

## FISH AND INDUSTRIAL FISHERIES

5 Hrs/week

SEMESTER-I

TOTAL 50 hrs

### BIOLOGY OF FIN FISH AND SHELL FISH: PART-I

**General characters and classification of phylum chordate up to classes.**

#### **Classification of super class Pisces;**

The differences between elasmobranches and teleosts. Study of external morphology of typical elasmobranches and teleosts.

The structures used in taxonomic studies like skin, colouration, scales, mouth, jaws etc.,

External characters of fishes – shape, head, mouth, eyes, barbules, operculum, fins, spines, trunk, tail, scales, lateral line.

External characters of Prawn, Lobsters, Bivalve, Gastropods and Cephalopods (two examples from each)

**15 hrs**

Commercially important orders, families, genera and species of elasmobranches and teleosts of Indian region and their identification. Identification of commercially important Fishes, Prawn, Lobsters, Bivalves, Gastropods and Cephalopods of India.

**15 hrs**

**Internal anatomy of fish;** Alimentary canal and associated structures.

Respiratory system, Gill, Swim bladder, Accessory respiratory organs.

Heart and circulatory system.

Nervous system and lateral line system, Sense organs.

**10 hrs**

**Food and Feeding;** Feeding habitat in various groups of marine and freshwater fishes.

Natural food of fishes.

Anatomical difference of herbivore and carnivore fishes.

Feeding habitat of Prawn, Crab, Lobsters, Bivalve and Cephalopods.

**05 hrs**

### **Reproductive system in fishes**

Reproductive behaviour and parental care.

Special behaviour, aggregation and shoaling.

Migration of fishes; anadromous and catadromous.

**05 hrs**

### **I SEMESTER PRACTICAL**

**4 hrs/ week**

1. Study of external morphology and morphometry of a typical teleost fish.

(Types of scales, fins and mouth type)

2. Identification, classification, description and economic importance of fin fish and shell fish of South India.

3. Mounting of Scale, Amphullae of Lorenzini and mounting of brain of shark.

### **SCHEME OF PRACTICAL EXAMINATION**

1. Mounting of Amphullae of Lorenzini/Scale/brain.	05 marks
2. Morphometry of the given fish.	10 marks
3. Identification 10X2	20 marks
4. Journal	05 marks

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**Total      40 marks**

## FISH AND INDUSTRIAL FISHERIES

5 Hrs/week

SEMESTER-II

TOTAL 50 hrs

### BIOLOGY OF FIN FISH AND SHELL FISH: PART-II

**Growth of Fish;** Absolute and relative growth. Isometric and allometric growth. Marking and tagging of fish for growth, length and weight relationship, ponderal index, relative factor, gonado somatic index.

4 hrs

**Reproduction;** Sex difference, sexual maturity, classification of maturity stages, estimation of fecundity, ova-diameter frequency, fecundity in relation to length, weight, age and food supply. Spawning habits, factor affecting spawning, spawning seasons and spawning frequency.

**Embryonic and early development;** Type of eggs, larvae. Metamorphosis of larvae, larval life and feeding habitats of fishes.

8 hrs

#### **Ornamental fishes and plants;**

Common species of ornamental fish suitable for aquarium.

Water equality for breeding tanks, selection and conditioning of fish. Freshwater ornamental species- livebearers, egg layers.

Maturation, secondary sexual characters, breeding habits. Parental care, development of eggs.

**Breeding of ornamental fish;** Egg scatters, egg depositors, mouth brooders, bubbles nest builders, livebearers etc.,

Hatching, larval rearing and their feeds and feeding. Use of pigment for colour enhancement.

15 hrs

Marine ornamental fishes, their habitat, collection from nature. Methods of collection. Transportation of live fish, use of sedatives. Others ornamental organisms like Sea anemone, Lobster, Shrimps, Octopus, and Starfish etc., used in the aquarium.

**4 hrs**

**Freshwater ornamental Plants;**

**Rooted plants;** Limnophila, Ditch moss, Potamogeton sppe., Cabomba, Ceretophyllum, Indian fern, Cryptocornye sppe., Amazon sward plant, Hair grass, Sagitteria, and Vallisneria.

