### COURSE STRUCTURE

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<th>SEMESTER</th>
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<th>Title of the paper</th>
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Skill Enhanced Courses Syllabus will be available in due course of time.
I - SEMESTER

Course: 1: INTRODUCTION TO CLASSICAL BIOLOGY

Hours/Week: 5

Credits: 4

Learning objectives

The student will be able to learn the diversity and classification of living organisms and understand their chemical, cytological, evolutionary and genetic principles.

Learning Outcomes

1. Learn the principles of classification and preservation of biodiversity
2. Understand the plant anatomical, physiological and reproductive processes.
3. Knowledge on animal classification, physiology, embryonic development and their economic importance.
4. Outline the cell components, cell processes like cell division, heredity and molecular processes.
5. Comprehend the chemical principles in shaping and driving the macromolecules and life processes.

Unit 1: Introduction to systematics, taxonomy and ecology.

1.2. Nomenclature – ICBN and ICZN, Binomial and trinomial nomenclature.
1.3. Ecology – Concept of ecosystem, Biodiversity and conservation.
1.4. Pollution and climate change.

Unit 2: Essentials of Botany.

2.1. The classification of plant kingdom.
2.2. Plant physiological processes (Photosynthesis, Respiration, Transpiration, phytohormones).
2.3. Structure of flower – Micro and macro sporogenesis, pollination, fertilization and structure of mono and dicot embryos.
2.4 Mushroom cultivation, floriculture and landscaping.

Unit 3: Essentials of Zoology

3.1. The classification of Kingdom Animalia and Chordata.
3.2 Animal Physiology – Basics of Organ Systems & their functions, Hormones and Disorders
3.3 Developmental Biology – Basic process of development (Gametogenesis, Fertilization, Cleavage and Organogenesis)
3.4 Economic Zoology – Sericulture, Apiculture, Aquaculture

Unit 4: Cell biology, Genetics and Evolution


4.3. Central Dogma of Molecular Biology.

4.4. Origin of life

Unit 5: Essentials of chemistry

5.1. Definition and scope of chemistry, applications of chemistry in daily life.

5.2. Branches of chemistry

5.3. Chemical bonds – ionic, covalent, noncovalent – Vander Waals, hydrophobic, hydrogen bonds.

5.4. Green chemistry

References


ACTIVITIES:

1. Make a display chart of life cycle of nonflowering plants.

2. Make a display chart of life cycle of flowering plants.

3. Study of stomata

4. Activity to prove that chlorophyll is essential for photosynthesis

5. Study of pollen grains.

6. Observation of pollen germination.

7. Ikebana.

8. Differentiate between edible and poisonous mushrooms.

9. Visit a nearby mushroom cultivation unit and know the economics of mushroom cultivation.

10. Draw the Ultrastructure of Prokaryotic and Eukaryotic Cell

11. Visit to Zoology Lab and observe different types of preservation of specimens
13. Visit to Zoo / Sericulture / Apiculture / Aquaculture unit
14. List out different hormonal, genetic and physiological disorders from the society
I - SEMESTER

Course: 2: INTRODUCTION TO APPLIED BIOLOGY

Hours/Week: 5  
Credits: 4

Learning objectives

The student will be able to learn the foundations and principles of microbiology, immunology, biochemistry, biotechnology, analytical tools, quantitative methods, and bioinformatics.

Learning Outcomes

1. Learn the history, ultrastructure, diversity and importance of microorganisms.
2. Understand the structure and functions of macromolecules.
3. Knowledge on biotechnology principles and its applications in food and medicine.
4. Outline the techniques, tools and their uses in diagnosis and therapy.
5. Demonstrate the bioinformatics and statistical tools in comprehending the complex biological data.

Unit 1: Essentials of Microbiology and Immunology

1.1. History and Major Milestones of Microbiology; Contributions of Edward Jenner, Louis Pasteur, Robert Koch and Joseph Lister.
1.2. Groups of Microorganisms – Structure and characteristics of Bacteria, Fungi, Archaea and Virus.
1.3. Applications of microorganisms in – Food, Agriculture, Environment, and Industry.
1.4. Immune system – Immunity, types of immunity, cells and organs of immune system.

Unit 2: Essentials of Biochemistry

2.2. Biomolecules II – Amino acids & Proteins.
2.3. Biomolecules III – Nucleic acids -DNA and RNA.
2.4. Basics of Metabolism – Anabolism and catabolism.

Unit 3: Essentials of Biotechnology

3.2. Environmental Biotechnology – Bioremediation and Biofuels, Biofertilizers and Biopesticides.
3.3. Genetic engineering – Gene manipulation using restriction enzymes and cloning vectors; Physical, chemical, and biological methods of gene transfer.
Unit 4: Analytical Tools and techniques in biology – Applications

4.1. Applications in forensics – PCR and DNA fingerprinting
4.2. Immunological techniques – Immunoblotting and ELISA.
4.3. Monoclonal antibodies – Applications in diagnosis and therapy.
4.4. Eugenics and Gene therapy

Unit 5: Biostatistics and Bioinformatics

5.1. Data collection and sampling. Measures of central tendency – Mean, Median, Mode.
5.3. Introduction, Genomics, Proteomics, types of Biological data, biological databases- NCBI, EBI, Gen Bank; Protein 3D structures, Sequence alignment
5.4. Accessing Nucleic Acid and Protein databases, NCBI Genome Workbench

REFERENCES


ACTIVITIES

1. Identification of given organism as harmful or beneficial.
2. Observation of microorganisms from house dust under microscope.
3. Finding Microorganism from pond water.
4. Visit to a microbiology industry or biotech company.
5. Visit to a waste water treatment plant.
6. Retrieving a DNA or protein sequence of a gene’
7. Performing a BLAST analysis for DNA and protein.
8. Problems on biostatistics.
9. Field trip and awareness programs on environmental pollution by different types of wastes and hazardous materials.
10. Demonstration on basic biotechnology lab equipment.
11. Preparation of 3D models of genetic engineering techniques.
12. Preparation of 3D models of transgenic plants and animals.

[NOTE: In the colleges where there is availability of faculty for microbiology and biotechnology, those chapters need to be handled by microbiology and biotechnology faculty. In other colleges, the above topics shall be dealt by Botany and Zoology faculty]
Course Outcomes

1. Acquire knowledge on the Classification of major groups of Finfish and Shell fish
2. Students will be familiar with the general characters of Finfish and Shell fish
3. Gain knowledge on the structure and functions of Digestive system
4. Understand the difference between the brain of fish and prawn
5. Acquire knowledge on the functional anatomy of fish and prawn

Unit I: General characters & Classification of Cultivable fin fish and shell fish
1.1 General Characters of Crustacea
1.2 Classification of Crustacean: Major groups up to orders and their important characters.
1.3 General Characters of fishes
1.4 Classification of Fishes: Major groups up to subclass and their important characters.

