West Bengal State University

DRAFT

SYLLABUS FOR THREE-YEAR B.Sc. DEGREE COURSE IN INDUSTRIAL FISH & FISHERIES UNDER CHOICE BASED CREDIT SYSTEM (CBCS)

(With effect from the session 2018-2019)

UG-CBCS SYLLABUS

IN

INDUSTRIAL FISH AND FISHERIES (Hons)

WEST BENGAL STATE UNIVERSITY

A. Number of courses:

Types of course	Core course (CC)	Elective course		Ability enhancement course		TOTAL
		Discipline specific elective course (DSE)	Generic elective course(GE)	Ability Enhancement compulsory course (AECC)	Skill Enhancement course (SEC)	
No. of course	14	4	4	2	2	26
Credit/course	6	6	6	2	2	140

TABLE-1: DETAILS OF COURSES & CREDIT UNDER CBCS

S. No.	Particulars of Course	Credit Point
1.	**Core Course: 14 papers**	**Theory + Practical**
1.A.	Core Course: Theoretical (14 papers)	14x4 = 56
1.B.	Core Course (Practical) (14 papers)	14x2 = 28
2.	**Elective Courses: 8 papers**	
2.A.	A. Discipline specific Elective(DSE): Theoretical (4 papers)	4x4 = 16
2.B.	DSE (Practical) (4 papers)	4x2 =8
2C.	General Elective(GE) (Interdisciplinary): Theoretical (4 papers)	4x4 = 16
2.D.	GE (Practical) (4 papers)	4x2 =8
3. Ability Enhancement Courses		
A.	AECC (2 papers of 2 credits each) ENVS, English Communication/MIL	2x2 = 4
B.	Skill Enhancement Course (SEC) (2 papers of 2 credits each)	2x2 = 4
	Total Credit:	**140**

TABLE-2: SEMESTERWISE DISTRIBUTION OF COURSE & CREDITS IN B.SC. in Industrial Fish and Fisheries (Hons)

Courses/ (Credits)	Sem-I	Sem-II	Sem-III	Sem-IV	Sem-V	Sem-VI	Total No. of Courses	Total credit
CC (6)	2	2	3	3	2	2	14	84
DSE (6)	--	--	--	--	2	2	04	24
GE (6)	1	1	1	1	--	--	04	24
AECC (2)	1	1			--	--	02	04
SEC (2)	--	--	1	1	--	--	02	04
Total No. of Course/ Sem.	4	4	5	5	4	4	26	--
Total Credit /Semester	**20**	**20**	**26**	**26**	**24**	**24**	------	**140**

❖ **COURSE CODE & COURSE TITLE:**

A. Core courses (CC)

CC1	Taxonomy of Aquatic organism + Lab.	4+2
CC2	Biology of Fish + Lab.	4+2
CC3	Fresh water Aquaculture and Aquatic Ecology + Lab.	4+2
CC4	Brackish Water Aquaculture and Mariculture + Lab.	4+2
CC5	Marine and Inland Water Fishery + Lab.	4+2
CC6	Aquaculture Nutrition + Lab.	4+2
CC7	Post-harvest Technology and Quality Control + Lab	4+2
CC8	Biostatistics and Computer Application + Lab.	4+2
CC9	Biological Tools and Techniques + Lab.	4+2
CC10	Ornamental Fish Culture + Lab.	4+2
CC11	Fishery Microbiology and Fish Pathology + Lab.	4+2
CC12	Fish Genetics and Biotechnology + Lab.	4+2
CC13	Fishery Economics and Extension + Market Survey Report	4+2
CC14	Entrepreneurship development + On Job Training	4+2

B. Discipline specific elective courses (DSE)

SEMERTER V DSE (any two)	i) Fish Feed Preparation and Quality Control + Lab. ii) Hatchery Technology + Lab. iii) Ornamental Fish Production and Management + Lab	4+2 4+2 4+2
SEMERTER VI DSE (any two)	iv) Fish By products and Waste Utilization + Lab v) Culture of live fish food organisms + Lab vi) Aquaculture Engineering + Lab	4+2 4+2 4+2

C. Generic elective courses (GE) [for the students of other discipline]: NIL

D. Ability enhancement compulsory courses (AECC)

AECC1	Environmental Sciences	2
AECC2	English/MIL Communication	2

E. Skill enhancement courses (SEC)

SEC1 (any one)	i) Soil and Water Quality Assessment ii) Value added Fishery Product	2
SEC2 (any one)	i) Aquarium Construction and Management ii) Ornamental Fish Breeding	2

TABLE-3: SEMESTER & COURSEWISE CREDIT DISTRIBUTION IN B.SC. (Hons.) in Industrial Fish and Fisheries

(6 Credit: 75 Marks)

SEMESTER-I			
Course Code	**Course Title**	**Course wise Class (L+P)**	**Credit**
IFFACOR01T IFFACOR01P	Taxonomy of Aquatic organism + Lab.	60 30	4 2
IFFACOR02T IFFACOR02P	Biology of Fish + Lab.	60 30	4 2
GE1		60 60	4 2
AECC-1	Environmental Sciences	30	2
Total	**4 courses**	**300**	**20**
SEMESTER-II			
Course Code	**Course Title**	**Course wise Class**	**Credit**
IFFACOR03T IFFACOR03P	Fresh water Aquaculture and Aquatic Ecology + Lab.	60 30	4 2
IFFACOR04T IFFACOR04P	Brackish Water Aquaculture and Mariculture + Lab.	60 30	4 2
GE2		60 60	4 2
AECC-2	English/MIL Communication	30	2
Total	**4 courses**	**300**	**20**
SEMESTER-III			
Course Code	**Course Title**	**Course wise Class**	**Credit**
IFFACOR05T IFFACOR05P	Marine and Inland Water Fishery + Lab.	60 30	4 2
IFFACOR06T IFFACOR06P	Aquaculture Nutrition & Biochemistry + Lab.	60 30	4 2
IFFACOR07T IFFACOR07P	Post-harvest Technology and Quality Control + Lab	60 30	4 2
GE3		60 60	4 2
IFFASEC01	Value added Fishery Product **or** Soil and Water Quality Assessment	30	2
Total	**5 courses**	**420**	**26**
SEMESTER-IV			
Course Code	**Course Title**	**Course wise Class**	**Credit**
IFFACOR08T IFFACOR08P	Biostatistics and Computer Application + Lab.	60 30	4 2
IFFACOR09T IFFACOR09P	Biological Tools and Techniques + Lab.	60 30	4 2
IFFACOR10T IFFACOR10P	Ornamental Fish Culture + Lab.	60 30	4 2
GE4		60 60	4 2
IFFASEC02	Aquarium Construction and Management or Ornamental Fish Breeding	30	2
Total	**5 courses**	**420**	**26**
SEMESTER-V			
Course Code	**Course Title**	**Course wise Class**	**Credit**
IFFACOR11T IFFACOR11P	Fishery Microbiology and Fish Pathology + Lab.	60 30	4 2
IFFACOR12T IFFACOR12P	Fish Genetics and Biotechnology + Lab.	60 30	4 2