**Floating Plants;** Duck weed, Pistia, Riccia and Salvinia.

Multiplication or ornamental plants, nutrients and optimum environment conditions for their growth.

**4 hrs**

**Construction and maintenance of Aquarium;**

Construction of home aquarium, material used, wooden and metal frame, frameless tanks, sealants and gums.

Design and construction of public freshwater and marine aquaria.

Aerators and filters, pebbles, ornamental objects and other equipments used in the aquaria.

Cleaning the aquarium, maintenance of water quality, control of snails.

Nutritional requirement for aquarium fishes. Preparation of dry feeds, feeding methods.

Maintenance of aquarium, Live food – brine shrimp, bloodworm, water flea, earthworm, infusoria, mosquito larvae, tubifex worm, other natural and artificial foods.

Common disease of aquarium fishes, and their diagnostics and treatment.

**15 hrs**

## **II SEMESTER PRACTICALS**

**4 hrs/ week**

1. Anatomy of typical elasmobranches and teleost (Dissection of Cranial nervous system and Arterial system).
2. Classification, Identification and Description of
  - a) Ornamental marine fishes
  - b) Ornamental freshwater fishes
  - c) Ornamental organism used in the aquarium
  - d) Ornamental plants
3. Construction and Maintenance of home aquarium.

## **SCHEME FOR PRACTICAL EXAMINATION**

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| 1. Dissection and display cranial/ arterial system in given fish-----          | 14 marks |
| 2. Identification and describe of aquarium fish / plants / other materials 8X2 | 16 marks |
| 3. Construction of aquarium  | 05 marks |
| 4. Journal   | 05 marks |

## FISH AND INDUSTRIAL FISHERIES

5 Hrs/week

SEMESTER-III

TOTAL 50 hrs

**CAPTURE FISHERIES;** Importance of capture fisheries of the World. Present yield and estimate of potential fisheries. International fisheries commissions.

The Inland capture fisheries resource of world and India. Riverine fisheries.

Fisheries of major and minor carps, catfishes and other groups.

Problems and managements.

**10 hrs**

Coldwater fisheries resources; Fisheries of trout, Mahaseer and other coldwater fish species.

Development and management.

**5 hrs**

Lacustrine fisheries sources, potentials and problems of development and management.

**5 hrs**

Estuarine fisheries resource; fishes of clupeoids, prawns, molluscs, mullets and other important groups. Fisheries of brackishwater lakes and backwaters.

**8 hrs**

**Capture fishers fisheries of marine;** Marine fisheries resources of India.

Pelagic fisheries; Fisheries of Oil sardines, Lesser sardines, Anchovies, Clupeoids, Mackerels,

Ribbon fisheries, Tunas, Seer fish, Carangids and Cephalopods.

**11 hrs**

**Mid water and demersal fisheries;** Fisheries of elasmobranches, Bombay duck, Catfishes, Silver bellies, Sciaenids, Pomfrets, Threadfins, Perches, Flatfish, Prawns, Lobsters, Crabs, Mussels, Oysters and Clams and their economic importance.

Fishing regulatory and Laws.

**11 hrs**

**III SEMESTER PRACTICAL**

**4 hrs/ week**

1. Freshwater fish gears and crafts.
2. Marine water gears and crafts.
3. Length and weight relationship in fishes.
4. Population structure and Length frequency data in fishes.

**SCHEME OF PRACTICAL EXAMINATION**

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|---|----------|
| 1. Length and weight relationship in fishes   | 15 marks |
| 2. Population structure and frequency data  | 05 marks |
| 3. Identification of gears and crafts 5X2   | 10 marks |
| 4. Visit to marine fish landing centre (study tour report)<br>(Compulsory study tour visit) | 05 marks |
| 5. Journals   | 05 marks |

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**Total      40 marks**

## FISH AND INDUSTRIAL FISHERIES

5 Hrs/week

SEMESTER-IV

TOTAL 50 hrs

### FISHERIES TECHNOLOGY;

Principles and importance of fish preservation – Sun drying, Salt curing, Pickling, Smoking, Chilling, Frying and Canning.

