

MAHATHMA GANDHI UNIVERSITY

Priyadarshini Hills, Kottayam

SYLLABUS OF

B.Sc. AQUACULTURE

2012

Course structure for BSc. Aquaculture

Semester – I

No	Course	Course Code	Title	Hr/week	Credits
1	Common course English			5	4
3	Core I	AQIF1T1	Biology of Fishes	2	2
4	Core II	AQIF1T2	Principles and Methods in Aquaculture	2	2
5	Core III	AQIF1T3	Freshwater aquaculture	2	2
6	Core Practical I	AQIF1P1	Biology of Fishes	2	1
7	Complementary Biochemistry			2	2
8	Complementary Biochemistry Practical			2	1
9	Complementary Zoology			2	2
	Complementary Zoology Practical			2	1
			Total	25	17

Semester I

Course code - AQIF1T1

Biology of fishes

Total hours - 36

Credits – 2

Module 1: General Characteristics and Taxonomy of Fishes (6 Hrs.)

Principles of zoological classifications, binomial nomenclature and linear hierarchy. Classification of commercially important fishes, crustaceans and molluscs. General characters of fishes crustaceans and molluscs. Sense organs in fishes – organs of smell, taste buds, lateral line system. Ampullae of Lorenzini etc. Sound production in fishes. Specialized organs in fishes – electric organs, venom and toxins in fishes. Colouration and Bioluminescence in fishes. Sense organs in crustaceans and molluscs. Buoyancy in fishes-swim bladder and mechanism of gas secretion.

Module 2: Feeding and Growth (6 Hrs.)

Feed and feeding habits – herbivores, carnivores and omnivores. Feeding adaptations methods employed in the study of gut content analysis volumetric, gravimetric etc.. Age and growth – Techniques used in the study – use of scales and otoliths, length frequency analysis. Length weight relationship. Equations used for deriving growth rates.

Module 3: Reproduction and Migration (6 Hrs.)

Reproduction – ovary and testes, structure, development of primary and secondary sexual characteristics. Sexual dimorphism in fishes and crustaceans.

Maturation and spawning in fishes, factors affecting maturation and spawning. Fecundity, condition factor, size at first maturity. Oviparous, viviparous and ovoviviparous fishes. Parental care and breeding migration in fishes and crustaceans. Biological clocks- diurnal, lunar, circadian and tidal rhythms. Migration in fishes –anadromous and catadromous, homing, instinct and orientation.

Module 4: Digestion, Respiration and Circulation (6 Hrs.)

Digestive system – General morphological feature of digestive system in fishes, Digestive system and process of digestion in prawn and mussel. (Type - Mullet, *P.monodon*, Fresh water Mussel)

Respiratory system – general description, aquatic respiration, respiratory gases, gaseous exchange, oxygen transport (Shark and Mullet). Adaptations for air breathing in fishes. Respiration in crustaceans and molluscs

Cardiovascular system – General features of heart and blood circulation, circulatory system and oxygen transport in fishes crustaceans and molluscs.

Module 5: Endocrinology (6 Hrs.)

Endocrine organs in fishes. Hormones and their role in control of reproduction in fishes. Endocrine system in crustacean and molluscs. Role of hormones in reproduction and moulting in crustacean.

Module 6: Excretion (Hrs 6)

Excretion and osmoregulation in freshwater and marine fishes.

Course code - **AQIF1T2**

Principles and Methods in Aquaculture

Total hours - 36

Credits - 2

Module 1 Introduction (6hrs.)

History, definition, scope and significance of aquaculture, comparison of aquaculture with agriculture and commercial fisheries. Different aquaculture systems. Aquaculture - Global and Indian Scenario.

Module 2: Pond Ecology(Hrs 6)

General concepts of ecology, productivity, carrying capacity, food chain and food web. Ecology of culture ponds. Nutrient cycles -- Nitrogen Phosphorous and Carbon. Laws of limiting factor. Fertilizations and manuring. Liming and application of fertilizers and manures, role of nutrients, the NPK contents of various fertilizers and manures, rate and precautions in the application of fertilizers and manures. Significance and important groups of phytoplankton, zooplankton and benthos in culture ponds. Nutrient dynamics, algal blooms. Selection of site, physico-chemical conditions of soil and water optimum for culture. Management of water and soil quality parameters. Correction of pH, measures for increasing the concentration of oxygen and reducing the concentration of ammonia and hydrogen sulphide.

Module 3 ...Types of ponds (6-hours)

Type of ponds – hatching, nursery, rearing, stocking and broodstocks – construction and management of culture system, size and depth of ponds, maintenance of ponds – positioning of different types of ponds in a fish farm.

Module 4...Cultivable Freshwater fishes (Hrs.6)

Criteria for the selection of species, Cultivable freshwater fishes- carps, airbreathing fishes, tilapia, trout, freshwater prawn, frogs.

Module 5...Brackishwater culture and mariculture (Hrs.6)

Brackishwater resources and fishes of commercial importance – Milk fish, mullet, pearl spot, seabass, shrimps, crabs; selection of site. Major brackish water culture systems in India, prawn filtration, Basabhandra, kharlands – Different organisms in Mariculture – mussel, edible oyster, pearl oyster and sea weeds.

Module 6:Fisheries institutes (Hrs 6)

Different organizations and institutes involved in fisheries and aquaculture research and development – FAO, NACA, SEAFDEC, INFOFISH, World Fish Centre, Bay of Bengal Programme, Institutes under ICAR, CSIR; NABARD, Ministry of Agriculture and Ministry of Commerce, Aquaculture Authority of India, NRSA, INCOIS etc. State organizations like Matsyafed, FFDA, BFFDA, ADAK, FIRMA and State Fisheries Department.

