

Fisheries Science/ Fisheries and Aquaculture

Semester I

UNIT NO.	TOPICS	CONTACT HOURS	MARKS
Unit 1 Introduction to Fisheries	<u>Chapter 1- Diversity of Aquatic Organisms</u> • Brief concept of aquaculture • Definition and importance of fisheries • Types of fisheries - inland, brackish and marine • Basic concept of extensive, intensive and super intensive aquaculture and integrated farming <u>Chapter 2- Introduction to Taxonomy</u> • Taxonomy- Definition and taxonomical hierarchy, • Systematics- Definition and importance • Species concept- Biological and evolutionary concept • Speciation (Allopatric, parapatric, peripatric, sympatric- definition and one example each) <u>Chapter 3- Taxonomy of fish</u> • Salient features and classification of fish up to class level • Diagnostic features <i>Labeo rohita</i> (Rohu), <i>Chitala chitala</i> (Chital), <i>Tenulosa ilisha</i> (Ilish), <i>Lates calcarifer</i> (Bhetki), <i>Barilius barila</i> (boroli), <i>Clarius batracus</i> (Magur), <u>Chapter 4- Taxonomy of crustacea and mollusca</u> • Salient features of Prawn (<i>Macrobrachium rosenbergii</i>, <i>Penaeus monodon</i>), Crab (<i>Scylla serrata</i>), Bivalves (<i>Pinctada sp.</i>), Gastropod (<i>Pila sp.</i>), Cephalopod (squid)	24	15

Unit 2 Biology of Digestion and Respiration	<u>Chapter 5- Fish Morphology</u> • Morphology and diversity of skin, scales, mouth, fins and tails <u>Chapter 6- Digestion</u> • Food and feeding habit of fish- herbivores, carnivores and omnivores. • Internal anatomy of alimentary system of herbivorous, carnivorous and omnivorous fishes. • Fish growth- isometric and allometric <u>Chapter 7- Respiration</u> • General description of respiratory organs in fish (Shark and Rohu) • Accessory respiratory organs in air breathing fishes (<i>Anabas sp.</i> <i>Clarias sp.</i>, <i>Heteropneustes sp.</i>)	16	12
Unit 3 Biology of excretion, circulation and reproduction	<u>Chapter 8- Excretion</u> • Structure of fish kidney • Osmoregulation in freshwater and marine teleosts (Euryhaline and stenohaline fishes), osmoregulators and osmoconformers. • Accessory excretory organs in fish (gills and skin) <u>Chapter 9- Circulation</u> • Structure of fish gill- Gill filaments, gill lamellae, gill arch and gill epithelium • General features of venous heart <u>Chapter 10- Reproduction</u> • Structure of ovary and testis in fish • Sexual dimorphism in fish • Oviparous, viviparous and ovo-viviparous fishes	15	8

Semester II

UNIT NO.	TOPICS	CONTACT HOURS	MARKS
Unit 4 Aquatic environment and ecology	<u>Chapter 11- Understanding of basic aquatic ecology</u> • Concept of habitat and ecological niches • Structure and function of aquatic ecosystem- productivity, energy flow in ecosystem, food chain, food web • Elementary idea of pond ecosystem and marine ecosystem <u>Chapter 12- Water Quality Parameters</u> • pH, turbidity, temperature, Dissolved Oxygen (DO), Biological Oxygen Demand (BOD). • Definition and significance of planktons (Zooplanktons and phytoplanktons- each with two examples.	32	13
Unit 5- Aquaculture systems and practices	<u>Chapter 13- Systems of Aquaculture</u> • Criteria for the selection of site and species for freshwater aquaculture- monoculture, polyculture, composite fish culture, brief concept of sustainable aquaculture (aquaponics). • Culture of air breathing fishes- <i>Anabas</i> sp. <u>Chapter 14- Culture and prawn and molluscs</u> • Culture of <i>Macrobrachium rosenbergii</i>, <i>Penaeus monodon</i> • Freshwater pearl culture- brief culture methodology, present status and prospects of pearl culture in India	35	12
Unit 6 Fisheries resources	<u>Chapter 15- Inland Fisheries Resources</u> • Brief idea about freshwater resources- status, prospects and problems in West Bengal	30	10