Processing and preservation of fish products and byproducts. Paste products, Minced meat, Fish Protein Concentrate, Fish meal, Shark liver oil, Fish body oil, Liquid fish (fish ensilage), Shark fins and fin rays, Fish skin leather, Ambergris, Fish cake, Fish salads, Fish wafers, Fish soup powder, Fish hydrolysate, Fish Sauce, Fish glue, Isinglass, Chitin and Chitosan, Pearl essence.

15 hrs

Sea weeds – Edible, Industrial and Pharmaceutical products and their uses.

Handling, preservation and transportation of fresh fish, freezing preservation of fish, modern techniques employed in fish preservations

10 hrs

Sanitation in processing and quality control of fresh and processed fish and fisheries products.

03 hrs

**Fish catching methods;** Indigenous fishing gears of India.

Recent development in fishing gears in India. Indigenous fishing crafts of India.



Mechanization of Indian fishing crafts, fishing vessels. Electronics in fishing industry.

Sea fishing methods.

**10 hrs**

**Pearl producing molluscs;** Freshwater and marine pearl producing molluscs.

Technology of Pearl production and their importance. Pearl production states in India.

**05 hrs**

**Fisherman Co-operative Societies;** Roll of co-operative in fishery economy.

Organization of fisherman Co-operative society.

Roll of Co-operative Societies in fish production and marketing.

Fisheries extension.

**07 hrs**

#### **IV SEMESTER PRACTICALS**

**4Hrs/week**

1. Study of By-products and their economic importance.  
(Fish wafers, Soup powder, Fish Ensilage, Shark fin and fin rays, Sardine oil, Chitosan, Fish sauce, Fish cake, FPC) etc.,
2. Preparation of Chitosan from prawn shells
3. Extraction of fish body oil and liver oil
4. Fish Food formulation and pellet preparation
5. Compulsory visit to cold storages and processing plants and fish landing centre and submission of study tour reports.

#### **SCHEME OF PRACTICAL EXAMINATION**

1. Identification, economic importance and edible importance of fish by-products 10X2 20 marks

2. Preparation of Chitosan/Fish liver oil/Body oil extraction and uses	05 marks
3. Fish feed preparation	05 marks
4. Field report	05 marks
5. Journal	05 marks

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**Total                    40 marks**

### FISH AND INDUSTRIAL FISHERIES

**PARER I**

**SEMESTER – V**

**TOTAL 50 hrs**

**5Hrs/week**

**Principles and practice of Aquaculture;**

Definition and history of Aquaculture; Scope and importance of aquaculture. Principles of site selection, Kinds of fish farm, Productivity of water, Soil and soil characteristics and other parameters. Different systems of aquaculture, monoculture, polyculture, integrated fish farming, pond culture, cage culture, pen culture, raft culture, extensive, semi intensive and intensive fish culture, raceway culture, sewage fed fish culture. Factors for success of fish culture enterprises.

**25 hrs**

Present status of Aquaculture, Preparation of culture pond, Pre stocking management, Control of aquatic weeds, aquatic insects, weed fishes, predators, algal blooms and their control, liming and fertilization, manuring of nursery and rearing ponds. Criteria of selection of species for culture, seed procurement and stocking. Post stocking management, phased manuring, supplementary feeds and feeding.

**10 hrs**

Breeding and culture of freshwater Prawns and their polyculture with finfish. Air breathing fish culture. Coldwater fishes and their culture.

**5 hrs**

Formulation of artificial diet of fishes. Storage of feeds, feeding techniques, natural feed and its importance in aquaculture. Aqua farm management, concepts and principles of aqua farm management.

**5 hrs**

Major cultivable freshwater fishes of India.

**5 hrs**

**V SEMESTER PRACTICAL**

**PAPER-I**

**4Hrs/week**

1. Water and soil analysis.

(Dissolved oxygen, carbon dioxide, alkalinity, salinity, pH, hardness, ammonia, and nitrates)

2. Soil parameters.

(Collection and preservation, analysis of particle size, water holding capacity, pH, and organic matter).