Unit 2: Digestive and Respiratory systems of Fish and shell fish
2.1 Digestive system of fish
2.2 Respiratory system of fish
2.3 Digestive system of Prawn
2.4 Respiratory system of prawn

Unit 3: Circulatory systems of Fish and shell fish
3.1 Cardiovascular system: Structure of heart in fishes
3.2 Blood vascular system in prawn

Unit 4: Nervous system of Fish and shell fish
4.1 Nervous system in fish: Structure and functions of Brain
4.2 Central Nervous system in prawn.

Unit 5 Reproductive system of Fish and shell fish
5.1 Urino-genital system in fishes
5.2 Reproductive system in prawn
II SEMESTER
Course No.: 3 Taxonomy and Functional Anatomy of Fin Fish and Shellfish
Credits :1

1. Study of mouth parts in herbivorous and carnivorous fishes
2. Comparative study of digestive system of herbivorous and carnivorous fishes
3. Demonstration of brain of fish
4. Demonstration of cranial nerves of fish
5. Demonstration of Nervous system of prawn
6. Exposure of gills of prawn
7. Exposure of gills of fish

REFERENCE BOOKS


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Course outcomes:

1. Gain Knowledge of feeding habits, gut content analysis and growth factors in fishes.
2. Understand the commercial importance of crustaceans and fish.
3. Understand and learn breeding in fishes, breeding habits, method of induced breeding in fishes.
4. To create awareness on parental care of Fishes and embryonic and larval development and environmental factors affecting development of major aquaculture organisms.
5. Acquire knowledge about Endocrine system in fishes.

SYLLABUS

UNIT- I: Specialised organs in fish

1. Sense organs of fishes and crustaceans.
2. Specialized organs in fishes – electric organ, venom and toxins.
4. Fish and Crustaceans of commercial importance.

UNIT- II: Food, Feeding and Growth

1. Natural fish food, feeding habits, feeding intensity, stimuli for feeding, utilization of food, gut content analysis, forage ratio.
2. Principles of Age and growth determination; growth regulation, Growth rate measurement –
   scale method, otolith method, skeletal parts as age indicators.
3. Length-frequency method, age composition, age-length keys, absolute and specific growth, back calculation of length and growth, annual survival rate.
4. Length-weight relationship.

UNIT- III: Reproductive Biology

1. Breeding in fishes, breeding places, breeding habits & places, breeding in natural environment and in artificial ponds, courtship and reproductive cycles.
2. Induced breeding in fishes.
3. Breeding in shrimp, oysters, mussels, clams, pearl oyster, pila, and cephalopods.

UNIT- IV: Development

1. Parental care in fishes, ovo-viviparity, oviparity, viviparity, nest building and brooding.
2. Embryonic and larval development of fishes.
3. Embryonic and larval development of shrimp, crabs and molluscs of commercial importance.
4. Environmental factors affecting reproduction and development of cultivable aquatic fin & shell fish.

UNIT- V: Hormones & Growth.

1. Endocrine system in fishes.
3. Molting, molting stages, metamorphosis in crustacean shell fish.
II SEMESTER
Course No.: 4 - Biology of Fin Fish & Shell Fish
credits : 1

1. Length-weight relationship of fishes
2. Gut content analysis in fishes and shrimp
3. Mouth parts and appendages of cultivable prawns, shrimps and other crustaceans
4. Study of eggs of fishes, shrimps, prawns and other crustaceans
5. Study of oyster eggs
6. Embryonic and larval development of fish
7. Study of gonadal maturity and fecundity in fishes and shellfish
8. Observation of crustacean larvae
9. Study of nest building and brooding of fishes

PRESCRIBED BOOK(S)

1. Bone Q et al., 1995. Biology of fishes, Blackie academic & professional, LONDON.

REFERENCES:

COURSE OUTCOMES
Co1 Understand the concept of blue revolution, analyse the history and compare the present status of aquaculture at global, national and state levels and its significance over agriculture.

Co2: Acquire knowledge in the different types of aquaculture, culture systems and culture methods in practice worldwide.

CO3: Gain knowledge in the different types of culture ponds.

Co4: Understand the arrangement of different types of ponds in a fish farm and design an ideal fish farm

CO5: Comprehend the best management practices to be adopted in aquaculture for good yield and acquire the skill in the analysis of water and soil parameters of a culture pond.

SYLLABUS
UNIT-I (Introduction)
1. Definition and History of Aquaculture
2. Concept of Blue Revolution and Pradhan Mantri Matsya Sampada Yojana (PMMSY)
3. Present status of Aquaculture at global level, India and Andhra Pradesh
4. Aquaculture versus Agriculture; Present day needs with special reference to Andhra Pradesh

UNIT-II (Types of Fish Ponds)
1. Lotic and lentic systems, streams and springs
   Classification of ponds based on water resources – spring, rain water, flood water, well water and water course ponds
2. Functional classification of ponds – head pond, hatchery, nursery, rearing, production and stocking
3. ponds; quarantine ponds, isolation ponds and wintering ponds

UNIT-III (Design and Construction of Aqua Farms)
1. Important factors in the construction of an ideal fish pond – site selection, topography, nature of the soil, water resources
2. Lay out and arrangement of ponds in a fish farm
3. construction of an ideal fish pond – space allocation, structure and components of barrage Pond

UNIT-IV (Aquaculture Systems and Practices)
1. Types of aquaculture  Fresh water aquaculture - Brackish water aquaculture - Mari culture
4. Fin fish culture methods - Monoculture, Poly culture and Monosex culture and Integrated fish farming.

UNIT-V  ( Management Factors of Culture Ponds, Pre-stockling Management

1. Dewatering, drying, ploughing/desilting
2. Predators, weeds and weed fish in culture ponds - Advantages and disadvantages of weed plants; Toxins used for weed control and control of predators. Liming and fertilization;
3. Algal blooms and their control
4. Stocking Management – Stocking density and stocking
5. Post-stockling Management Feeding: Role of nutrients
6. Water quality: Physico-chemical conditions of soil and water optimum for culture – temperature, depth, turbidity, light, water and shore currents, pH, DOD, CO\textsubscript{2}, NH\textsubscript{3}, NO\textsubscript{2}

III SEMESTER
Course No.: 5 - Basic Principles of Aquaculture
credits :1

1. Estimation of Carbonates, Bicarbonates in watersamples
2. Estimation of Dissolved Oxygen
3. Estimation of Ammonia in water.
4. Estimation of Total Hardness of water sample.
5. Study of beneficial and harmful algal species
6. Collection, identification and isolation of zooplankton and phytoplankton
7. Collection and study of aquaticweeds, aquatic insects, weed fish and larvivorous fish
8. Field visit to hatchery, nursery, rearing and stocking ponds of aqua farms.