IFFADSE01T IFFADSE01P	Fish Feed Preparation and Quality Control + Lab.	60 30	4 2
IFFADSE02T IFFADSE02P	Hatchery Technology + Lab.	60 30	4 2
IFFADSE03T IFFADSE03P	Ornamental Fish Production and Management +Lab	60 30	4 2
Total	**4 courses**	**360**	**24**
SEMESTER-VI			
Course Code	**Course Title**	**Course wise Class**	**Credit**
IFFACOR13T IFFACOR13P	Fishery Economics and Extension + Market Survey Report	60 30	4 2
IFFACOR14T IFFACOR14P	Entrepreneurship development + On Job Training	60 30	4 2
IFFADSE04T IFFADSE04P	Fish By products and Waste Utilization + Lab	60 30	4 2
IFFADSE05T IFFADSE05P	Culture of live fish food organisms + Lab	60 30	4 2
IFFADSE06T IFFADSE06P	Aquaculture Engineering + Lab	60 30	4 2
Total	**4 courses**	**270**	**24**
Total (All semesters)	***26 courses***	***2070***	***140***

COURSE TYPE

Course Type	Course Name	Credits
CC1	Taxonomy of Aquatic organism + Lab.	4+2
CC2	Biology of Fish + Lab.	4+2
CC3	Fresh water Aquaculture and Aquatic Ecology + Lab.	4+2
CC4	Brackish Water Aquaculture and Mariculture + Lab.	4+2
CC5	Marine and Inland Water Fishery + Lab.	4+2
CC6	Aquaculture Nutrition + Lab.	4+2
CC7	Post-harvest Technology and Quality Control + Lab	4+2
CC8	Biostatistics and Computer Application + Lab.	4+2
CC9	Biological Tools and Techniques + Lab.	4+2
CC10	Ornamental Fish Culture + Lab.	4+2
CC11	Fishery Microbiology and Fish Pathology + Lab.	4+2
CC12	Fish Genetics and Biotechnology + Lab.	4+2
CC13	Fishery Economics and Extension + Market Survey Report	4+2
CC14	Entrepreneurship development + On Job Training	4+2
DSE (any two)	i) Fish Feed Preparation and Quality Control + Lab. ii) Hatchery Technology + Lab. iii) Ornamental Fish Production and Management + Lab.	4+2 4+2 4+2
DSE (any two)	iv) Fish By products and Waste Utilization + Lab v) Culture of live fish food organisms + Lab vi) Aquaculture Engineering + Lab	4+2 4+2 4+2
GE1		4+2
GE2		4+2
GE3		4+2
GE4		4+2
SEC1 (any one)	i) Soil and Water Quality Assessment ii) Value added Fishery Product	2
SEC2 (any one)	i) Aquarium Construction and Management ii) Ornamental Fish Breeding	2
AECC1		2
AECC2		2

SEMESTER I

IFFACOR01T : Taxonomy of Aquatic organism

Module – 1 : **Introduction to Taxonomy (10 hours)**

Importance of Taxonomy- Kinds of classification- Phenetic, natural, cladistics, and evolutionary classification. Zoological Nomenclature - International Code of Zoological Nomenclature; Typification, type and its kinds - primary types: - Allotype, Holotype, Lectotype, Paratype and Syntype.

Module – 2 : **Taxonomy of Fish (20 hours)**

Basic methods used in taxonomic studies -Morphometric, Meristic, Descriptive, Karyotypes and biochemical characteristics. General and outline classification of elasmobranchs and teleosts up to orders with examples.

Module - 3 : **Taxonomy of Crustacea (15 hours)**

Classification of major crustaceans upto orders; Species of Decapod crustaceans; External features used for Taxonomic Identification of *Macrobrachium rosenbergii*, *Penaeus monodon*, *Scylla serrata* and Lobster.

Module – 4: **Taxonomy of Mollusca (15 hours)**

Classification of phylum Mollusca upto orders. General features of gastropods, bivalves and cephalopods. Taxonomic features of mussels, oyster, clams and scallops.

IFFACOR01P: Taxonomy of Aquatic organism Lab (30 hours)

1. Dichotomous Key Identification of selected commercial inland and marine species [IMC, Silver carp, Grass carp, common carp.]
2. Identification of fry & fingerling stages of IMC & Bhetki.
3. Identification of larval stages of crustaceans and molluscs. (Nauplius, Mysis, Zoea, Megalopa, Glochidium, Trochophore)
4. Morphometric, meristic and descriptive study of IMC, Silver carp , *Mystus*, Tilapia

IFFACOR02T : Biology of Fish

Module – 1 : Food and Feeding (15 hrs)

Food and Feeding habit of fish- herbivores, carnivores and omnivores. Macrophagous, Microphagous, Benthophagous and Planktivore feeding adaptations. General morphology of alimentary system of herbivorous, carnivorous and omnivorous fishes. Process of digestion in fish and prawn.

Module – 2 : **Circulation and Respiration (15 hrs)**

Respiratory system- General description of respiratory organs in fish (type – shark and *Labeo*) Aquatic respiration, respiratory gases & gaseous exchanges. Adaptation of air breathing fishes. Respiration in prawns and fresh water mussels. Cardiovascular system – general features of heart, circulatory system and oxygen transport in fishes (type – shark and *Labeo*), crustacean (*Penaeus monodon*) and molluscs (type- freshwater mussel).

Module – 3 : Reproduction and Endocrinology (15 hrs)

Structure of ovary and testis in fish. Sexual dimorphism in fishes and crustaceans (prawns & mud crab). Maturity stages and spawning in fishes, Factors affecting spawning in fish. Oviparous, viviparous and ovo-viviparous fishes, Types of eggs in fishes, parental care and breeding. Endocrine organs in fishes and crustaceans (prawn). Role of hormones in reproduction of fishes and crustaceans (prawn). Induced breeding of fish. Diurnal, lunar, Circadian and tidal rhythm. Migration in fishes, homing instinct and orientation,

Module – 4 : **Excretion, Osmoregulation and Sense organs (15 hrs)**

Structure of teleostean kidney, Kidney function in marine and fresh water teleosts. Osmoregulation in freshwater teleosts, marine teleost and elasmobranches. Sense organs in fishes – Organ of smell, taste buds, lateral line system, ampullae of Lorenzini. Sound production in fishes. Specialized organ in fishes- electric organ, poison gland; coloration and bioluminescence. Buoyancy in fishes – swim bladder and mechanism of gas secretion.

IFFACOR02P: Biology of Fish Lab (30 hrs)

1. Sampling and Gut Content Analysis of fish (Points method and Occurrence method)
2. Identification of scale types (Cycloid, Ctenoid, Placoid) and fins of fish
3. Dissection - Alimentary canal of fish (Tilapia)
4. Dissection-Urinogenital system of fish (Tilapia)
5. Fecundity estimation in fish (Tilapia & Bata)
6. Estimation of gonado-somatic index & determination (Tilapia & Bata)
7. Visit to fish landing centre and Report submission

SEMESTER II

IFFACOR03T : Fresh water Aquaculture and Aquatic Ecology

Module 1 : Freshwater Fish Culture (10 hrs)

Various freshwater organisms used for aquaculture in India. Culture of carps-Nursery rearing and stocking ponds – composite fish culture, Preparation of ponds– different methods for the eradication of weed fishes, predators, aquatic insects and aquatic weeds, stocking and post stocking management, harvesting. Culture of air breathing fishes- *Channa*, catfishes, Anabas. Culture of cold water fishes in India.