3 Aquatic insects, aquatic weeds, predatory & weed fishes. (Identification and describe)

**SCHEME FOR PRACTICAL EXAMINATION**

1. Water analysis –DO/Alkalinity/Hardness	10 marks
2. Water analysis CO <sub>2</sub> / ammonia/ Nitrate/salinity	10 marks
3. Soil organic matter/ Soil/ water pH.	09 marks
4. Identifications 3x2	06 marks
5. Journal	05 marks

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**Total 40 marks**

### **SEMESTER – V**

**PARER II**  
**5Hrs/week**

**TOTAL 50 hrs**

#### **COSTAL AQUACULTURE;**

Marine fisheries resource of India, Brakishwater fisheries resource of India. Important species of Pennaeid prawns and life history of typical Prawn, hatchery production of seed, nursery rearing, transportation of Prawn seed, hatchery management. Breeding and culture of brakishwater fish - Milk fish, Mulletts, Pearl spot, Sea bass etc. Mariculture of edible oysters, mussels, Clams, Sea urchin, Sea cucumber and culture of sea weeds. Fisheries Institutes of India.

**22 hrs**

#### **Fish pathology;**

Significance of fish disease in relation to aquaculture practices. Principles of disease diagnosis and fish health management. Disease caused by crustaceans, parasites (Ergasilosis, Lerniae, Argulus, Isopodeparasite). Protozoan diseases, Fungal diseases, Viral diseases and Bacterial diseases of fishes, symptoms and their control methods.

**22 hrs**

#### **Fish Histology;**

Histological studies of most important internal organs of fish - gills, liver, Intestine, Kidney, Muscle.

**6 hrs**

**V SEMESTER PRACTICAL****PAPER-II****4 Hrs/week**

1. Identifications of fish parasites.
2. Identification of cultivable fishes.
3. Techniques involved in the investigation of disease.
4. Histological and Histochemical technique.
5. Stain preparation and staining technique.
6. Economics of Composite fish culture.
7. Economics of fish cum paddy culture.
8. Economics of fish cum poultry farming.
9. Economics of fish cum dairy farming.
10. Economics of fish cum horticulture.
11. Economics of freshwater Prawn.
12. Economics of monoculture of brakishwater milk fish culture.
13. Field visit to fish seed hatchery and fisheries Institutes.

**SCHEME FOR PRACTICAL;**

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|---|----------|
| 1. Identification of fish pathogens (3x2)                 | 06 marks |
| 2. Identifications of Permanent histological slides. 3x 2 | 06 marks |
| 3. Preparation and Identification of permanent slide      | 10 marks |
| 4. Fisheries economics. (2x4 problems)                    | 08 marks |
| 5. Journal  | 05 marks |

6. Field report

05 marks

**Total**

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**40 marks**

## **VI SEMESTER**

**PAPER-I**  
**4 Hrs/week**

**TOTAL 50 hrs**

### **FISH GENETICS, SEED PRODUCTION AND ENVIRONMENTAL BIOLOGY**

Principal of Mendelian genetics, multiple alleles, interactions, Linkage and crossing over.

Introductions to cytogenetics and its application.

Sex determination and control mechanism and Inheritance.

Different methods of breeding-Inbreeding, out breeding, cross breeding, selective breeding, random breeding.

Hybridization and transgenic fish. Cryopreservation of gametes, Gynogenesis, androgenesis, polyploidy, production of monosex and sterile fish and their significance in aquaculture. Sex reversal techniques.

Principal of biochemical and molecular genetics and its applications.

**15 hrs**

Roll of gonadotrophin in fish breeding, Brood stock management, breeding of carps and other cultivable fishes, induced breeding. Ovulation agent used (fish pituitary glands, human chorionic gonadotrophin), pheromones and other new generation drugs.

Hatchery technology, bund breeding, riverine seed collection, seed transportation, Different stages of fish seed (spawn, fry, fingerlings).