PRESCRIBED BOOKS:


REFERENCES:


REFERENCES

III SEMESTER
Course No.: 6 - Capture Fisheries
credits : 3

Course Outcomes
CO1: Understand the EEZ concept & its implementation in fisheries
CO2: Knowledge on Fish Distribution
CO3: Acquire Knowledge on the Riverine systems of India
CO4: Gain Knowledge on Reservoir Fishery

Unit I : Fish Catch Statistics :-
1.1 Fish production of the world both inland and marine, contribution of different countries, position of India in the Fish Catches.
1.2 The EEZ concept & its implementation in fisheries. The Indian EEZ, Fishery survey in India

Unit II : Fish Distribution .
2.1 General account of the distribution
2.2 Biology and fishery of important fishes and other aquatic animals of India,
2.3. Economically Important Fresh Water Fishes of Andhra Pradesh.

Unit-III Riverine Fishery I :-
3.1 Important characters of Streams.
3.2 Different riverine systems in India, and their fishery: The Ganga River System, the Brahmaputra river system,

Unit-IV Riverine Fishery II :-
4.1 The East Coast River System.
4.2 The West Coast River System, River Jhelum of the Indus River System, Fisheries of trout and Mahseer, Problems and management.

Unit-V Reservoir Fishery (Lacustrine Fishery) :-
5.1 Definition of a Lake, Origin and classification of lakes.
5.2 Kolleru Lake and its fishery.
5.3 Different reservoirs of River systems in India with special reference to Nagarjuna Sagar,
PRACTICALS SEMESTER – II
1. Identification of Freshwater fishes based on colour, Pigmentation, morphometric and meristic characters and other characters relevant to the group.
2. Identification of fry and fingerlings of Indian Major Carps.
3. Examination of Commercially Important Freshwater fishes and prawns, from the point of view of ecology and fishery.
4. Knowledge of common types of Freshwater craft and gear on models provided in the department.
Field Work : Visit to fish landing centers of rivers, lakes and reservoirs.

Reference Books :-
Course outcomes:
1. Learn the Status, Scope and Prospects of fresh water aquaculture in the world, India and AP.
2. Learn about Major Cultivable Indian Carps and Exotic fish Species introduced in India.
3. Know about recent developments in the culture of clarius, anabas and murrels and special systems of aquaculture.
4. Gain knowledge of commercially valuable Fresh water prawns of India and their culturing methods.

UNIT-I: Introduction to Freshwater Aquaculture
1.1 Status, scope and prospects of fresh water aquaculture in the world, India and AP
1.2 Different fresh water aquaculture systems

UNIT-II: Carp Culture
2-1 Major cultivable Indian carps – Labeo, Catla and Cirrhinus & Minor carps
2-2 Exotic fish species introduced to India – Tilapia, Pangassius and Clarius sp.

UNIT-III
3.1 Composite fish culture system of Indian and exotic carps
3.2 Impact of exotic fish, Compatibility of Indian and exotic carps and competition among them

UNIT-IV: Culture of air-breathing and cold water fish
4-1 Recent developments in the culture of clarius, anabas, murrels,
4-2 Advantages and constraints in the culture of air-breathing and cold water fishes- seed resources,
    feeding, management and production
4-3 Special systems of Aquaculture- brief study of culture in running water, re-circulatory systems, cages and pens, sewage-fed fish culture

UNIT-V: Culture of Prawn
5-1 Fresh water prawns of India - commercial value
5-2 Macrobrachium rosenbergii and M. Malcomsonii– biology, seed production, pond preparation,
    stocking, management of nursery and grow-out ponds, feeding, morphotypes and harvestin
1. Identification of important cultivable carps.
2. Identification of important cultivable air-breathing fishes.
3. Identification of important cultivable freshwater prawns.
4. Identification of different life history stages of fish.
5. Identification of different life history stages of fresh water prawn.
6. Identification of commercially viable crabs – Scylla serrata, Portunus pelagicus, P.sanguinolentus,
   Neptunus pelagicus, N. Sanguinolentus.
8. Identification of oysters of nutritional significance – Crossostrea madrasensis, C.gryphoides,
   C. cucullata, C.rivularis, Picnodanta.
10. Identification of developmental stages of oysters.

PRESCRIBED BOOK(S):

REFERENCES:
Course Outcomes:

CO1: Knowledge on development and present status of brackish water farming in India.
CO2: Learn about the types of culture systems
CO3: Gain knowledge on commercial value of prawns in India
CO4: Know about the biology of important shrimps
CO5: Know about the species of crabs and edible oysters cultured

Unit – I Introduction
1.1 Introduction, History, Development and present status of brackish water farming in India.
1.2 Brackish water as a medium for aquaculture, ecological factors – Abiotic and biotic factors.
1.3 Types of culture systems – Traditional, extensive, semi-intensive and intensive culture systems of shrimp, their management and economics.

Unit – II Culture of brackish water prawns
2.1 Culture practices of Penaeus monodon/ P.vannamei
2.2 Brackish water prawns of India – Commercial value.
2. Morphotypes and harvesting

Unit – III Biology of Shrimp
3.1 Biology of Penaeus monodon,
3.2 Biology of P.indicus
3.3 Biology of P.vannamei.

Unit – IV Management practices
4.1 Nutritional requirements of cultivable prawns.
4.2 Natural food and artificial feeds and their importance in shrimp culture
4.3. Pond preparation, stocking, of Hatchery, Nursery, grow out ponds. and harvesting of shrimp.

Unit – V Culture of Brackish water species
5.1 Species of crabs cultured, biology and culture technique, prospects in India.
5.2 Species of edible oysters, culture techniques used for farming edible oysters.
5.3 Important species of pearl oysters and method of artificial pearl production.
Identification of cultivable fresh water and marine water prawns (any 3 each)

Identification of marine crabs and oysters of commercial importance (any 2 each).

3. Identification of Phytoplankton and Zooplankton (any 5 each).

4. Identification of different live feed organisms for shrimp larvae (any 4)

5. Identification of larval stages of prawn. 6. Demonstration of eye stalk ablation in penaeus monodon.

References :

2. Prawn and prawn fisheries by Kurain and Sebestain.
7. Identification and mounting of appendages of prawn / shrimp.
8. Field visit to prawn / shrimp hatchery
9. Field visit to prawn / shrimp culture ponds.
**Course outcomes:**
1. Provide students with knowledge about fish diseases and pathological aspects of diseases.
2. Learn about Fungal, Viral and Bacterial diseases of finfish.
3. Gain knowledge of Nutritional deficiency related diseases and antibiotic and chemotherapeutics.
4. Understand and learn the importance of diagnostic tools in identification of diseases and application and development of vaccines.