Module –2 : Culture of prawn and molluscs (10 hrs)

Cultivable species of freshwater prawn, Biology and culture of *Macrobrachium rosenbergii*. Fresh water pearl culture, Present status of pearl culture in India and its prospects.

Module – 3 : Systems of Aquaculture (10 hrs)

Criteria for the selection of site and species for fresh water aquaculture. Fish culture in ponds, cages, pens, raceways indoor tanks. Monoculture, polyculture, composite fish culture, Sewage fed fish culture. Integrated fish farming.

Module –4: Aquatic Ecosystem (10 hrs)

Types of fresh water ecosystem – lotic and lentic. Working of an ecosystem- energy flow, Productivity of water bodies. Primary, secondary, tertiary factors affecting primary production. Significance of toxic substances to the food web, Bioconcentration, Biomagnification, Eutrophication, aquatic pollution.

Module – 5 : Pond ecology (5 hrs)

Introduction, Types of pond, Zones of freshwater pond, Abiotic and biotic components of the pond ecosystem, fundamentals of pond ecology- habitats in the pond community, food webs and food chain, ecological make up of a pond.

Module – 6 : Riverine ecology (5 hrs)

Introduction, characteristics of lotic habitat, adaptation of lotic animals, river zonation, major river systems in India, Ganga river system – threats and management, problems encountered in fisheries development of major rivers.

Module –7 : Lacustrine and reservoir ecology (10 hrs)

Introduction , Classification of lakes, zonation of lakes, stratification of lakes, biological communities of lake, major lakes and reservoirs in India., problems encountered in fisheries development.

IFFACOR03P : Fresh water Aquaculture and Aquatic Ecology Lab (30 hrs)

1. Water and soil quality management (pH, Temperature, Transparency, DO, CO_2, Alkalinity, Hardness, Organic carbon)
2. Identification of cultivable freshwater species (*Labeo rohita, L. bata, L. calbasu, Cirrhinus mrigala, Catla catla, Hypophthalmichthys molitrix, Clarias batrachus, Ctenopharyngodon idella, Cyprinus carpio, Tor tor*)
3. Microscopic identification of phytoplanktons (5 nos) and zooplanktons (5Nos) from pond water.
4. Fish Farm Visit and report submission

IFFACOR04T : Coastal Aquaculture and Mariculture

Module 1: Introduction (15 hrs)

Brackish water as a medium for aquaculture and present status of brackish water farming in India. Ecological factors – abiotic and biotic factors. Selection of site, general planning and design of brackish water farms. Characteristics of marine habitat, hydrological cycle, Zonation of marine habitat, coral reefs- importance and threats, classification of estuaries, major estuaries, ecology of estuarine and brackish water system, issues and challenges of managements of brackish water systems, problems encountered in fisheries development of major estuaries.

Module 2: Brackish water Finfish Culture(10 hrs)

Cultivable species in brackish water systems. Culture practices – monoculture and polyculture of *Chanos chanos, Mugil cephalus, Etroplus suratensis*. Nursery, rearing and grow out in ponds, cages and pens.

Module 3: Shell fish Culture (10 hrs)

Species of shrimps cultured in brackish water – *Penaeus mondon, Penaeus indicus, Penaeus vannamei.* Extensive, semi-intensive and intensive shrimp farming practices. Species of crabs cultured and culture techniques, prospects in India.

Module 4: Mariculture (10 hrs)

Open sea farming – scope and species cultured. Selection of site for sea farming. Different designs of open sea farming structures – construction of cages – bioengineering problems and solutions. Sea bass, Cobia culture. Species of lobsters, culture, problems and prospects in India; lobster fattening.

Module 5: Molluscans, Echinoderms and Seaweed Culture (15 hrs)

Molluscan culture – species of edible oysters, mussels and clams cultured. Important species of pearl oysters and methods of artificial pearl production. Importance of Echinoderms and species cultured. Culture of seaweeds, common cultivable species, culture techniques and harvesting. Important seaweed products.

IFFACOR04P : Coastal Aquaculture and Mariculture Lab (30 hrs)

1.Identification of cultivable marine and brackish water finfish (*Lates calcarifer, Etroplus sp., Chanos chanos, Liza parsia, Scoliodon sp., Dasyatis sp.)* and shellfish (*Penaeus mondon, Penaeus indicus, Sepia sp.)*.

2. Identification of cultivable seaweeds.

3. Designing of different farming systems – cages, pens, rafts and racks; Visit to coastal aqaufarms.

SEMESTER III

IFFACOR05T: Inland and Marine Fishery

Module 1: Riverine and Coldwater Fisheries (10 Hrs.)

Inland fish production in India- Riverine fisheries – major river systems in India, capture fisheries, fishing methods, recent statistics of catches, problems encountered in fisheries development of major rivers. Cold water fisheries- major rivers and uphill lakes and species – problems encountered and management in fisheries development of rivers and lakes supporting cold water fisheries.

Module 2: Reservoir and Estuarine Fisheries (10 Hrs.)

Reservoir fisheries- Major reservoirs in India- capture fisheries, fishing methods, recent statistics of catches, problems encountered in fisheries development. Estuarine fisheries- definition and classification of estuaries- capture fisheries resident and migrant species, fishing methods, recent statistics of catches, problems encountered in fisheries development of major estuaries. Backwater fishery resources of India and its potential.

Module 3: Marine Fisheries- Pelagic Resources (10 Hrs.)

Marine fishery resources in India- important fishing zones including Wadge bank, maritime states. Major pelagic resource groups– sardines, mackerel, anchovies, ribbon fishes, tuna, Bombay duck, seer fishes. Methods of fishing - Recent catch statistics of pelagic fisheries.

Module 4: Marine Fisheries- Demersal Resources (10 Hrs.)

Major demersal resource groups- elasmobranchs, cephalopods, silver bellies, flat fishes, crabs, sciaenids, pomfrets, prawns, lobsters, molluscan resources. Methods of fishing, recent catch statistics. Fishery of mud banks.

Module 5: Marine Fisheries - Deep Sea Resources (10 Hrs.)

Major deep sea resources - fishes, shrimps, lobsters – status of deep sea fishing in India. Chartered fishing in India- policies and problems. Marine fish production in India - Estimated fishery resources – inshore – offshore - deep sea resource.

Module 6: Fishery Assessment and Regulations (10 Hrs.)

Stratified random sampling for estimation of fish landing. Over fishing – Economic and biological. Conservation and regulation of fishing pressure - closed season, sanctuaries. Important fishing regulations KMFRA, Deep Sea fishing Policy.

IFFACOR05P : Inland and Marine Fishery Lab. Credit (30 hrs)

1. Analysis of water quality (pH, salinity, phosphate, nitrate).
2. Analysis of species composition of commercial catches at landing and assembling centres, sampling and familiarization of commercially important groups.
3. Observations and experimental operations of selected fishing gears in inland / estuarine waters.
4. Maintenance of records on catch data- field study.

