# CURRICULUM FOR FISHERIES BIOLOGY
## IN UNDER GRADUATE DEGREE PROGRAMME
### CBCS SYLLABUS SCHEDULE 2016 – 2017

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<th>Course category</th>
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**Signature:**

Professor & Chairman
Board of Studies in Zoology
Department of Zoology
Kerala University
Warangal - 506009.

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UNIT I – Origin, Types and classification of lakes,

1.1. Inland water types: Lentic and lotic habitats – their identities and distribution, ponds and lakes, streams and rivers; Major rivers and lakes of India.
1.2. Origin and classification of lakes.
1.3. Anomalous properties of water, their influence on biota in inland waters.
1.4. Temperature and Light: Thermal stratification and its overall impact, thermal classification of lakes; Factors affecting light penetration in natural waters.

UNIT II - Physicochemical Properties of lake water

2.1. Dissolved oxygen: Sources, losses and distribution patterns.
2.2. Identification of oxygen depletion problems and control mechanisms in fish ponds.
2.3. Carbon dioxide: Sources, losses and distribution patterns; role of carbon dioxide in chemical buffering.

UNIT III - Biological properties of lake water

3.1 Composition, classification and distribution patterns in lakes and rivers. Plankton:
3.2. Benthos: Composition, classification and distribution of benthos in lakes and rivers.
3.3. Nekton and its significance.
3.4. Large Aquatic Plants: Classification, distribution and limnological significance.

UNIT IV – Productivity of lake.

4.1. Productivity: Concept of productivity, methods for the estimation of primary, secondary and tertiary productivity; Classification of lakes based on productivity; indices of productivity in lakes
4.2. Turbidity: Causes, consequences and control.
4.3. Eutrophication: Causes, consequences and control mechanisms.
REFERENCE BOOKS


PRACTICALS – 40 Marks

1. Physicochemical parameters of water:
   pH, Temperature, Dissolved oxygen, Alkalinity, Hardness BOD and COD
2. Collection and identification of fresh water zooplankton
3. Collection and identification of fresh water phytoplankton
4. Collection and identification of benthos from lakes and ponds, streams and canals.
5. Collection and identification of aquatic plants from different fresh water bodies.

[Signature]

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UNIT I - Classification of fishes

1.1. Classification of fishes: Major groups up to subclass and their important characters.
1.2. Skin: Structure and function of skin in fishes.
1.3. Scales: Structure of placoid, cycloid, ctenoid, cosmoid and ganoid scales.
1.4. Fins: Structure and types of fins.

UNIT II - Feeding habits of fishes

2.1. Age and Growth: Methods of determination of age; Methods for studying growth, Length-Weight relationship and Condition factor.
2.2. Natural food of fishes-types of food, herbivorus, carnivorus, omnivorus fishes.
2.3. Feeding habits - predators, grazers, strainers, suckers and parasites;
2.4. Feeding adaptations and stimuli for feeding.

UNIT III - Digestive, Respiratory and excretory systems in fishes

3.1. Respiratory system: Structure of gills and accessory respiratory organs.
3.2. Cardiovascular system: Structure of cardiovascular system in fishes.
3.3. Nervous system: Structure and function of brain and cranial nerves.
3.4. Excretory system and Osmoregulation: Structure and function of kidneys in fishes.

UNIT IV - Endocrine and reproductory systems in fishes.

4.1. Endocrine system: Structure and function of pituitary gland, thyroid gland, ultimobranchial glands,
4.2. Chromaffin tissue, adrenocortical tissue and corpuscles of stannous.
4.3. Reproductive system: Reproductive structures in teleosts; maturity stages of gonads.
4.4. Fecundity and Gastro, Gonado-somatic Index (GSI).
REFERENCE BOOKS


Practicals-40 Marks

1. Morphometric & meristic data of selected food fishes:
   - *Catla catla,*
   - *Laboe rohita*
   - *Cat fishes,*
   - *Clarious batracus,*
   - *Channa striata etc.,*

2. Identification of types of scales and fins
3. Digestion system of fishes - Dissection
4. Wabarian Osicle - Dissection
B.Sc. FISHERIES BIOLOGY SYLLABUS UNDER CBCS
(With effect from 2016-2017)
III - SEMESTER
PAPER III – FISH PHYSIOLOGY (Theory)

Max. Marks: 60

UNIT I – Digestion and metabolism in fishes

1.1. Digestion: Digestion of carbohydrates, lipids and proteins;
1.2. Digestive enzymes and regulation of their secretions; Absorption and assimilation of nutrients;
1.3. Role of hormones in the regulation of digestion; Factors affecting digestion and transport of nutrients.
1.4. Metabolism: Pathways of cellular metabolism.