**UNIT I: Pathology and parasitology**

1-1 Introduction to fish diseases – Definition and categories of diseases – Disease and environment
1-2 Disturbance in cell structure – changes in cell metabolism, progressive and retrogressive tissue changes, types of degeneration, infiltration, necrosis, cell death and causes
1-3 Atrophy, hypertrophy, neoplasms, inflammation, healing and repair

**UNIT II: Fungal and viral Diseases of fin fish.**
2-1 Fungal diseases (both of shell and finfish) – Saprolegniosis, brachiomycosis,ichthyophorus diseases – Lagenidium diseases – Fusarium disease, prevention and therapy
2-2 Viral diseases – Emerging viral diseases in fish, haemorrhagic scepticemia, spring viremia of carps, infectious hematopoietic necrosis in trout, infectious pancreatic necrosis in salmonids, swim-bladder inflammation in cyprinids, channel cat fish viral disease, prevention and therapy

**UNIT III: bacterial Diseases of fin fish.**
2-3 Bacterial diseases – Emerging bacterial diseases, aeromonas, pseudomonas and vibrio infections, columnaris, furunculosis, epizootic ulcerative syndrome, infectious abdominal dropsy, bacterial gill disease, enteric red mouth, bacterial kidney disease, proliferative kidney disease, prevention and therapy

**UNIT IV: Protozoan Diseases of fin fish.**
Protozoan diseases: Ichthyophthiriasis (White spot Disease), Costiasis, Whirling disease

**UNIT V: Nutritional diseases**
4-1 Nutritional pathology – lipid liver degeneration, Vitamin and mineral deficiency diseases. Aflatoxin and dinoflagellates.
4-2 Antibiotic and chemotherapeutics. Nutritional cataract. Genetically and environmentally induced diseases.
IV SEMESTER
Course No.: 9 - Fish Health Management
credits :1

1. Enumeration of Bacteria by TPC Method
2. Enumeration of total Coli forms
3. Observation of gross pathology and external lesions of fish with reference to the common diseases in aquaculture
4. Examination of pathological changes in gills and gut lumen, lymphoid organ, muscles and nerves of fish
5. Collection, processing and analysis of data for epidemiological investigations of viral diseases
6. Bacterial pathogens – isolation, culture and characterization
7. Identification of parasites in fishes: Protozoan, Helmiths, Crustaceans
8. Estimation of dose, calculation of concentration, methods of administration of various chemotherapeutics to fish and shell fish
9. Estimation of antibiotics used in aquaculture practices

PRESCRIBED BOOK(S):

REFERENCES:
4. Bullock G et.al., 1972 Bacterial diseases of fishes. TFH publications, New Jersey
Course outcomes:
1. Provide students with knowledge about shrimp diseases and pathological aspects of diseases.
2. Learn about Fungal, Viral and Bacterial diseases of shellfish.
3. Gain knowledge of Nutritional deficiency related diseases and antibiotic and chemotherapeutics.
4. Understand and learn the importance of diagnostic tools in identification of diseases and application and development of vaccines.
5. To know about production of disease free seeds and good feed management.

Syllabus

UNIT I: Viral Diseases of shell fish (Symptoms, Treatment and Prophylaxis)
1-1 Major shrimp viral diseases – Bacculovirus penaeii, Monodon Bacculovirus,
1-2 Bacculoviral midgut necrosis, Infectious hypodermal and haematopoietic necrosis virus, Hepatopancreatic parvo like virus,
1-3 Yellow head bacculovirus, white spot bacculovirus.

UNIT II: Bacterial Diseases of shell fish (Symptoms, Treatment and Prophylaxis)
2.1 Bacterial diseases of shell fish – aeromonas, pseudomonas and vibrio infections,
2.2 Luminous bacterial disease, filamentous bacterial disease. Prevention and therapy

UNIT III: Protozoan Diseases of shell fish (Symptoms, Treatment and Prophylaxis)
3-1 Protozoan diseases- Ichthyophthiriasis, Costiasis,
3-2 Whirling diseases, trypanosomiasis

UNIT IV: Health management
4-1 Diagnostic tools – immune detection- DNA/RNA techniques, General preventive methods and prophylaxis. Application and development of vaccines.
4-2 Quarantine – Significance, methods and regulations for transplants.

UNIT V: Production of disease free seeds
5-1 Production of disease-free seeds. Evaluation criteria of healthy seeds.
5-2 Good Feed management for healthy organisms, Zero water exchange, Probiotics in
1. Enumeration of Bacteria by TPC Method
2. Observation of gross pathology and external lesions of fish and prawn with reference to the common diseases in aquaculture
3. Examination of pathological changes in gut lumen, hepatopncreas, lymphoid organ, muscles and nerves of prawn and shrimp
4. Collection, processing and analysis of data for epidemiological investigations of viral diseases
5. Bacterial pathogens – isolation, culture and characterization
6. Antibiograms – preparation and evaluation
7. Molecular and immunological techniques; Biochemical tests; PCR; ELISA; Agglutination test; Challenge tests; Purification of virus for development of vaccines (Demonstration at institutes/labs)
8. Estimation of dose, calculation of concentration, methods of administration of various chemotherapeutics to fish and shell fish
9. Estimation of antibiotics used in aquaculture practices
10. Estimation of probiotics used in aquaculture
I

SEMESTER

Course No.: 11 - Fish nutrition & Feed technology

credits :3

**Course outcomes:**

1. Understand Nutritional requirements of cultivable fishes and factors affecting energy partitioning and feeding.
2. Know different types of feed and FCR and different types of feeders
3. Gain Knowledge of Feed manufacture and storage methods of feeds
4. Understand the value of Feed additives and Non-Nutrient ingredients.
5. To create awareness of different nutritional deficiency and importance of natural and supplementary feeds and balanced diet.

**UNIT-I: Nutritional requirements of cultivable fish**

1.1 Requirements for energy, proteins, carbohydrates, lipids, fiber, micronutrients for different stages of cultivable fish and prawns
1-2 Essential amino acids and fatty acids, protein to energy ratio, nutrient interactions and protein sparing effect
1.3 Dietary sources of energy, effect of ration on growth, determination of feeding rate, check tray

**UNIT-II: Forms of feeds & Feeding methods**

2-1 Fed conversion efficiency, feed conversion ratio and protein efficiency ratio
2-2 Wet feeds, moist feeds, dry feeds, mashes, pelleted feeds, floating and sinking pellets, advantages of pelletization
2-3 Manual feeding, demand feeders, automatic feeders, surface spraying, bag feeding and tray feeding

**UNIT-III: Feed manufacture & Storage**

3-1 Feed ingredients and their selection, nutrient composition and nutrient availability of feed ingredients
3-2 Feed formulation – extrusion processing and steam pelleting, grinding, mixing and drying, pelleting, and packing
3-3 Water stability of feeds, farm made aqua feeds, micro-coated feeds, micro-encapsulated feeds and micro-bound diets
3-4 Microbial, insect and rodent damage of feed, chemical spoilage during storage period and proper storage methods.