IFFACOR06T: Aquaculture Nutrition & Biochemistry

Module 1. Nutrient requirement of fish & Feed ingredients (10 Hours)

Principles of fish nutrition. Basic structure, classification and general features of protein, carbohydrates and lipids. Role of nutrients: Proteins and amino acids, fatty acids and lipids, carbohydrates, vitamins and minerals. Non-protein nitrogen sources. Role of natural food in fish nutrition. Feed additives - Pigments, immunostimulants, Chemo-attractants, Feed stimulants, Growth promoters, Preservatives; anti-nutritional factors. Criteria for the selection of ingredients for feed preparation. Different feed ingredients- animal, plant, microbial in origin, Fish meal, SCP, silages, fermented products. Storage, quality standards, proximate composition and chemical evaluation.

Module 2. Fish Feed and feed manufacturing (10 Hours)

Types of feed: Dry (pellets, flakes, powdered, micro-encapsulated, microbound and micro-coated diets, Particle assisted rotationally agglomerated microparticulate diet (PARA); Marumerized extruded microparticulate diet (MEM); nano diets, non-dry. Feed formulation methods - Pearson's method, quadratic equation, linear programming; limitations. Feed manufacturing equipments and processes: Pulverizer, grinder, mixer, pelletizer, crumbler, drier, Extruder/ Expander, Vacuum coater, fat sprayer. Different size and grades of fish / shrimp feeds – starter, grower and finisher feeds. Storage and transportation of feeds. Quality problems- toxins, pests, rancidity.

Module 3. Feed management (10 Hours)

Practical feeding in grow-out of fishes and shrimps. Feeding strategies - Feed ration, feed quantity estimation, feeding frequency and feeding methods (Check trays, demand feeders, automatic feeders, feed dispensers). Farm made feeds, factory made shrimp and fish feeds in India. Feed storage: Hydro-stability of feed and their storage; Prevention of spoilage from rancidity, fungus and associated toxins.

Module 4. Feed quality (10 Hours)

Feed energetics, feed conversion ratio, protein efficiency ratio, feed conversion efficiency, net protein utilization, specific growth rate, average weight gain, gross growth coefficient, average daily gain, survival rate. EAAI, chemical score, biological value. Physical properties of feed: Leaching, water stability, bulk density, water absorption, expansion ratio, sinking velocity. Aquafeed industries in India. Factors affecting digestibility. Quality standards.

Module 5. Larval nutrition (10 Hours)

Quality requirements of larval feeds (particle size and digestibility), Bacterioplankton, phytoplankton and zooplankton and their role in larval nutrition. Bio-enrichment, biofilm /periphyton and its uses. Culture of single cell proteins and their nutritional quality, culture of important microalgae, rotifers, artemia, cladocerans, copepods, oligochaetes, nematodes and insect larvae.

Module 6. Biochemistry (10 Hours)

General Introduction for importance of Biochemistry in Fisheries & Food Technology, Carbohydrates (Basic structure & classification, general features), Proteins (Basic structure & classification, general features) & Amino acids, Lipids (Basic structure & classification, general features), Enzymes (Classification, Mode of Action, Factors controlling enzymatic action, Michelis – Menten Equation)

IFFACOR06P : Aquaculture Nutrition & Biochemistry Lab (30 hrs)

1. Identification of feed ingredients
2. Processing of feed ingredients
3. Feed additives
4. Feed formulation and preparation
5. Determination of sinking rate and water stability of feeds.
6. Determination of proximate composition of feed
7. Estimation of physical properties of feed: Bulk density, water absorption, expansion ratio, sinking velocity.
8. Extraction & Analysis techniques of Carbohydrates, Proteins & Lipids.
9. Live feed culture.

IFFACOR07T: Post-harvest Technology and Quality Control

Module 1: Fishing Crafts (10 Hrs.)

Different types of fishing crafts in India- inland and marine – traditional, motorized and mechanized, trawlers, gill netters, purse seiners, long liners, trollers, deep sea vessels. Boat building materials – Wood, FRP, Cement, Steel and its advantages & disadvantages. Wood preservation techniques. Basic terminology related to boat design, Lines plan. Otter boards & its type

Module 2: Fishing Gears (10 Hrs.)

Traditional and modern fishing gears ; Fishing gear materials - natural and synthetic, yarn numbering systems, types of knots, knotless netting, meshes, braiding, shaping, creasing, baiting, fly-meshing, tailoring; Mounting of webbing – different methods, hanging coefficient, take up ratio; Modern commercial fishing methods- Operation and classification of trawling, purse seining, lampara net fishing, gill netting, line fishing. Squid jigging. Fishing accessories-hooks, floats, sinkers and ropes.

Module 3: Responsible Fisheries and Fisheries Legislation (5 Hrs)

Concept of Responsible Fisheries; Monsoon trawl ban, closed season, mesh size regulations, juvenile fishing, Exclusive Economic Zone (EEZ), Coastal Regulation Zone (CRZ), Integrated Coastal Zone Management (ICZM). MSY, MEY, Over fishing, Recruitment over fishing, Aquaranching. Indian fisheries Act.1976. Coast Guard Act.1978, Maritime zones of India Act. 1981

Module 4: Seafood Spoilage (5 hrs)

Proximate composition of seafood. Spoilage pattern of seafood. Spoilage indices. Onboard handling of seafood. Importance of hygiene and sanitation in fish handling. Quality of water and ice in fish handling and processing. Different types of ice used in the seafood industry and their merits.

Module 5: Common Seafood Preservation Techniques (10 Hrs)

Principles of smoking, drying and salting of fish, Traditional drying / curing methods. Different types of drying. Spoilage of dried products. Different types of smoking: Cold, hot smoking, electrostatic smoking. Spoilage of smoked products. Principle of fermentations: fermented products. Fundamental principles involved in chilling and freezing of fish and fishery products. Thermal processing (Cooking, Sous-vide, Canning), Principles involved in canning of fish. Retortable pouch processing. Spoilage of canned products. Principles of freeze drying. AFD and its merits. Introduction to extrusion technology.

Module 6: Non-thermal Food Processing Techniques, Storage and Packaging (10 Hrs)

Principles and advantages of high pressure processing, Ultrasound food processing, Pulsed electric filed processing, Pulsed light technology, microwave processing, Irradiation. Different types of cold storages. Functions of packing. Different types of packing materials.

Module 7: Quality Assurance and Export of Fishery Products (10 Hrs)

Quality control – basic concepts, quality and quality control. Sanitation procedures in seafood processing plants. Waste management in fish processing industries. Risk factors in seafood biotoxins, seafood pathogens, endogenous parasites. Methods of evaluating fish freshness and quality or ganoleptic, physical, chemical, microbiological and instrumental methods. Quality control programmes - pre-shipment inspection, IPQC, MIPQC, HACCP and ISO Series in seafood industry. Quality standards in India and major importing countries like USA, Japan and EU. Export of fishery products from India – major countries, important products, export documents and procedures. Traceability, Quality certifications, Ecolabelling.

IFFACOR07P : Post-harvest Technology and Quality Control Lab (30 hrs)

1. Identification of traditional & modern fishing gears – Using FAO catalogue.
2. Fishing accessories (floats, ropes, sinkers, swivels, shackles, fishing rods).
3. Identification of synthetic and natural fibres.
4. Different types of hooks and baits.
5. Determination of moisture content in fish and fishery products.
6. Calculation of ice for chilling fishes.
7. Filleting of fish.
8. Drying of fish. Organoleptic analysis of canned product.
9. Visit to Fish Processing center.