UNIT II – Neuro endocrine, Respiration and circulation in fishes

2.1. Respiration: Definition of respiration; external respiration and internal respiration.
2.2. Mechanism of gaseous exchange, CO₂ transport, countercurrent principle, water flow across the gills, respiratory pumps.
2.3. Circulation: Role of blood in transport of gases; composition and function of blood.

UNIT III – Sensory organs and osmoregulation in fishes

3.1. Sensory organs: Structure and function of chemo-, photo- and phonoreceptor, lateral line sense organs.
3.3. Osmoregulation: Mechanism of osmotic and ionic regulation; endocrine control of Osmoregulation
3.4 Fish migration – types of migration and impact on fish resources.

UNIT IV – Excretion and reproduction in fishes

4.1. Excretion: Mechanism of excretion of nitrogenous waste, water and ion balance.
4.2. Reproduction and Endocrinology: Development of gonad, oogenesis, spermatogenesis,
4.3. Metabolic changes during oogenesis and spermatogenesis; hormonal control of reproduction in fish.
REFERENCE BOOKS


Practicals-40 Marks

2. Estimation of primary productivity in fresh water bodies.
4. Enumeration and biomass estimation of benthos from lakes, ponds, streams and canals.
5. Study of Inland Capture Fishes:
   - Cat fishes – any three
   - Clupeids – any three
   - Other miscellaneous fishes – any three

[Signature]

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Department of Zoology
Karnataka University
Warangal - 506004.
UNIT I – Nutrition and fish feed

1.1. Nutritional requirements of cultivable fish.
1.2. **Natural food**: Importance in aquaculture; Fish food organisms – acteroplankton, phytoplankton and zooplankton and their role in larval nutrition.
1.3. **Supplementary feeds**: Types of feeds - Wet feed, moist feed, dry feed, mashies, pelleted feeds - floating and sinking pellets, microencapsulated diets.
1.4. **Feed additives**: Binders, antioxidants, enzymes, pigments, growth promoters, feed stimulants; use of preservatives.

UNIT II - Nutritional biochemistry

2.1. Principles of fish nutrition and terminologies
2.2. Classification of nutrients - nutrient quality and evaluation of Proteins, lipids and carbohydrates.
2.3. Digestive enzymes and feed digestibility.
2.4. Factors affecting digestibility. Nutritional deficiency diseases.

UNIT III – Nutritional bioenergetics

3.1. Energy requirement of fishes, protein to energy ratio, digestible energy,
3.2. Nitrogen balance index, protein sparing effect, high energy feeds, isocaloric diets.
3.3. Metabolic rate - Energy budgets; Energy efficiency of fish production.
3.4. Protein efficiency ratio, net protein utilization and biological value.

UNIT IV – Feed manufacture, feeding strategies and feed evaluation

4.1. Forms of feeds: wet feeds, moist feeds, dry feeds, mashies, pelleted feeds, Floating and sinking pellets.
4.2. Feed additives: binders, antioxidants, enzymes, pigments, growth promoters, feed stimulants and shellfish. Feed formulation and manufacturing.
4.3. Feed storage, use of preservatives and antioxidants.
4.4 Feed evaluation - feed conversion ratio, feed efficiency ratio
REFERENCE BOOKS


Practical-40 Marks

1. Proximate composition analysis of feed ingredients and feeds.
2. Preparation of artificial feeds using locally available feed ingredients.
4. Effect of storage on feed quality.
5. Identification of common feed ingredients.
6. Proximate analysis: Moisture, Crude Protein, Crude Lipid, Ash, Acid insoluble ash, Nitrogen free extract of feed fish tissue, Fatty acid analysis, Calcium, Phosphorus content of feed.