**UNIT-IV: Feed additives & Non-nutrient ingredients**

4-1 Binders, anti-oxidants, probiotics
4-2 Feed attractants and feed stimulants
4-3 Enzymes, hormones, growth promoters and pigments
4-4 Anti-metabolites, aflatoxins and fiber.

**UNIT-V: Nutritional Deficiency in Cultivable fish**

5-1 Protein deficiency, vitamin and mineral deficiency symptoms
5-2 Nutritional pathology and ant-nutrients
5-3 Importance of natural and supplementary feeds, balanced diet.
IV SEMESTER  
Course No.:11 - Fish nutrition & Feed technology  
credits :1 

1. Estimation of protein content in aquaculture feeds  
2. Estimation of carbohydrate content in aquaculture feeds  
3. Estimation of lipid content in aquaculture feeds  
4. Estimation of ash in aquaculture feed  
5. Study of water stability of pellet feeds  
6. Feed formulation and preparation in the lab  
7. Study of binders used in aquaculture feeds  
8. Study of feed packing materials  
9. Study of physical and chemical change during storage  
10. Study on physical characteristics of floating and sinking feeds  
11. Visit to a aqua-feed production unit  

PRESCRIBED BOOK(S):  

REFERENCES:  
Course outcomes:
1. Gain knowledge of basic concepts of economics with reference to fisheries and various factors influencing the fishery products price.
2. Know about fisheries marketing, methods of economic analysis of business organizations and preparation of project and project appraisal.
3. To know about application of economic principles to aquaculture operations.
4. Get the broad knowledge of scope and objectives, principles of fisheries extension.
5. Understand the importance of transfer technology of ICAR programmes and training at DAATT Centers and their role in education of aqua farmers through print and electronic media.

SYLLABUS

UNIT – I Introduction
1-1 Meaning and scope of economics with reference to fisheries
1-2 Basic concepts of economics – goods, services, wants and utility, demand and supply, value price, market demand and individual demand, elasticity of demand.
1-3 Theory of production, production function in fisheries
1-4 Various factors influencing the fishery product’s price

UNIT – II Fisheries marketing
2-1 Basic marketing functions, consumer behavior and demand, fishery market survey and test marketing a product
2-2 Fish marketing – prices and price determination of fishes
2-3 Marketing institutions- primary (producer fishermen, fishermen cooperatives, and fisheries corporations) and secondary (merchant/agent/speculative middlemen)
2-4 Preparation of project and project appraisal

UNIT-III Fisheries economics
3-1 Aquaculture economics- application of economics principles to aquaculture operations
3-2 Cost and earnings of aquaculture systems – carp culture, shrimp farming systems, hatcheries, Cost and earnings of fishing units and freezing plants
3-3 Socio-economic conditions of fishermen in Andhra Pradesh, Role of Matsyafed and NABARD in uplifting fishermen’s conditions, fishermen cooperatives
3-4 Contribution of fisheries to the national economy

UNIT-IV Fisheries extension
4-1 Fisheries extension – scope and objectives, principles and features of fisheries extension education
4-2 Fisheries extension methods and rural development
4-3 Adoption and diffusion of innovations

UNIT-V Transfer of technology
5-1 ICAR programs – salient features of ORP, NDS, LLP, IRDP, ITDA, KVK, FFDA, FCS, FTI, TRYSEM
5-2 Training – meaning, training vs. education and teaching
5-3 DAATT centres and their role in tot programs, video conferencing, education of farmers through print and electronic media
1. Basic marketing functions
2. Prices and price determination of fishes
3. Fisheries extension
4. Education of Fish farmers
5. Field notes and necessary inputs – should be focused in the practicals

**Prescribed Books:**

**References:**
Course outcomes:

CO1: Gain Knowledge on Aquarium Fishes
CO2: Have Knowledge on fresh water and marine water Ornamental Fishes
CO3: Have Practical knowledge on the setting up of aquarium
CO4: Gain knowledge on water quality management for different types of aquariums
CO2: Apply the knowledge for self employment

SYLLABUS

UNIT I: Introduction
1-1 Aquarium and ornamental fishes – introduction
1-2 Present status of Aquarium trade in the world and India
1-3 Aquarium accessories – aerators, filters, lighters and heaters
1-4 Water quality needs and different kinds of feeds

UNIT II: Fresh water ornamental fishes
2-1 Live bearers, gold fish, koi, gourami, barbs and tetras, angel fish and cichlid fish
2-2 Brood stock development, breeding, larval rearing and grow out
2-3 Larval feeds and feeding

UNIT III: Marine ornamental fishes
3-1 Varieties and habitat of marine ornamental fishes
3-2 Major marine ornamental fish resources of India
3-3 Collection and transportation of live fish, use of anaesthetics
3-4 Breeding of marine ornamental fish
3-5 Other aquarium animals – sea anemones, lobsters, worms, shrimps, octopus and starfish

UNIT IV: Aquarium management
4-1 Setting up fresh water, marine and reef aquariums
4-2 Water quality management for different types of aquariums
4-3 Common diseases of aquarium fish, diagnosis and treatment
4-4 Temperature acclimatization and oxygen packing for aquarium fish

UNIT V: Commercial production of aquarium fish and plants
5-1 Commercial production units of ornamental fish- requirements and design
5-2 Commercial production of goldfish, live bearers, gouramies, barbs, angels and tetras
5-3 Mass production of aquarium plants
5-4 Retail marketing and export of ornamental fish
V SEMESTER
Course No.: 13 - Ornamental Fishery
credits :1

PRACTICALS:
1. Study of aerators – types and structures
2. Water circulation methods in aquarium and filtration
3. Collection and identification of aquarium plants
4. Identification of common marine aquarium fishes
5. Identification of common fresh water aquarium fishes
6. Breeding of egg layers
7. Breeding of live bearers
8. Evaluation of significance of aquaria for commercial and domestic use.

PRESCRIBED BOOK(S):
2. Van Ramshort JD 1978. The complete aquarium encyclopedia, Elsevier

REFERENCES:
Course outcomes:
CO1: Have knowledge on traditional, motorized and mechanized fishing crafts of India
CO2: Gain knowledge on Design of fishing gear and fish catching methods
CO3: Learn about the type of anchors and Navigation equipment
CO4: Gain knowledge on Remote sensing applications in fish finding and catching
CO5: Learn about the Fish Processing Equipment

SYLLABUS

UNIT I: Fishing crafts
1-1 Different types of fishing crafts in India- inland and marine- traditional, motorized and mechanized.
1-2 Classification of fishing craft.
1-3 Boat building materials - wood, steel, FRP, ferro-cement, aluminum etc.,
1-4 Mechanization of fishing craft and its impact

UNIT II: Fishing gear
2-2 Design of fishing gear and fish catching methods
2-2 Fishing accessories, Netting materials – natural and synthetic fishing gear materials and yarn numbering system
2.3 Active fishing gear - classification and description of modern fishing gears.- Design and operation of –trawls, purse seines, ring seines, beach / shore seine, boat seine, pole and line, squid jigs, trolling.