SEC1 (any one)

IFFASEC01: **Value added Fishery Product**

Different types of value added products from fish and shell fish. Advantage of value addition. Significance of value addition in the sea food industry. Fish mince based products. Preparation of coated fishery products - different types of batter and breading and it's application. Quality evaluation. Preparation of products of fish/ prawn pickle, prawn chutney powder, fish soup powder, fish fillets, fish curry, fish cutlet, marinated products.

IFFASEC01: Soil and Water Quality Assessment

Soil and water interaction: Physical and chemical properties of soil and water, Productivity vs nutrient quality and quantity of soil and water; aquatic microorganisms and their role in carbon, nitrogen, phosphorus and sulphur cycles and impact on aquatic habitats and species.
Soil and water quality monitoring: soil and water quality standards; soil and water quality monitoring and management. Water quality parameters and their interaction- physical and chemical characteristics - turbidity, color – temperature - chemical constituents, taste, color, acidity, alkalinity - CO_2, hardness, pH – Methods of testing.

SEMESTER IV

IFFACOR08T: Biostatistics and Computer Application

Module 1: Basic Statistics (15 Hrs)

Origin, growth, meaning, definition and use of statistics. Methods of data collection. Biological data collection. Sampling methods. Biological sampling. Classification and tabulation; Diagrammatic and graphical representation of data.

Permutation and combination. Basics of Probability. Chi-square test, t-test, f-test, Z- test. Analysis of Variance (Basics). Measures of Central tendency and dispersion. Application of regression and correlation. Applications of linear regression in fisheries. Length weight relationship in fishes; Methodology for estimation of marine fish landings in India.

Module- 2: Computer – basic. (15 hrs)

Computer organization- input – output devices, Binary system, operating system, types of programming languages (Machine languages, Assembly languages, high level languages. Data organization, Drives, Files, Directories. Types of Memory (primary and secondary), RAM, ROM, PROM, EPROM. Secondary storage devices (FD, CD, HD, Pen drive) I/O Devices (Scanner, Plotters, Plasma Display) Numbering system and introduction to Binary, Microprocessor.

Module3 : Office Applications (15 hours)

Office application software; Word Processors; Spreadsheet; Presentation; Data Base Management; SQL.

Module 4: Web Development and programming (15 hours)
Introduction to the World Wide Web; Basics of web development using HTM L; Creation of email accounts; Application of Search Engines.

IFFACOR08P : Biostatistics and Computer Application Lab. (30 hrs)
1. Formatting a document using word, use of mail merge
2. Use of internet to collect fisheries data - FAO, NACA, ICLARM.
3. Graphical representation and tabulation
4. Calculation of mean, median and mode.
5. Standard deviation, Mean deviation and Quartile deviation
6. Length weight relationship studies in fishes.

IFFACOR09T : Biological Tools and Techniques

Module 1. Microscopy (15 Hrs)
Simple Microscope; Compound Microscope; Phase-Contrast Microscope; Transmission Electron Microscope; Scanning Electron Microscope; Fluorescent Microscope; Microphotography; Micrometry

Module 2. Chromatography (15 Hr)
Chromatographic techniques- Paper Chromatography, Thin layer chromatography, Ion exchange chromatography, gel filtration chromatography, gas chromatography, HPLC.

Module 3.Electrophoresis (15 hrs.)
Principle of electrophoresis, types gel electrophoresis, SDS-PAGE. Centrifugation - Types of centrifugation – differential and density gradient.

Module 4. Histology (15 Hrs.)
Histochemical and histological preparation of fish tissue. Fixation and fixatives, Temporary and Whole mount, Specimen preparation for TEM and SEM.

IFFACOR09P : Biological Tools and Techniques Lab (30 hrs)
1. Microtomy and staining of fish tissue- Liver, Kidney, Ovary, Testes, Stomach and Intestine.
2. Pituitary extract preparation.
3. Electrophoresis/paper chromatography (Demonstration).

IFFACOR10T : Ornamental Fish Culture

Module 1: Aquarium design and Construction (10 Hrs)
Introduction to aquarium. World aquarium trade and present status. Design and construction of home and public aquaria (freshwater and marine), oceanarium. Aquarium accessories - Aerators, filters (different types) and lighting. Water quality requirements.

Module 2: Aquarium Management (10 Hrs)
Setting up of aquarium – under gravel filter, pebbles, plants, drift wood, ornamental objects and selection of fishes, Quarantine measures. Aquarium maintenance and water quality management for fresh water and marine aquariums. Control of snail and algal growth. Handling, care, packing and transportation of fishes - Use of anaesthetics. Temperature acclimation.

Module 3: Freshwater Ornamental Fishes (10 Hrs)
Species of ornamental fishes - their taxonomy and biology- Live bearers, Gold fish and Koi, Gourami, Barbs and Tetras, angel fish, cichlids. Maturation, secondary sexual characters, breeding habits, spawning, parental care, fertilization and development of eggs. Hatching, larval rearing and their health. Freshwater plants – their taxonomy and morphology.

Module 4: Commercial Production (10 Hrs)
Commercial production of goldfish, live bearers, gouramies, barbs and tetras, angel fish. Natural ponds for the mass production of ornamental fishes. Multiplication of aquarium plants – different methods. Indigenous ornamental fishes of West Bengal.

Module 5: Marine Ornamental Fishes (10 Hrs)

Marine ornamental fishes – varieties and their habitat. Major marine ornamental fish resources of India. Method of collection of live fish. Breeding of marine ornamental fishes (clown fishes and Damsel fishes). Reef aquarium and live rocks. Other ornamental organisms – anemones, worms, lobsters, shrimps, octopus, starfish.

Module 6: Nutrition and Disease (10 Hrs)

Nutritional requirements of aquarium fishes. Different kinds of feeds. Culture of fish food organisms, Preparation of dry feeds, Feeding methods. Use of pigments for colour enhancement. Larval feeds and feeding. Provision of nutrients and optimum environmental conditions for their growth. Common diseases of ornamental fishes and their control and prophylaxis – itch disease, tail and fin rot, dropsy, Trichodiniasis, Argulosis, Gyrodactylosis, Dactylogyrosis, gas bubble disease.

IFFACOR10P : Ornamental Fish Culture Lab (30 hrs)

1. Fresh water Ornamental fishes (Exotic-Goldfish, Angel, Tiger barb, Sword tail, Fighter fish, Oscar. Indigenous- Dwarf Gourami, Indian glass fish, Zebra Danio, Y loach, Peacock eel, Rosy barb)
2. Aquarium accessories (Aerators/filters/decors/feeding equipments/heaters/pumps/lights)
3. Aquarium plants (6 species)
4. Aquarium setting (Freshwater)

SEC2 (any one)

IFFASEC02: Aquarium Construction and Management

Ornamental fish culture as hobby. Design and construction of different types of aquarium, frameless tank. Selection of suitable species, species combination. Water quality management and maintenance of aquarium. Use of aerators, filters, heater and thermometer etc. Aquarium plants and their propagation.

IFFASEC02: Ornamental Fish Breeding

Breeding and rearing of ornamental fishes. Brood stock management. Management practices of ornamental fish farm. Common diseases and their control. Conditioning, packing, transport and quarantine method. Trade regulation and wild act in relation to ornamental fishes.