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Professor&Chairman
Board of Studies in Zoology
Department of Animal
Gauhati University
B.Sc. FISHERIES BIOLOGY SYLLABUS UNDER CBCS
(With effect from 2016-2017)
V- SEMESTER
PAPER: GE-1
AQUACULTURE (Theory)

Max. Marks: 80

Unit I. Introduction

1.2. History of aquaculture: Present global and national scenario.
1.3. Fishery Resources in India, classification of Fishes, and classification of Fisheries.
1.4. Criteria for selection of candidate species for aquaculture.
1.5. Biology of major candidate species for freshwater aquaculture.

Unit II. Culture Systems

2.1. Site Selection, design and construction of fish pond.
2.2. Seed production and transportation- Induced Breeding, and Bundh Breeding.
2.3. Pre-stocking and post stocking pond management.
2.4. Monoculture, polyculture, integrated culture, extensive, semi-intensive, intensive and super intensive aquaculture.
2.5. Culture of major carps: Catla catla, Labeo rohita, Cirrhinus mrugala

Unit III. Pond Management.

3.1. Water and soil quality in relation to fish production
3.2. Physico-chemical and biological factors ponds.
3.3. Primary productivity - Energy flow.
3.4. Fish food organisms and supplementary food
3.5. Types of fish diseases and their control measures

Unit IV. Harvesting and Post-Harvesting Techniques

4.1. Types of craft and gear used to harvest the fish.
4.2. Culture of Shrimp.
4.3. Culture of prawn
4.4. Marketing and cost economics of aquaculture.

REFERENCE BOOKS

[Signature]
Professor & Chair
Board of Studies in Zoology
Department of Zoology
Kerala University
Warangal - 506 008.
6. ICAR. 2006. Handbook of Fisheries and Aquaculture. ICAR.

Practicals-40 Marks

1. Identification of common Fresh water aquarium fishes (10 Nos.)
2. Indigenous ornamental fishes of Telangana (5Nos.)
3. Breeding of live bearers-Guppy
4. Breeding of egg layers- gold fishes
5. Breeding of bubble nest builder- Gourami
6. Control of snails in ornamental fish culture system
7. Ornamental fish farms- general description
8. Marine aquarium fishes and invertebrates

Field visit:
1. Visit to aqua farms for water and soil sample collection

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Kerala University
Woriongo 506 009,
UNIT I – Viral diseases

1.1. Viral hemorrhagic septicemia. Clinical symptoms, pathology and control measures
1.2. Koi Herpesvirus Clinical symptoms, pathology and control measures
1.3. Infectious haemopoitic necrosis virus Clinical symptoms, pathology and control measures
1.4. Aquabirnavirus and betadona virus Clinical symptoms, pathology and control measures

UNIT II – Bacterial and fungal diseases

2.1. Gill, Tail Rot and Fin Rot, Dropsy and Red Pest disease - Clinical symptoms, pathology, prevention and control measures
2.2. Columnaris - Mouth Fungus Clinical symptoms, pathology, prevention and control measures
2.3. epizootic ulcerative syndrome (EUS), clinical symptoms and treatment of EUS.
2.4. Clinical symptoms, pathology, prevention and control measures of Lagenidium disease (Larval Mycosis) and Brown gill disease.

UNIT III - Protozoan, Helminth and Crustacean diseases.

3.1. Velvet, Rust - Gold Dust Diseases - Clinical symptoms, pathology and control measures.
3.2. Brooklynellosis, Hexamita and Costia Clinical symptoms, pathology and control measures.
3.4. Gyrodactylus, Dactylogryrosis, Argulosis and Lernaeasis diseases - Clinical symptoms, pathology and control measures.

UNIT II - Nutritional and Ecological diseases.

4.1. Diseases of vitamin deficiency and Fatty liver degeneration.
4.2. Carbohydrates, proteins and lipid deficiency diseases in fish.
4.3. Gas bubble disease and lack of oxygen - Clinical symptoms, pathology and control measures
4.4. Environmental stress on outbreaks of infectious diseases of fishes

Max. Marks: 50

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REFERENCE BOOKS


Practicals-30 Marks

1. Isolation and maintenance of bacteria from fishes and water.
2. Examination of moribund fish for viral and bacteria diseases; Sampling techniques,
3. Microbial identification Enumeration of bacteria on fish by TPC method
4. Histopathological observation of diseases fish organs.
5. Identification of various finfish / shellfish disease
6. Parasite in fishes, protozoan, helmights, crustaceans
7. Prophylaxis for the prevention of outbreak of fish disease
8. Processing and study of the arthropods and their larval stages, staining and study of the protozoans Fixation and staining of protozoa, examination of biopsy material, examination of tissue sections for parasites.