UNIT III: Anchors, Fish Finding & Navigational Equipment
3-1 Types of Anchors – Chains, ropes, blocks, leads and drogues
3-2 Echo sounders, fish finders, sonar and net sonde
3-3 Chronometer, gyro compass, radar, decca, omega etc.

UNIT IV: Exploration of fish and Conservation
4-1 Remote sensing applications in fish finding and catching
4-2 Turtle exclusion devices
4-3 By-catch reduction devices
4-4 Destructive and prohibited fishing practices

UNIT V: Fish Processing Equipment
5-1 Ice making machinery, Brine tank
5-2 Arrangements for leak detection
5-3 Operation of various freezing machinery
5-4 Special equipment for freeze-drying, irradiation and cryogenics
V SEMESTER
Course No.: 14 - Fishery Engineering
credits :1

PRACTICALS:
1. Site survey: preparation of site map and contour map
2. Ice making and harvesting
3. Testing different netting materials- natural and synthetic
4. Estimation of buoyancy and de-buoyancy of different floating and sinking materials
5. Designing trawl net by conducting survey
6. Solving problems on finding position of gravity, flotation and buoyancy
7. Visit to fishing harbor to study deck machinery
8. Visit to fishing harbor to study hull equipment
9. Visit to boat building yard and dry docking yard
10. Visit to a fish processing unit to study the equipment used in fish processing

PRESCRIBED BOOKS:

REFERENCES:
V SEMESTER
Course No.: 15 - Fish Processing Technology
credits :3

Course outcomes
CO1: Understand the Principles of fish preservation
CO2: Learn about fundamental principles involved in chilling and freezing of fish and fishery products
CO3: Understand the methods of drying, smoking and freeze drying
CO4: Knowledge about packaging materials and the process of packing
CO5: Gain knowledge about the export of Fishery products from India

SYLLABUS

UNIT 1: Introduction
1.1 Principles of fish preservation.
1.2 Quality of water and ice in fish handling and processing.
1.3 Preparation of ice. Different types of ice used in the seafood industry and their merits.

UNIT 2: Freezing and Canning:
2.1 Fundamental principles involved in chilling and freezing of fish and fishery products.
2.2 Various freezing methods. Freezing of shrimps and fishes.
2.3 Changes during the cold storage of fish and fishery products.
2.4 Principles involved in canning of fish. Different types of containers.

UNIT 3: Drying, Smoking and Freeze-drying:
3.1 Different types of drying. Factors affecting drying.
3.2 Packing and storage of dried products. Spoilage of dried products. Preventive measures
3.3 Smoking of fish, Salting of fish

UNIT 4: Packing, Cold Storage and Export of Fishery Products:
4.1 Functions of packing. Different types of packing materials and its quality evaluation.
4.2 Packing requirements for frozen and cured products.
4.3 Statutory requirements for packing.
4.4 Labeling requirements. Different types of cold storages, Insulated and refrigerated vehicles.

UNIT 5: Export of fishery products
5.1 Export of Fishery products from India - major countries, important products, export documents and procedures.
5.2 Prospects and constraints in export including tariff and non-tariff barriers, marine insurance, export incentives, registered exporters
Experiments:
1. Determination of moisture content in fish and fishery products
2. General description – freezing
3. Processing shrimp
4. Filleting of fish
5. Drying of fish
6. Organolptic analysis of fish
7. Preparation of fishery by products
8. Preparation of shark fin rays fish maws, chitin, fish wafer
9. Fish pickling
10. Value added fishery products, fish curry, cutlets fish finger.
11. Preparation of surimi

Filed visit:
1. Visit to sea food pre-processing plants
2. Visit to fish processing plants

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Text books:
1. K.Gopakumar, Fish Processing Technology, ICAR, New Delhi
2. T.K. Govindan, Fish Processing Technology Oxfor & IBH Publication Co.
4. Borgstrom,G. Fish as Food.
5. K.K. Balachandran, Postharvest Technology in Fish and Fishery Products. 6. Moorjani,M.V.
Fish Processing in India.
8. CIFT. Manual of Quality Control in Fish and Fishery Products. 9. Gopakumar,K. Fish Packaging Technology

Reference Books:
VII SEMESTER
Course No.: 16: - Post Harvest Technology & Transportation
credits :3

Course Out comes:

Syllabus

Unit I: Harvest, Handling and Principles of Fish Preservation
1-1 Harvest methods, Normal harvest and emergency harvest,
1.2 Handling of fresh fish, storage and transport of fresh fish, post-mortem changes (rigor
mortis and spoilage), spoilage in marine fish and freshwater fish.
1.3 Principles of preservation—cleaning, lowering of temperature, rising of temperature,
dehydration, use of salt, use of fish preservatives, exposure to low radiation of gamma rays.

Unit II: Fishery Products
2-1 Different types of value added products from fish and shell fish
2-2 Fish mince and surimi
2-3 Coated fishery products—different types of batter and breading

Unit III: Fishery by-products
3.1 Fish meal, fish protein concentrate, isinglass, fish liver oil, fish body oil
3.2 Fish hydrolysates, chitosan, glucosamine hydrochloride, pearl essence, ambergris, fish
silage, fish maws, fish leather, shark fin rays

Unit IV: Sea weed products
4.1 Preparation of agar, align and carrageen
4.2 Use of seaweeds as food for human consumption, in disease treatment and preparation
of therapeutic drugs.

UNIT V: TRANSPORTATION
5-1 Outlets for aquaculture products,
5-2 Transport of seed and brood stocks.
5-3 Causes of mortality during transport, techniques of transport, open and closed systems,
methods of transportation, use of anaesthetics.
PRACTICALS:
1. Determination of moisture content in fish and fishery products
2. Chilling of fish using ice
3. Processing shrimp
4. Filleting of fish
5. Drying of fish
6. Preparation of boiled fish products
7. Preparation of shark fin rays, fish meal, chitin, and fish water
8. Fish pickling
9. Value added fishery products, fish curry, cutlets and fish fingers
10. Estimation of lactic acid content in fermented fish products

2. Wheaton FW and Lawson TB 1985. Processing aquatic food products. Wiley inter-science publication, USA

2. Moorjani MN 1998. Fish processing in India, ICAR, New Delhi
Course Outcomes
CO1: Learn about history and development of microbiology
CO2: Understand the ultra structure of prokaryotic cell
CO3: Gain knowledge about different culture techniques.
CO4: Application of routine tests for identification of bacteria
CO5: Know about intrinsic and extrinsic factors affecting spoilage.