Application of genetics in fish farming.

**10 hrs**

## Environmental Biology

Definition, scope and importance of ecology. Ecological habitats, abiotic and biotic factors.

Primary productivity of water mass and fish production, trophic levels of fish in the food chain, predatory prey relationship, ecology of freshwater ponds, ecology of river, ecology of estuaries, brackishwater and sea. Nutrition Cycles: Carbon cycle, Nitrogen cycle and oxygen cycle and Phosphorous.

Water and soil pollution, source and effects and control.

Pesticide impact on aquatic organisms, thermal pollution, radioactivity, assessment and monitoring of water pollution.

**25 hrs**

### **VI SEMESTER PRACTICAL PAPER – I**

**4Hrs/week**

1. Plankton study: Collection methods and preservation.  
(Five from fresh water: Five from marine water)
2. Primary productivity (light and dark bottle).
3. Induced breeding technique.
4. Composite fish culture.
5. Study of different stages of fish seed. (spawn, fry, fingerlings)
6. Gonad somatic index in fishes

### **SCHME OF PRACTICAL EXAMINATION**

1. Identification	5X2	10 marks
2. Primary productivity		15 marks
3. Induced breeding		05 marks
4. Field trip		05 marks
5. Journal		05 marks
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<b>Total</b>		<b>40 marks</b>

## VI SEMESTER

**PAPER-II**  
**4 Hrs/week**

**TOTAL 50 hr**

### **FISH BIOTECHNOLOGY, BIOCHEMISTRY AND FISH MICROBIOLOGY**

Biotechnology scope and its importance in fisheries, molecular techniques in stock characterization, Principles and applications of HPLC, Principles and application of PCR, Principles and applications of SDS page, Electrophoresis. General properties of organic and inorganic compounds. Role of herbal therapy in fish health management. Application of molecular engineering and nucleic acid manipulation in fisheries.

**10 hrs**

### **BIOCHEMISTRY**

Carbohydrates: Classification, properties of important monosaccharide, disaccharides, polysaccharides.

Lipid classification, properties and functions

Protein classification, properties and functions

Enzymes, classification and applications

Vitamins dietary sources and functions

Special reference to fish moisture, fish protein, fats, ash, contents, fish enzymes and non protein nitrogen compounds like- Tri-methylamine oxide, urea, free alpha amino acids and volatile bases.



Bioenergetics (Kreb's cycle, glycolysis, electron transport system)

**25 hrs**

### **FISH MICROBIOLOGY**

Microbiology scope and its importance in fisheries

Classification of microorganisms, Microbial taxonomy, bacteria, fungi, algae, protozoa and virus.

Nature of microbial cell surface, cell membrane, flagella, capsule, mucus sheet, gram negative and positive bacteria.

Isolation and cultivation of microorganisms. Isolation of culture, enrichment technique, nature of growth, factor influencing growth, growth phases and methods of growth measurements.

Sterilization methods principles and application, preservation and maintenance of culture.

Pathogenic microorganisms in fishes, role of microorganisms in fisheries, Pathogenic organism encountered in fish products, fecal indicator organisms.

Post mortem biochemical changes in fishes.

**15 hrs**

### **VI SEMESTER PRACTICAL**

### **PAPER-II**

**4Hrs/week**

1. Preparation of percent Molarity, molality, normality of a solution.
2. Assay enzyme activity of analyses.
3. Quantitative analysis of protein by spectrometry method.
4. Study of microbial instruments.
5. Sterilization of glassware.
6. Preparation of media, nutrient agar, nutrient broth.
7. Bacterial staining techniques.
8. Culture of microorganism in soil and water.
9. Estimation of glucose and glycogen in fish tissue and blood.
10. Electrophoresis and its application in fisheries (SDS Page)

### **SCHEME PRACTICAL**

1. Identification, description and use 5X2

10 marks

2. Estimation of glucose/glycogen in fish tissue/blood 12 marks

3. Estimation of protein in fish tissue

(Total/soluble/structural protein)

13 marks

4. Journal

05 marks

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**Total 40 marks**