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Professor of Zoology
Head of Studies in Zoology
Department of Zoology
K.N. Medical University
Warangal-506009.
UNIT I – Water quality, fertilizers and manures, liming

1.1 Water quality: Constituents of water, Water quality parameters – optimal levels and their management in freshwater fish.

1.2 Fertilizers and manures: Different kinds of fertilizers and manures, fertilizer grade, source, rate and frequency of application; Ecological changes taking place after fertilizing;

1.3 Biofertilizers: Role of inorganic, organic and biofertilizers in aquaculture practices; Utilization of bioactive compounds by microorganisms.

1.4 Liming: Properties of liming materials, lime requirements and application of liming materials to ponds, effects of liming on pond ecosystem.

UNIT II – Dynamics of dissolved oxygen and aeration

2.1. Dynamics of dissolved oxygen: Dial changes in dissolved oxygen concentration,

2.2. Oxygen budget of culture ponds; algal die-off, overturns,

2.3. Identification of oxygen problems.

2.4. Aeration: Principles of aeration, emergency aeration, destratification and practical considerations.

UNIT III – Hatchery and aquatic weed management

3.1. Hatchery management: Fish hatchery - Hatchery protocols, seed rearing technology;

3.2. Packaging and transport of seed. Shrimp hatchery – Larval rearing; culture and use of different live feed; different chemicals and drugs used; water quality and feed management.

3.3. Water discharge standards; Effluent treatment in hatcheries.

3.4. Aquatic weed management: Common weeds and problems in culture ponds; Chemical, biological and mechanical control methods; Algal bloom control.

UNIT IV – Pollution during aquaculture practices.

4.1. Chemical treatments: Potassium permanganate, hydrogen peroxide, calcium hydroxide;

4.2. Reduction of pH, control of turbidity, salinity, hardness, chlorides, water exchange, chlorine removal; rotenone, formalin and malachite green;

4.3. Methods of applying chemicals.

4.4. Pollution in relation to aquaculture practices.

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REFERENCE BOOKS


Practical-30 Marks

1. Types of Aerators.
2. Studies of fish breeding and gamete preservation. Method to identify quality seeds stress test and microscopic examination.
3. Design and construction of fish hatcheries.

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Kaveri University
Warangal - 506 009.
UNIT – I Introduction to Aquarium

1.1. History of animal keeping and present-day aquatic animal husbandry industries.
1.2. Physical, chemical and biological processes occurring in the aquarium environment.
1.3. Proper set-up and maintenance of home aquaria.
1.4. Current internal and external factors that impact the operational role and function of zoological facilities with aquatic animal collections.

UNIT – II Selection and maintenance of Aquarium

2.1. Introducing and Caring for Saltwater Fish and Freshwater Fish
2.2. Selecting Appropriate Fish and Appropriate Placement and Equipment
2.3. Diversity, anatomy, physiology, sensory biology, and behavior of freshwater and marine fishes and the constraints placed upon them in a controlled environment.
2.4. Common Fish Diseases.

UNIT – III AQUARIUM FISH BREEDING

3.1. Basic patterns of aquatic environment, biological balance, nitrogen cycle in the water, water features, Equipment, types of aquariums,
3.2. Factors influencing breeding and fish keeping.
3.3. Principles of aquarium fish breeding, rearing principles.
3.4. Fish nutrition and feed sources. Commercialization opportunities in aquaristic practice.

UNIT – IV Life Support System, Design and Operation of Aquarium

4.1. Role of life support systems in maintaining a balanced, stable aquatic environment.
4.2. Design, construct and maintain semi-closed, closed and open systems.
4.3. Maintenance of Aquarium – Cleaning, Water and Troubleshooting
4.4. Selection of aquarium fishes and plants
Practical-40 Marks

1. Aquarium design and construction. Culture of live fish food organisms (Phytoplankton and Zooplankton).
3. Fabrication of public & home aquarium
5. Culture of common aquarium fish feed.
6. Study of common aquarium fish
7. Identification of common freshwater aquarium fishes and breeding trials of selected freshwater fishes
8. Aquarium fabrication, setting and maintenance.
9. Preparation of powdered and pelleted feed for ornamental fishes.
10. Field visit to aquarium plant, experimental treatment, assessment of water quality.