SYLLABUS

UNIT 1: Introduction:
1.1 History and development of microbiology – Different members of the microbial community
1.2 General characteristics of bacteria, fungi, viruses, algae and protozoan’s.

UNIT II: Microbial structures
2.1 Ultra structure of prokaryotic cell – structure and function of bacterial cell wall, plasma membrane, capsule, flagella and endospore.

UNIT III: Aquatic Microbiology I
3.1 Microflora of aquatic environment, Different culture techniques.
3.2 Nutrition and growth of bacteria – different types of media for isolation of bacteria and fungi.

UNIT IV: Aquatic Microbiology II
4.1 Isolation, enumeration, preservation and maintenance of cultures.
4.2 Routine tests for identification of bacteria – morphological, cultural biochemical and serological.
4.3 Basics of mycological and virology techniques.

UNIT V: Fish Microbiology
5.1 Perish ability of seafood – Fish as an excellent medium for growth of microorganisms.
5.2 Spoilage microflora of fish and shellfish
5.3 Intrinsic and extrinsic factors affecting spoilage.
VII SEMESTER
Course No.: 17 - Fishery Microbiology
credits :1

Experiments/Activities
1. Sterilization technique- dry heating, autoclaving
2. Media preparation
3. Isolation and maintenance of bacteria from fishes and water.
4. Gram staining of bacteria
5. Enumeration of bacteria by TPC method
6. Enumeration of total coli forms.
7. Evaluation of fish / fishery products for organoleptic, chemical and microbial quality

Collection:

Text Books:
1. Pelzar, Reid & Chan – Microbiology
2. Prescott, Harley & Klein – Microbiology
3. Adelogerg, Ingra & Wheates – Introduction to Microbial World
4. Windsor and Barlow. Introduction to Fishery Byproducts.
5. CIFT. Proceedings on Summer Institute on Non-traditional Diversified Fish Products &Byproducts.
6. Anon. Productivity in Aquatic Bodies.
9. Connell,J.J. Control of Fish Quality
10. Bigh,E.G. Seafood Science and Technology

Reference Books
2. Borgstrom,G. Fish as Food
3. Suzuki,T. Fish and Krill Protein: Processing Technology
VII SEMESTER
Course No.:18 - Quality Control in Processing Plants
credits :3

Course Outcomes:

CO1: Gain Knowledge on Quality management, total quality concept.

CO2: Know about fish inspection in India

CO3: Understand Statistical analysis Quality problems in fishery products

CO4: Know about certification of export worthiness of fish processing units,

CO5: Application of laboratory techniques for detection and identification of food poisoning bacteria

SYLLABUS

UNIT I:
1.1 Quality management, total quality concept and application in fish trade.
1.2 Quality assessment of fish and fishery products - physical, chemical, organoleptic and microbiological.
1.3 Quality standards, Quality Assurance.

UNIT 2:
2.1 Fish inspection in India, process
2.2 Water quality in fishery industry, product quality
2.3 Water analysis, treatments, chlorination, ozonisation, UV radiation, reverse osmosis, techniques to remove pesticides and heavy metals.

UNIT 3:
3.1 Sensory evaluation of fish and fish products, basic aspects, different methods of evaluation, taste panel selection & constitution
3.2 Statistical analysis Quality problems in fishery products
3.3 Good manufacturing practices.
3.4 HACCP and ISO 9000 series of quality assurance system, validation and audit.
National and international standards, EU regulation for fish export trade,

UNIT 4:
4.1 IDP and SAT formations in certification of export worthiness of fish processing units,
4.2 Regulations for fishing vessels pre-processing and processing plants, regulations.
4.3 Factory sanitation and hygiene: National and international requirements, SSOP.

UNIT 5:
5.1 Hazards in sea foods: Sea food toxins, biogenic amines, heavy metals and industrial pollutants.
5.2 Infection and immunity, Microbial food poisoning, bacteria of public health significance in fish /fishery products / environments - Salmonella, Clostridia, Staphylococcus, E. coli, Streptococcus, Vibrio, Aeromonas, Listeria, Yersinia, Bacillus.
5.3 Laboratory techniques for detection and identification of food poisoning bacteria.
Mycotoxins in cured fish, bacterial associated with fish disease.
1. Practical Assessment of quality of fresh fish by sensory, biochemical, and instrumental methods.
2. Chlorination and Hardness estimations
3. Quality analysis of canned, frozen, cured and pickled fish products.
4. Quality tests for tin and corrugated containers.
5. Assessment of plant, equipment sanitation and personnel hygiene.
6. Detection of filth and extraneous matter in traditional processed products.

Reference books
Course Outcomes:

CO1: Understand the Status of Crustacean farming in India

CO2: Gain Knowledge Important cultivable species of shrimps and prawns

CO3: Acquire knowledge on crustaceans culture

CO4: Importance of farming of Prawns and Shrimps

CO5: Gain Knowledge on diseases of Crustaceans

SYLLABUS

UNIT – 1
1.1 Status of Crustacean farming in India
1.2 Food and Export value of Crustaceans; Present status of their resources and culture practices.

UNIT 2 –
2.1 Important cultivable species of shrimps and prawns, their food and feeding habits and their reproductive biology.
2.2 Types of farming: traditional, extensive, semi-intensive and intensive methods; their management techniques.

UNIT 3 –
3.1 Crustaceans culture in cages, re-circulatory systems, rice fields and super intensive and ultra intensive systems.
3.2 Supplementary feeding: dry feeds, wet feeds, role of artificial feeds; feed ingredients and nutritional quality.

UNIT 4 -
4.1 Farming of Prawns and Shrimps – Pond and Large Scale farming; Composite Culture; Farming of Crab and Lobster.

UNIT 5 -
5.1 Diseases of Crustaceans – Bacterial, Fungal and Viral diseases encountered during large scale culture of Crustaceans
Practicals:
1. Identification of shrimp up to species level based on morphological characters.
2. Dissect and display the appendages of shrimp and crab.
3. Dissect and display the digestive system of shrimp, crab and lobster.
4. Dissect and display the reproductive system of shrimp and squilla.
5. Identification:
   A. Cultivable crustaceans
   B. Larval forms
   C. Shrimp and crab feed.

References:
Shigueno K Shrimp culture of Japan AITP, Tokyo
Milne PH Fish & shellfish farming in coastal waters FNB
McVey JP Crustacean aquaculture CRC handbook CRC press
Korringa P Farming of marine fishes & shrimps Elseiver
Walne PR Culture of bivalve mollusks PNB
Course Outcomes:

UNIT - 1

UNIT - 2
Hatchery management and seed production oyster, pearl-oysters, mussels and seaweeds. Feed and nutrition. Harvesting of fry, packaging and transport of fry; Small scale hatcheries. Nursery Management: preparation of nurseries; Effect of physico-chemical factors, feeding and control of predators.