	• Brief idea about brackish water resources - present status, prospects and problems in West Bengal • Brief idea about coastal resources - present status, prospects and problems in West Bengal • Brief idea about sewage fed resources - present status, prospects and problems in West Bengal		
--	--	--	--

Class- XI

SUBJECT- FISHERIES SCIENCE /FISHERIES AND AQUACULTURE

COURSE CODE: PRACTICAL

CONTACT HOURS- 30

CONTACT HOURS- 30

TIME ALLOWED– 3 Hours

MAXIMUM MARKS - 30

EVALUATION SCHEME	MARKS
One major experiment Part- A (experiment no.- 1, 2, 3, 4, 5,6)	6
One minor experiment Part- A (experiment no.- 7,8,9)	5
Slide preparation Part- A (experiment no.- 10,11)	3
Spot identification (Part- B) (three)	6 (2X3)
Investigatory project (Part- C)+ Viva voce	5 (3+2)
Practical record + Viva voce	5 (3+2)

A. List of experiments:

1. Study and describe locally available common Indian major carp (any one specimen).
2. Study and describe locally available common Indian minor carp (any one specimen).
3. Study and describe locally available common exotic carps (any one specimen).
4. Study and describe locally available common air- breathing fishes (any one specimen).
5. Study and describe locally available crustacea (any one specimen).
6. Water quality parameter analysis (pH, turbidity, temperature)
7. Study and description of swim bladder of any common carp
8. Morphometry (General length, eye diameter, pectoral fin, pelvic fin, tail fin)
9. Study of locally available aquatic weed (any one)
10. Prepare a temporary mount to observe zooplankton/ phytoplankton available in pond water
11. Study of different types of fish scales (cycloid, ctenoid and placoid)

B. Study and observe the following (Spot identification)

1. Specimens/slides/models. Identify with reasons- prawn (*Macrobrachium* sp./ *Penaeus* sp.), Crab (*Scylla* sp.), gastropod (*Pila* sp.), Bivalve (*Pinctata* sp.), starfish, Cephalopod (Squid), Cartilaginous fish (Shark)
2. Virtual specimens/slides/models. Identifying features of – fish blood. Venous heart, structure of fish gill, anatomy of alimentary system.
3. Microscopic identification of zooplankton and phytoplankton (*Daphnia*, *Cyclops*, *Spirogyra*, *Oscillatoria*, *Volvox*)

C. Investigatory Project: (any one)

1. Nature study (visit to a local water body)
2. Enlistment of locally available aquatic organisms (Fish, crustaceans, gastropods, bivalves, aquatic weeds etc.).
3. Nutrient profiling (Chart preparation) of indigenous fishes, crustaceans, gastropods, bivalves etc.

Semester III

UNIT NO.	TOPICS	CONTACT HOURS	MARKS
Unit 7- Fish feed and feed management	<u>Chapter 1: Fish feed manufacturing</u> • Types of feed- live, Dry (pellets, flakes, powdered, micro-encapsulated, micro bound and micro-coated diet) and non-dry diets (Definition) • Storage and transportation of feeds • Quality problems- toxins (Aflatoxin) and pests (beetles and mites) <u>Chapter 2: Feed management</u> • Feeding strategies- feed ration, feed quantity estimation, feeding methods (check trays, demand feeders, automatic feeders, feed dispensers- definition only) • Feed storage: Hydro-stability of feed and their storage (brief concept) • Prevention of spoilage from rancidity <u>Chapter 3: Feed quality</u> • Feed conversion ratio, protein efficiency ratio, feed conversion efficiency, specific	40	16

	growth rate, average weight gain, gross growth coefficient (Definition only)		
Unit 8- Fish pathology and health management	<u>Chapter 4: Fin Fish Pathology</u> • Fungal disease- Saprolegniasis • Bacterial disease- Dropsy • Protozoan disease- white spot disease • Metazoans- Argulus • Viral disease- IPN (Causative agents, symptoms and prophylaxis) <u>Chapter 5: Shell Fish Pathology</u> • Black gill disease • Brown spot disease (Causative agents, symptoms and prophylaxis) <u>Chapter 6: Fish health management</u> • Defense system and mechanism in fish and shellfish: innate and acquired immunity • Application of vaccines and antibiotics in fish (Examples)	38	13
Unit 9- Fish behavior	<u>Chapter 7: Fish parental care</u> • Patterns of parental care- Fish species that build nests, fish species that do not build nests, viviparity, care for young (one example for each type) <u>Chapter 8: Fish migration</u> • Definition • Patterns of migration- anadromous, catadromous and amphidromous (definition and one example from each) • Causes of migration • Migratory species (example: Cod, Salmon, eel and ilisha)	12	6