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UNIT – I: Process Biochemistry

1.1. Major and minor constituents of fish, their distribution and function - moisture, proteins, Lipids, carbohydrates, vitamins and minerals.
1.2. Post-mortem biochemical changes in fish - rigor mortis, autolysis, auto-oxidation and their significance.
1.3. Oxidative deterioration
1.4. Toxins and toxic substances in fish.

UNIT – II: Microbiology

2.1. Biochemical and microbial spoilage of fish;
2.2. Factors affecting spoilage of fish.
2.3. Role of bacteria and moulds in fish preservation
2.4. Pathogenic organisms encountered in fish products, fecal indicator organisms.

UNIT – III: Handling and Fish Preservation

3.1. Handling, storage and transport of fresh fish, sanitary and phyto-sanitary requirements for maintenance of quality.
3.2. Principles of fish preservation; preservation of fish by curing, drying, salting and smoking; chilling and freezing of fish; canning of fish and fish products.
3.3. Modern techniques employed in fish preservation: Accelerated Freeze Drying (AFD), Irradiation.
3.4. Fishery by-products and waste utilization.

UNIT – IV: Quality Management and Certification

4.1. HACCP (Hazard Analysis and Critical Control Points) and Good Manufacturing Practices:
4.2. HACCP Principles, Practical aspects of planning and implementation,
4.3. Verification, Validation and Audit.
REFERENCE BOOKS

5. Govindan, TK. 1985. Fish Processing Technology, Oxford-IBH.

PRACTICALS-30 Marks

1. Determination of moisture content in fish and fishery products
2. General description — freezing
3. Processing shrimp
4. Drying of fish
5. Organoleptic analysis of fish
6. Preparation of fishery byproducts
7. Preparation of shark fin rays, fish maws, chitin and fish wafer
8. Fish pickling and Value added fishery products, fish curry, cutlets, fish finger.
9. Filleting of fish, treatments, glazing, packaging, freezing, Processing of Prawns, Lobster, Squid, Cuttlefish, Crab etc. in different styles. Packaging and Freezing, Freezing curve, determination of freezing point.
UNIT I – Economics - production and cost benefit analysis

1.1. The basis of production; Interrelationships of aquaculture systems.
1.2. Production Economics: Basic economic principles applied to fish production;
1.3. Input-output relationships, maximum level of input, least-cost combination of inputs,
    Maximum level of output, combination of products, economies of size.
1.4. Cost-Benefit Analysis: Production costs - fixed costs, variable costs, gross revenue,
    economic analysis; Partial budget analysis; Cash flow analysis.

UNIT II – Marketing economics and economic feasibility of investment analysis

2.1. Marketing Economics: Fish marketing methods in India;
2.2. Basic concepts in demand and price analysis; demand, supply and fish prices,
    elasticity of demand (price elasticity of demand, income elasticity of demand, cross
    elasticity of demand).
2.3. Economic feasibility of investment analysis: Methods of feasibility analysis; the
    payback period, average rate of return, discounting method,
2.4. Net Present Value, Benefit-cost Ratio, Internal Rate of Return.

UNIT III – Economics of unit costs

3.1. Economics of fish production farm (Unit costs).
3.2. Fresh water fish farming in ponds – a small scale business
3.3. Composite fish culture – large scale
3.4. Technical parameters that needs to be considered

UNIT IV – Fisheries extension.

4.1. Fisheries training and Education in India: Training Institutes, Universities, Research
    organizations.
4.2 Institutional funding to fisheries and aquaculture sector.
4.3. Socio-economic conditions of fishermen and fish farmers.
4.4. Fishermen Co-operative societies.

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Professor & Chairman
Board of Studies in Zoology
Department of Zoology
Kerala University
Warangal-500004.
REFERENCE BOOKS


Practicals-30 Marks

2. Visit to fish farms, prawn farms and hatcheries – discussion on socio economic issues in aquaculture development.
3. Data collection on cost and returns of different fishing methods (instead of economics of capture fisheries);
4. Structural Change in the seafood export of India-Estimation of DRC, NPC for selected groups of exports.

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Professor-Head

[Institution]