SEMESTER V

IFFACOR11T : Fishery Microbiology and Fish Pathology

Module 1: Introduction & Structure of microbes (5 Hrs.)

General characteristics of bacteria, fungi, viruses, algae and protozoans. Structure and function of bacterial cell wall, plasma membrane, capsule, flagella and endospore. Structure of fungi and yeast cell. Structure of virus.

Module 2: Isolation and culture of microbes. (5 Hrs.)

Prokaryotic growth – characteristic features of bacterial growth curve – Effect of environmental factors on growth. Nutrition and growth of bacteria – different types of media for isolation of bacteria and fungi. Isolation and culture of bacteria and fungi from water and sediment. Different culture techniques.

Module 3: Aquatic and fish microbiology (5 Hrs.)

Microflora of aquatic environment. Autotrophic and heterotrophic microorganisms in aquatic environment. Nutrient regeneration, role of microbes in biogeochemical cycles – Carbon, Nitrogen, Phosphorus and Sulphur cycles.

Health significant bacteria in culture ponds. Culture characteristics and epidemiology of E. coli.

Perishability of seafood – Microbial spoilage of fish and shell fish. Spoilage microflora. Intrinsic and extrinsic factors affecting spoilage. Microflora associated with body parts. Food borne pathogens. Sources of contamination.

Module 4. Pathology and Fish Parasitology (5 hours)

Pathogenic Vibrios, *Salmonella*, *Aeromonas hydrophila*, and *Pseudomonas*. Common bacterial diseases of fin fishes - Enteric red mouth disease, Epizootic ulcerative syndrome, Bacterial cold water disease, Furunculosis, Vibriosis, dropsy, gill disease. Bacterial diseases of shellfish - Vibriosis, Hepatopancreatitis, Mycobacteriosis. Bacterial luminescent disease and Bacterial filamentous disease. Diagnosis and treatment protocols. Management of culture

systems. Disease and environment. Stress as a factor in diseases. Parasitism- host parasite relationship.

Module 5. Bacterial, Fungal ,Viral, Protozoan and Metazoan diseases (20 hours)

Bacterial diseases- infectious abdominal dropsy, tail and fin rot. Fungal diseases- Saprolegniasis, Branchiomycosis, Ichthyophonus disease, Laginedium disease, Fusarium disease. Viral diseases in finfishes – Infectious Haematopoietic Necrosis, Infectious Pancreatic Necrosis, Viral Haemorrhagic Septicaemia, Spring Viraemia of carps, Channel catfish disease, Lymphocystis disease. Viral pathogens in shell fishes- *Bacculovirus penaeii*, White spot syndrome virus, Monodon bacculovirus, bacculovirus midgut necrosis, Heapatopancreatic virus, Yellow head bacculovirus, Systemic Ectodermal Mesodermal bacculovirus, Protozoan disease- Ichthyophthiriasis, Costiasis, whirling disease, Trypanosomiasis. Metazoan diseases- Dactylogyrosis, Gyrodactylosis, Hirudinosis, Lernaeosis and Argulosis.

Module 6: Nutritional and Environmental diseases. (8 hours)

Nutritional pathology- Vitamin and mineral deficiency diseases. Aflatoxin and dinoflagallates. Antibiotics and chemotherapeutics. Nutritional cataract, fish anaemia, enlarged liver, lordosis, broken back disease. Environmental diseases- Gas bubble disease, yolk coagulation disease, blue sac diseases in eggs, alkalinosis, acidosis. Hereditary diseases.

Module 7. Immunology and Fish health management (12hours)

Introduction to fish immunology and terminologies; Defense system and mechanism in fish and shellfish: innate and acquired immunity. Application and development of vaccines and antibiotics. General preventive methods and prophylaxis. Methods for disease control and management, chemotherapeutic agents, host management, prophylaxis-vaccines, adjuvants, immunostimulants and probiotics. Use and abuse of antibiotics and chemicals in health management. Fish health and quarantine systems. Seed certification, SPF and SPR. Good pond management practices. Methods of pathological examinations of fish and infectious diseases. Evaluation criteria of healthy seeds. Good feed management for healthy organisms.

IFFACOR11P : Fishery Microbiology and Fish Pathology Lab Credit-2

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 coliforms (MPN technique)
7. Identification of various finfish / shellfish disease
8. Parasite in fishes, protozoan (Ichthyophthiriasis, Trichodiniasis, whirling diseases) helminths (Dactylogyrosis and Gyrodactylosis), crustaceans (Lernaeosis, Argulosis)

IFFACOR12T: Fish Genetics and Biotechnology

Module 1: Basic Genetics (12 Hrs)

Structure of Chromosome & DNA, Knowledge of gene, Genotypes & Phenotypes, Principles of genetics, Mendel's law of inheritance - allelic and non-allelic interactions of genes – complete, incomplete, pleotropism, epistasis, supplementary and complementary genes. Biochemical genetics, quantitative genetics, population genetics, Basic Molecular Genetics, DNA Replication)

Module 2: Selection and Hybridization (10 Hrs)

Principles of breeding - methods and selection, selective hybridisation, intra-specific and inter-specific hybridisation – GIFT tilapia. Hybrid vigor, inbreeding and cross breeding.

Module 3: Sex determination. (10 Hrs)

Practical application of genetics in aquaculture. Genetics of sex determination in fish. Gonochorism, Hermaphroditism, Protandry, Protogyni, Environmental Influence of Sex Determination.

Module 4: Aquaculture Biotechnology (10 Hrs)

Recombinant DNA technology,. Aquaculture biotechnology- Biotechnological tools for aquaculture, gene manipulation in fish, transgenic fish production, transgenic synthetic hormone for fish breeding.

Module 5: Chromosome manipulation in fish (10 Hrs)

Polyploidy, gynogenesis and androgenesis. Monosex production, super male and super female fish production techniques, sex reversal - methods. Cryopreservation of gametes.

Module 6: Marine Biotechnology (8 Hrs)

Application of tissue culture in sea weed and pearl production. Marine toxins. Industrial chemicals and pharmaceuticals from marine sources. Use of probiotics and antibiotics in aquaculture operations.

IFFACOR12P : Fish Genetics and Biotechnology Lab Credit-2

1. Mitotic and meiotic chromosome preparation and their identification in fish.
2. Karyotype study.
3. Isolation of DNA from fish blood.

DSE (any two)

IFFADSE01T: Fish Feed Preparation and Quality Control

Fish feed preparation:- Nutritional requirement of cultivable fish and shell fish. Feed formulation and manufacturing. Forms of feeds-moist feed, dry feeds, mashes, pelleted feeds, floating and sinking pellets. Feed additives, binders, antioxidants, enzymes, pigments, growth promoters, feed stimulants, and uses of probiotics. Feed storage, use of preservatives and antioxidants.

Fish evaluation- feed conservation ratio, feed efficiency ratio, protein efficiency ratio, net protein utilization and biological value

Feeding devices and methods: - Nutritional deficiency diseases.

IFFADSE01P : Fish Feed Preparation and Quality Control Lab

Proximal composition analysis of feed ingredients & feeds. Preparation of artificial feeds using locally available feed ingredients. Determination of sinking rate and stability of feed. Effect of storage on feed quality. Visit to a fish feed farm.

