | | |
| Unit – III | Care and maintenance of aquarium - criteria for selection of ornamental fishes - water quality management – Feeds and probiotics. | | | | |
| Unit – IV | Diseases management – bacterial, fungal and viral diseases –prevention and control. | | | | |
| Unit – V | Hatchery production – farm and hatchery design and construction - Brooder management. Breeding-Ornamental Fishes, invertebrates and plants -Genetics and Biotechnological application in aquarium fish production- – packaging and transport. | | | | |
| References and Textbooks | | | | | |
| Anderson, C. (2009). <i>Reef fishes of the Maldives</i> . Republic of Maldives: Manta Marine Pvt Ltd. | | | | | |
| Boyd, C., & Tucker, C. (1998). <i>Pond Aquaculture: Water Quality Management</i> . Springer International Publishing. | | | | | |
| Coche, A. G., & Muir, J. F. (1992). <i>Pond Construction</i> . Daya Publishing House. | | | | | |
| Coleman, N. (2000). <i>Marine life of the Maldives</i> (Atoll Editions). Sea Challengers. | | | | | |
| Dash, M. C., & Patnaik, P. N. (1994). <i>Brackish Water Prawn Culture</i> . Palani Paramount Publications. | | | | | |
| Gupta, S., Mohapatra, B., & Routray, P. (2008). <i>Textbook of Breeding and Hatchery Management of Carps</i> . Narendra Publishing House. | | | | | |
| Thomas, P. C., Rath, S., & Mohapatra, K. D. (2013). <i>Breeding and Seed Production of Finfish and Shellfish</i> . Daya Publishing House. | | | | | |
| Outcomes | <ul style="list-style-type: none"> ➤ The students gain knowledge in aquarium construction and management. ➤ The students will learn about selection and hatchery production of aquarium fishers. | | | | |

| Semester - VI | | | | |
|--|---|-----|---|-----|
| Course Code | DSE-III | T/P | C | H/W |
| 22BMB6E3 | COASTAL DISASTER MANAGEMENT | T | 6 | 6 |
| Objectives | <ul style="list-style-type: none"> ➤ To learn about the natural hazards, threats and disaster mitigation. ➤ To understand the risk reduction measures and risk management. | | | |
| Unit - I | Hazards-Definition –Hazards as natural process - Benefits and importance of disasters, Nature disaster- Death and Damage - Evaluating hazards - Human response to hazards. | | | |
| Unit – II | Major threats to coastal ecosystem- Habitat loss- Landslides -Sea level change, water quality, marine resource depletion, Earthquakes, Tsunami, Volcanic activity, Coastal flooding, Cyclones, Erosion, Sea water intrusion, Causes, preventive measures and early warning systems. | | | |
| Unit – III | Disaster mitigation and actions to reduce risks- Mitigation actions, types of mitigation measures, Environmental hazards, assessment and response, the scale of disaster. Causes, characteristics and effects of various disasters. | | | |
| Unit – IV | Nature, humanity and development, interruption of development and programme by disasters, loss of resources, impact on investment and climate. | | | |
| Unit – V | Geohazards, natural disaster reduction, problems of financing and insurance, trends in climatology, meteorology and hydrology, seismic activities and training for emergency management. | | | |
| References and Textbooks | | | | |
| Haruyama, S.,&Sugai,T. (2016). <i>Natural Disaster and Coastal Geomorphology</i> . Springer. | | | | |
| Miguel, E., Hiroshi, T., & Tomoya, S. (2015). <i>Handbook of Coastal Disaster Mitigation for Engineers and Planners</i> . Butterworth-Heinemann. | | | | |
| Pranam, D. (2011). <i>Disaster Management and Preventions</i> . LAP Lambert Academic Publication. | | | | |
| Sinha, P. C. (1998). <i>Encyclopaedia of Disaster Management</i> (Vols. 1-4). Anmol Publications Pvt. Ltd. | | | | |
| Vidyanathan, S. (2011). <i>An Introduction to Disaster Management</i> . IKON Books. Harsh K Gupta. (2013). <i>Disaster Management</i> . Universities Press (India) Pvt. Ltd. | | | | |
| Outcomes | <ul style="list-style-type: none"> ➤ The students gain more knowledge in disaster mitigation assessment. ➤ The students able to understand on disaster risk reduction and management. | | | |

| Semester - VI | | | | |
|---|--|-----|---|-----|
| Course Code | DSE-IV | T/P | C | H/W |
| 22BMB6E4 | MARINE BIOFOULING AND MANAGEMENT | T | 6 | 6 |
| Objectives | <ul style="list-style-type: none"> ➤ To learn about the marine corrosion and biofouling. ➤ To understand the process of biofouling and its management. | | | |
| Unit - I | Corrosion-Definition, basic aspects of corrosion, types, mechanism – corrosion testing and monitoring. | | | |
| Unit – II | Basics of biofouling- Principle, Biofilm, micro and macrofouling organisms –Factors inducing biofouling. | | | |
| Unit – III | Biofouling Communities–attached macro-fouling communities – mobile communities. Role of microorganisms in biocorrosion. | | | |
| Unit – IV | Biofouling as a Pathway: Ports, harbors, marinas, vessels, Mariculture, fishing and diving equipment. Economic losses and health hazards - imposex. | | | |
| Unit – V | Biofouling control and Management: Anti-fouling paints and other measures – anti-fouling systems – Cleaning of ships- dry docking, and aquaculture Industries – Current practice – natural and non-toxic antifoulants– education and training. | | | |
| References and Textbooks | | | | |
| Alexander I. R. (2005). <i>Marine biofouling: Colonization Processes and Defenses</i> . CRC Press. | | | | |
| Drane, C.W. (1963). <i>Chapter on natural waters. Corrosion</i> (Vol. 1). Shrier, L. L. (Ed.) London: George Newness Limited. | | | | |
| Lynn, J. (2008). <i>Marine Biofouling and Invasive species: Guideline for Prevention and Management</i> . Compiled by Lynn Jackson on behalf of The Global Invasive programme and The UNEP Regional Seas Programme. | | | | |
| Peter, M.,& Peter, P. (2011). <i>Handbook of Hot-dip Galvanization</i> . John Wiley & Sons. | | | | |
| Volkan, C.,& Bayan Al-Numan (2011). <i>Corrosion Chemistry</i> . Wiley-Scrivener. | | | | |
| Outcomes | <ul style="list-style-type: none"> ➤ The students will gain knowledge about marine corrosion and biofouling organisms. ➤ The students able to understand the biofouling formation, control and management. | | | |