Semester IV

UNIT NO.	TOPICS	CONTACT HOURS	MARKS
Unit 10- Aquarium fisheries	<u>Chapter 9: Aquarium design and construction</u> - Design and construction of domestic and commercial aquaria (freshwater and marine) - Aquarium accessories- aerators, filters (different types) and lighting - Water quality requirement <u>Chapter 10: Ornamental fishes</u> - Indigenous ornamental fishes (freshwater and marine) of West Bengal - Diagnostic features of <i>Carassius auratus</i> (Gold fish), <i>Pterophyllum scalare</i> (Angel fish), <i>Poecilia sphenopes</i> (Molly), <i>Betta sp.</i> (Fighter). - Economic Importance	15	10
Unit 11- Commercial fish management	<u>Chapter 11: Induced breeding of fishes</u> - Concept of induced breeding, captive breeding of carps - Methods of pituitary extract preparation, dosage determination and injection to the brood fishes. <u>Chapter 12: Rearing of larval and brood fishes</u> - Nursery tank - Rearing tank - Storage tank <u>Chapter 13: Fish By-products and Waste utilization</u> - Fish body oil - Fish liver oil - Fish meal - Fish gelatin - Fish manure	20	12

Unit 12- Fisheries Economics and Entrepreneurship	<u>Chapter 14: Fishing crafts and gear</u> • Types of fishing crafts in India (Fishing boats, trawlers, deep sea vessels, trollers, gill netters) • Types of fishing gear (nets, lines, traps, hooks, rope, floats, sinkers) • Fish finding devices (GPS navigator, Sonar, Remote sensing) <u>Chapter 15: Responsible Fisheries and Fisheries Legislation:</u> • Monsoon trawl ban, mesh size regulation, juvenile fishing, overfishing • Important Acts about fisheries in India (West Bengal Inland Fisheries Act 1984, West Bengal Marine Fishery Rules 1995, Coastal Aquaculture Authority Act 2005, Fisheries Act 2018) <u>Chapter 16: Entrepreneurship Development:</u> • Need, scope, characteristics, and types of entrepreneurships • Social responsibility and business ethics • Prospective of Aquaculture in Socio-economic impact and rural development of respective areas • Marketing strategies and storage • Financial management	23	13
--	--	-----------	-----------

Class- XII

SUBJECT- SUBJECT- FISHERIES SCIENCE /FISHERIES AND AQUACULTURE

COURSE CODE: PRACTICAL

CONTACT HOURS- 30

TIME ALLOWED– 3Hours

MAXIMUM MARKS - 30

EVALUATION SCHEME	MARKS
One major experiment Part- A (experiment no.- 1, 2, 3,4)	6
One minor experiment Part- A (experiment no.- 5,6,7,8)	5
Identification of fishing crafts and gears (Part B)	6 (3+3)
Field visit (Part- C) + Viva voce	8 (5+3)
Practical record + Viva voce	5(3+2)

A. List of experiments:

1. Set up of domestic aquarium
2. Bait preparation
3. Study and describe **any one** fish pathogen and its related disease. Comment on the symptoms of the disease.
4. Estimation of production cost/ Preparation of balance sheet for commercial aquarium
5. Describe **any one** fish migratory pattern (through picture)
6. Identifying characters of **any one** ornamental fish
7. Identifying characters of **any one** aquarium accessory
8. Identifying characters of **any one** fish feed

B. Identification of fishing crafts and gears (Models/pictures):

1. Net (Knot-less net/ gill net/hand net)
2. Fishing hook (Barbless/barbed)
3. Cage trap
4. Commercial fishing rope (any)
5. Deep sea vessels
6. Fishing boat
7. Trawlers

C. Field visit: (any one)

- a. Local fish market visit
- b. Visit to hatcheries/nurseries/fish culture units
- c. Visit to any ICAR institutes (CIFE/CIBA/CIFRI/BWTC etc.)
- d. Visit to aquarium fish culture units