IFFADSE02T: Hatchery Technology

Freshwater and marine fish seed resources. Natural breeding of finfishes. Selection of riverine spawn collection sites, gears used and methods of collection. Spawn quality and quantity indices. Advantages and disadvantages of riverine seed collection. Sexual maturity and breeding season of various cultivable species. Development of gametes in male and female. Fish egg and embryonic development. Methods of breeding; bundh breeding - wet and dry bundhs, collection and hatching eggs, factors involved in bundh breeding, advantages and disadvantages of bundh breeding. Induced breeding of warm water finfishes, environmental factors affecting spawning, sympathetic breeding. Hypophysation of fishes. Fish pituitary gland – its structure, collection, preservation and preparation of extract for injection, dosages and methods of injection. Brood-stock management and transportation of brood fish. Synthetic hormones used for induced breeding of carps. Different types of fish hatcheries-traditional, Chinese, glass jar and modern controlled hatcheries. Causes of mortalities of eggs and spawn and remedies. Spawn rearing techniques. Use of anaesthetics in fish breeding and transport. Breeding techniques for Indian major carps, exotic carps, mahaseers, trouts, tilapias, catfishes, grey-mullets, milk fish, pearl spot, sea bass, sea horse, groupers, pacu, cobia, pompanos and indigenous fishes, etc. Off-season and multiple breeding of carps.

IFFADSE02P : Hatchery Technology Lab

Study of maturity stages in fishes. Collection and preservation of fish pituitary gland, preparation of PG extract, Hypophysation. Calculation of fecundity. Brood-stock maintenance and selection of breeders for injection. Histological studies of ovary and testes. Different fish hatchery systems, study of fish eggs and embryonic developmental stages. Identification of eggs, spawn, fry and fingerlings of different species. Preparation and management of fish nursery. Fish seed and brood-stock transportation, use of anaesthetics, disinfectants and antibiotics in fish transport.

IFFADSE03T: Ornamental Fish Production and Management

World trade of ornamental fish and export potential. Different varieties of exotic and indigenous fishes. Principles of a balanced aquarium. Fabrication, setting up and maintenance of freshwater and marine aquarium. Water quality management. Water filtration system-biological, mechanical and chemical. Types of filters. Aquarium plants and their propagation methods. Lighting and aeration. Aquarium accessories and decorative. Aquarium fish feeds. Dry, wet and live feeds. Breeding and rearing of ornamental fishes. Brood stock management. Application of genetics and biotechnology for producing quality strains. Management practices of ornamental fish farms. Common diseases and their control. Conditioning, packing, transport and quarantine methods. Trade regulations and wild life act in relation to ornamental fishes.

IFFADSE03P : Ornamental Fish Production and Management Lab

Identification of common ornamental fishes and plants. Fabrication of all-glass aquarium. Setting up and maintenance of Aquarium accessories and equipment. Conditioning and packing of ornamental fishes. Preparation of feed. Setting up of breeding tank for live bearers, barbs, goldfish, tetras, chiclids, gouramis, fighters and catfishes. Identification of ornamental fish diseases and prophylactic measures.

SEMESTER VI

IFFACOR13T : Fishery Economics and Extension

Module 1: Principles of economics and marketing (20 hrs.)
Definition, subject matter and scope of economics. Law of diminishing returns, laws of increasing, constant and decreasing utility returns. Law of equi-marginal returns. Importance of economics in aquaculture development. Markets and their kinds. Law of demand and supply, price determination, problems of fish marketing in India. Exports of fish and fishery products, trends and problems therein.

Module 2: Economy of fishermen (10 hrs.)
Fishermen populations, GDP from fisheries sector, foreign exchange earnings and employment potential of fishing industry.

Module 3: Socio-Economic impact & Rural Development (10 hrs.)
Resource use and development, Socio-economic analysis, Socio-demographic profile, work contribution, household expenditure, income contribution, decision making, female headed household, impact of different age groups, socio-economic condition of fisherman.

Module 6: Fishery Livelihood (20 hrs.)
Modes of fisheries management - Open access, regulated, advisory; participatory, user rights; International fishery regulations, treaties and instruments; Input control measures such as access control, size, type, number and power of boats, duration of fishing; Output control measures such as Total Allowable Catch, Catch Quotas, Licensing. Technical control measures such as size limitations, closed fishing areas, closed seasons, size of nets and mesh size regulations, limited entry; Impediments to fisheries governance; UNCLOS, India's commitment to international treaties and resolutions. Vulnerability of fishers to changes in resource availability, exploitation and utilization patterns; Marginalization of fishermen, small scale processors and traders due to changing scenarios of product diversification, markets and trade; Impact of dams, river linking, CRZ, Biodiversity Bill, protected/closed area, fishing bans, closed seasons, protected areas, mangroves, sanctuaries and parks on the fisher communities. Land and water body use issues in fisheries. Role of extension in fisheries, mechanisms and modes of extension and their impact on capture fisheries and fisher's livelihood, alternative livelihood options; Management of conflicts within sub-sectors in fisheries; Women in fisheries, status, role, impact, future; Vulnerability of fishers to natural disasters and coping mechanisms in disaster management.

IFFACOR13P : Market Survey Report; Credit-2

IFFACOR14T : Entrepreneurship Development

Module 1: Introduction (10hrs)
Definitions and approaches, Scope and importance of Management, Management as an art of Science- Comparative Management. Functions of Managers- Environment Impact management. Planning, Organising, Staffing, Directing and Controlling. Contributions of Henry Fayol to the Scientific Techniques of management.

Module 2: Human resource Management (10 hrs)
Manpower planning and recruitment- Organisational Development- Training, Motivation, Morale and Productivity, Leadership, Organizational communication, Conflicts and Decision making. Important Institutions involved in human resource development in Fisheries sector.

Module 3: Processing Sector Management & Project formulation (10 Hrs)
Organizational setup in processing Industries, State Fisheries Department. Role of EIA, MPEDA and CIFT in the processing Industry. India's share In the International trade of sea foods. Project formulation, Process identification, Pre feasibility- technical, Economical and Social feasibility. Concept of capital budgeting and Its importance. Socially and financially viable indicators- CI, EG, RoR, DCF, NPV, IRR, and sensitivity analysis. CPM, PERT and Decision making.

Module 4: Fisheries Acts (10hrs)
Indian fisheries Act, National Institutions of Governance in Marine affairs of India-Criteria for regulation of Fishing effort. Code of conduct for responsible fisheries, WTO, Important acts pertaining to fisheries in Kerala - Kerala Marine Fisheries Act.

Module 5: Marketing management (10 hrs)
Market management- Concepts of Marketing- Market Mix, Market segmentation, Factor determining the buying decisions, Channels of distribution. Determining the selling price- Price spread, advertising and sales promotion.

Module 6: Cooperatives and Agencies in Fisheries (10 hrs)
Definition, Principles of co-operatives, Role of National Cooperative development Corporation (NCDC), Matsyafed,

National Federation of Fishermen cooperatives, FFDA, BFFDA, ADAK, FIRMA, BENFISH, SFDC. Problems of Fishery Cooperatives. Cooperatives and their importance in fish production and marketing. Role of NABARD and SIDBI.