UNIT - 3
Culture of pearl oyster and pearl production; Culture of cephalopods. Different types of Culture Methods

UNIT - 4
Water quality management and biofouling. Harvesting, post-harvest technology, management, production and economics.

UNIT - 5

Practicals:

I. Dissections:
1. Digestive system of cephalopods and bivalves
2. Reproductive system of cephalopods and bivalves
3. Gill mounting of molluscs

II. Identification:
A. Cultivable Molluscs
B. Sea weeds and their by-products,
C. Predators
D. Models of Culture systems

References:
Bardach JE et al aquaculture wiley Interscience Milne fish and shellfish farming fish In coastal waters
Culture of bivalve mollusks Pillay & dill advances in aquaculture FAO
Korringa fish farming of the oyster Elsevier
Course Outcomes

CO1: Know about the basic principles of genetics
CO2: Understand the chromosome theory of inheritance
CO3: Acquire knowledge on the importance of genome size in fishes
CO4: Discuss the basic role of genetics in Aquaculture
CO5: Gain knowledge on applications of markers for species identification

SYLLABUS

UNIT I
1.1 Principles of Genetics: Mendelian principles,
1.2 Probability of Mendelian inheritance, modification to Mendelian ratios.

UNIT II
2.1 Chromosome theory of inheritance; genetic basis of determination of sex in fish and shellfish.
2.2 Chromosome manipulation: Induction of chromosomal ploidy, polyploidy & aneuploidy, gynogenesis, androgenesis, sex reversal, transgenesis and its applications in aquaculture.

UNIT III:
3.1 Genome size in fishes, Mechanism of variations in genome size.
3.2 Sex control and its role in aquaculture
3.3 Cryopreservation of gametes, in-vitro fertilization, artificial insemination.

UNIT IV
4.1 Role of genetics in Aquaculture: Genetic selection, inbreeding, cross breeding, hybridization, karyotyping, heterosis, hybrid vigour, introgression.
4.2 Genetic tools for aquaculture applications: DNA markers in stock identification-allozymes, RFLP, RAPD, AFLP, Microsatellite, ESTs and SNPs, mt DNA.

UNIT V:
5.1 Applications of markers for species identification, hybridization, stock identification,
5.2 Genetic diversity and conservation, Parentage, Linkage, QLT mapping and microarray genes.
5.3 Karyotyping and chromosome banding- C-banding, G-banding, NOR banding.
9Numericals on DNA markers

References:

1. Pandian TJ, Strussmann CA & Marian MP Fish Genetics & Aquaculture Science Pub
2. Biotechnology
3. Lakra/Singh Fish genetic resources
4. Mirza Akbar Khan Genetic Embryology and fishes
5. References:
11. Pandian TJ, Strüssmann CA & Marian MP. 2005. Fish Genetics and Aquaculture
16. Biotechnology. ICAR.
18. Sea Grant Programmes, USA.
21. of Fish and Shellfish Resources, Managing Diversity.
Course outcomes

CO1: Understand the life history of milk fish, sea bass, yellow tail.
CO2: Gain Knowledge on pond preparation and fertilization
CO3: Acquire skills in Hatchery and Nursery management
CO4: Learn about production and quality control
CO5: Know about ranching methods and implements.

SYLLABUS

UNIT 1
1.1 Important cultivable finfish species and the life history of milk fish, seabass, yellow tail.

UNIT 2
2.1 Criteria for selection of finfish for culture. Classification of culture systems: ponds, pens, cages, raceways.
2.2 Pond preparation and fertilization; eradication of weed and Predatory finfishes.

UNIT 3:
3.1 Hatchery management and seed production of mullets, milkfish, seabass.
3.2 Feed and nutrition.
3.3 Harvesting of fry, packaging and transport of fry; Small scale hatcheries.
3.4 Nursery Management: preparation of nurseries; effect of physico-chemical factors, feeding and control of predators

UNIT - 4
4.1 Culture practices of milkfish, mullets, seabass and yellowtail. Monoculture and polyculture
4.2 Principles and practices. Integrated farming, organic farming and their management.
Harvesting and post-harvesting technology of cultured finfish.
4.3 Production, quality control, marketing and economics.

UNIT – 5
5.1 Aquaranching – Principles and Practices,
5.2 Large Scale culture in Natural waters, Ranching methods and implements.

Practicals:
1. Fish identification based on morphometric and meristic data.
2. Dissect and display the digestive system of herbivorous and carnivorous fish and reproductive system of fish
3. Important calculations in aquaculture: FCR and FCE, Daily ration of feed, Survival rate, Specific growth rate, quantifying the seed for transport.

4. Identification:
A. Cultivable fishes
B. Predatory and weed fishes
C. Fertilizers
D. Supplementary feeds
Course Outcomes
CO1: Knowledge on types of immunity
CO2: Understand the concept of lymphatic system
CO3: Gain knowledge on structure, types and functions of antibodies
CO4: Discuss about types of autoimmune diseases.
CO5: Acquire knowledge on importance of vaccines

SYLLABUS

UNIT I
1.1 Immunity and types of immunity.
1.2 Fundamental concepts and anatomy of the immune system, components of innate and acquired immunity, Phagocytosis, Complement and inflammatory responses,
1.3 Organs and Cells of the immune system-primary and secondary lymphoid organs

UNIT II
2.1 Lymphatic system, Lymphocyte circulation, Lymphocyte homing, Mucosal and Cutaneous associated Lymphoid tissue (MALT & CALT); Mucosal immunity.
2.2 Antigens: Types and properties. Major Histocompatibility Complex (MHC) - MHC genes,
2.3 Immune responsiveness and disease susceptibility and HLA typing.

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

UNIT IV:
4.1 Disorders of immune system: autoimmunity - types of autoimmune diseases.
4.2 Immunodeficiency- Primary immuno deficiencies, Acquired or secondary immuno deficiencies,
4.3 Hypersensitivity.
4.4 Hybridoma technology - mono and polyclonal antibodies.

UNIT V
5.1 Vaccines- Live, killed, attenuated, sub unit vaccines.
5.2 Non-specific immunity of shellfish.
5.3 Active and passive immunization; ELISA, RIA and Immuno electrophoresis applications.
5.4 Transplantation- Immunological basis of graft rejection. Tumor immunology- Tumor antigens; immune response to tumors and tumors evasion of the immune system, Cancer immunotherapy.

Practicals:
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.
5. Separation of leucocytes by dextram method.
6. Demonstration of phagocytosis.
7. Immuno electrophoresis, Isolation of antibody from serum, Nonspecific immune response

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 Palaniparamount

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