IFFACOR14P : On Job Training; Credit 2

DSE (any two)

IFFADSE04T : Fish By products and Waste Utilization

Fish meal. Dry reduction and wet reduction methods – specification – packaging and storage. Fish oil – body oil – liver oil – extraction – purification – preservation – storage – application. Shrimp wastes – chitin – chitosan - production – uses. Fish protein concentrate. Fish hydrolysate, partially hydrolyzed and deodorized fish meat, functional fish protein concentrate and the reincorporation to various products. Fish silage – acid silage – fermented silage – application. Fish maws, shark leather, fish glue, fish gelatin, isinglass, pearl essence, shark fin rays, beach - de - mer. Biochemical and pharmaceutical products. Utilization of seaweeds: agar agar, algin, carrageenan.

IFFADSE04P : Fish By products and Waste Utilization Lab

Preparation of fish meal, fish body oil, fish liver oil, fish maws, isinglass, fish silage, ensilage, fish glue, fish gelatin, fattice, pearl essence, chitin, chitosan and fish manure Preparation of acid and fermented silage. Preparation of fish protein concentrate and fish hydrolysate.

IFFADSE05T : Culture of live fish food organisms

Candidate species of phytoplankton and zoo-plankton as live food organisms of freshwater and marine species. Tropic potentials- proximate composition of live feed. Biology and culture requirements of important live food organisms. Green algae, blue-green algae, spirulina, diatoms, infusoria, rotifers, cladocerons, tubifex, brine shrimp, chironomids. Culture of earthworms, bait fish and forage fish.

IFFADSE05P: Culture of live fish food organisms Lab:

Methods of isolation and identification of different live food organism. Laboratory scale culture of selected live food organisms. Evaluation of live food organisms. Decapsulation technique and hatching method of brine shrimp cysts.

IFFADSE06T: Aquaculture Engineering

Technical components of farm designing, future trends in aquaculture engineering. Aquaculture facilities: Planning process, site selection and evaluation, design, components and construction of tanks, ponds, cages and hatcheries. Water intake and outlet: Pipe line, water flow and head loss, pumps. Aeration and oxygenation: Design and fabrication of aerators, oxygen injection system Recirculation and water use system: Definition, components and design. Feeding system: Different types of feeding equipment, feed control systems, dynamic feeding systems.

IFFADSE06P : Aquaculture Engineering Lab:

Visit to aqua farms; Contour survey and mappings; Evaluation of performance of seepage controlling devices; Designing of fresh or brackish water fin and shellfish farms; Designing of fresh or brackish water fin and shellfish hatcheries; Estimation of construction cost of FRP and cement hatchery units, inlets, outlets, sluice gate, monks, hatchery sheds, supply channel and drainage systems, gravitational flow; Design and construction of effluent treatment plant for hatchery; Evaluation of capacity of aeration devices.

Reference Books

- Aline W. 1980Fish Diseases. Springer Verlag.
- Austin B & Austin DA. 1987Bacterial Fish Pathogens (Diseases in Farm and Wild). Ellis Harward.
- Axelrod HR & Sweenen ME. 1992The Fascination of Breeding Aquarium Fishes. TFH Publ.
- Axelrod HR. 1967Breeding Aquarium Fishes. TFH Publ.
- Bone Q and R Moore, Biology of Fishes, Talyor and Francis Group, CRC Press, U.K.
- Bardach JE, Rhyther JH & Mc. Larney WO. 1972.Aquaculture Farming and Husbandry of Freshwater and Marine Organisms. John Wiley & Sons.
- B. N. Yadav. Fish and Fisheries.

Chakraborty C & Sadhu AK. 2000. Biology Hatchery and Culture Technology of Tiger Prawn and Giant Freshwater Prawn. Daya Publ. House.
D. V. Bal and K. V. Rao. Marine fisheries of India. Tata McGraw Hill
Diwan AD, Joseph S & Ayyappan S. 2008. Physiology of Reproduction, Breeding and Culture of Tiger Shrimp.
Narendra Publ. House.
Evans D. H. and J. D. Claiborne, The Physiology of Fishes, Taylor and Francis Group, CRC Press, UK
FAO 2001. Planning and Management for Sustainable Coastal Aquaculture Development. FAO
ICAR. 2006. Handbook of Fisheries and Aquaculture. ICAR. 23
Ivar LO. 2007. Aquaculture Engineering. Daya Publ. House.
Khanna S.S. and H.R. Singh, A text book of Fish Biology and Fisheries, Narendra Publishing House
Kapoor, Khanna. Ichthyology Handbook.
Lagler, Bardach, Miller and Pacino. Ichthyology.
Matthew Landau. Introduction to Aquaculture.
Mcvey JP. 1983. Handbook of Mariculture. CRC Press.
Mills D. 1981. Aquarium Fishes. Kingfisher Books.
Nair PR. 2008. Biotechnology and Genetics in Fisheries and Aquaculture. Dominant Publ.
Norman, J.R. A history of Fishes, Hill and Wang Publishers
Padhi BK & Mandal RK. 2000. Applied Fish Genetics. Fishing Chimes.
Pandian TJ, Strüssmann CA & Marian MP. 2005. Fish Genetics and Aquaculture Biotechnology. Science Publ.
Purdom CE. 1993. Genetics and Fish Breeding. Chapman & Hall.
Pillay TVR & Kutty MN. 2005. Aquaculture - Principles and Practices. Blackwell.
Pandey, Shukla. Fish and Fisheries.
Primrose SB. 1989. Modern Biotechnology. Blackwell.
Reddy PVGK. 2005. Genetic Resources of Indian Major Carps. FAO Publ.
Reddy PVGK, Ayyappan S, Thampy DM & Krishna G. 2005. Text book of Fish Genetics and Biotechnology. ICAR.
Roberts RJ. 2001. Fish Pathology. 3rd Ed. WB Saunders.
Ryman N & Utter F. (Eds.). 1988. Population Genetics and Fishery Management. Washington Sea Grant Programmes, USA.
Sarkar S; Kundu G & Chaki K C- Introduction to Economic Zoology, NCBA, Kolkata
Saxena A. (Ed.). 2003. Aquarium Management. Daya Publ.
Schaperclaus W. 1986. Fish Diseases. Vols. I, II. Oxonian Press.
Srivastava, C.B.L. Fish Biology, Narendra Publishing House Thomas PC, Rath SC & Mohapatra KD. 2003. Breeding and Seed Production of Finfish and Shellfish. Daya Publ. House.
Thomas L. 1995. Fundamentals of Aquacultural Engineering. Chapman & Hall. von der Emde, R.J. Mogdans and B.G. Kapoor. The Senses of Fish: Adaptations for the Reception of Natural Stimuli, Springer, Netherlands
V.G.Jhingran. Fish and Fisheries of India.
Wedmeyer G, Meyer FP & Smith L. 1999. Environmental Stress and Fish Diseases. Narendra Publ. House.
Wheaton FW. 1977. Aquacultural Engineering. John Wiley & Sons.

The criteria for admission

1. A candidate shall be allowed to take up Honours in Industrial fish and fisheries if he/she has passed the subject biology/ chemistry/ food and nutrition / physics.

2. The subject biology / biotechnology be treated as related subject.

**** Other criteria as University norms.**