Freshwater aquaculture

Course code - **AQIF1T3**

Total hours - 36

Credits – 2

Module 1: Freshwater Fish Culture (Hrs 6)

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, Heteropneustes, Clarius, Anabas. Culture of cold water fishes in India.

Module 2: Culture of Prawns, Molluscs and Frog (Hrs 6)

Cultivable species of freshwater prawns and their biology – culture of *Macrobrachium rosenbergii*.,. Important freshwater molluscs of Kerala. Freshwater pearl culture – Present status of freshwater pearl culture and production in India. Prospects of culturing frog in India.

Module 3: Aquaculture for stable environment (Hrs 6)

Sewage fed fish culture, sewage treatment,– Sewage cum fish culture in India. Fish in relation to public health – Larvivores fishes and mosquito eradication using fishes.

Module 4 Reservoir fisheries (6Hrs)

Major reservoirs in India, measures for increasing production from reservoirs in India and abroad, Game fishery.

Module 5: Integrated Farming

(Hrs- 6)

Recent development in integrated farming – Rice cum fish culture, Duck cum fish culture, Poultry cum fish culture and Pig cum fish culture. Organic aquafarming. Fish culture in cages and pens. Running water fish culture.

Module 6 : Systems in freshwater Aquaculture

(6 hrs)

Fish culture in cages and pens, race way, indoor tanks, canals, silo culture, Aquaponics. Monoculture, polyculture, composite fish culture.

Core practical – 1

Course Code - AQIF1P1

Biology of Fishes

Experiments:

1. Morphometric measurements of fishes
2. Fin forms of fishes and swimming behaviour
3. Types of scales, mounting of placoid, cycloid & ctenoid scales
4. Adaptation of mouth in relation to the feeding habit.
5. Examination of structure of gill and assessment of feeding behaviour – sardine/ channa sp.
6. Mounting of appendages of Prawn
7. Length – weight analysis of fishes
8. Dissect and display of alimentary canal of fishes (Sardine/Mullet)
9. Dissect and display of alimentary canal/nervous system of prawns
10. Fecundity estimation in fishes/ prawn and its relationship with length and weight
11. Estimation of gonado-somatic index & determination
12. Determination of ova diameter
13. Gut content analysis - demonstration
14. Estimation of relative length of gut

Semester – II

No	Course	Course Code	Title	Hr/week	Credits
1	Common course English			5	4
2	Core IV	AQIF2T4	Brackishwater Aquaculture and Mariculture	2	2
3	Core V	AQIF2T5	Hatchery Technology in Aquatic Organisms	2	2
4	CoreVI	AQIF 2T6	Fishing Methods	2	2
5	Core Practical II	AQIF2P2	Taxonomy, Fisheries and Fishing technology (P)	2	1
6	Complementary Biochemistry			2	2
7	Complementary Biochemistry Practical			2	1
8	Complementary Zoology			2	2
9	Complementary Zoology Practical			2	1
			Total	25	17

Semester – IICourse code - **AQIF2T4****Brackishwater Aquaculture and Mariculture**

Total hours - 36

Credits – 2

Module 1: Introduction

(6 Hrs)

Introduction, history, development and present status of brackishwater farming in India. Brackishwater as a medium for aquaculture, ecological factors – abiotic and biotic factors. Selection of site, general planning and design of brackish water farms.

Module 2: Brackishwater Finfish Culture

(6 Hrs)

Selection of cultivable species in brackish water systems, their biology and culture practices – monoculture and polyculture of – *Chanos chanos*, *Mugil cephalus*, *Lates calcarifer*, *Etroplus suratensis*, *Oreochromis mossambicus*. Nursery, rearing and grow out in ponds, cages and pens.

Module 3: Crustacean Culture

(6 Hrs)

Species of shrimps cultured in brackishwater and their biology – *Penaeus mondon*, *Penaeus indicus*, *Penaeus vannamei*. Extensive, semi-intensive and intensive shrimp farming practices. Species of crabs cultured, biology and culture techniques, prospects in India. Culture of lobsters – experimental culture and prospects in India.

Module 4: Mariculture

(6 Hrs)

Ecological subdivisions of the sea. Selection of site and selection of materials for sea farming. Different designs of open sea farming structures – construction of cages – bioengineering problems and solutions – scope of open sea farming in India. Important fin fishes cultured in the open seas and the culture systems. Present status and recent developments in mariculture.

Module 5: Molluscan Culture and Seaweed Culture (6 Hrs)

Molluscan culture – species of edible oysters, mussels and clams cultured, culture techniques used for farming edible oysters and mussels. Important species of pearl oysters and method of artificial pearl production. Importance of Echinoderms, Sponges . Culture of seaweeds, common cultivated species, culture techniques and harvesting. Important seaweed products.

Module 6: Mariculture and Environment

(6 Hrs)

Environmental impact of brackishwater and coastal aquaculture- effluent discharge, eutrophication, chemical residues including antibiotics and hormones, destruction of natural habitat including paddy field and mangroves. Corals, its importance and conservation. Social issues and conflicts with other users on resources. Salinity intrusion

Course code - **AQIF 2T5**

Hatchery Technology in Aquatic organisms

Total hours - 36

Credits – 2

Module 1: Carp Hatchery (6Hrs)

Hatchery management-seed production of carps. Hypophysation of Indian major carps and exotic carps, history of hypophysation. Pituitary gland. Collection and preservation of gland. Other ovulating agents. Brood stock management, sexing, dosage for injection, mechanism of ovulation. Development of carp eggs, different carp hatcheries. Nursery rearing of carp seed.

Module 2: Carp Production System (6 Hrs)

Production of common carp seeds, breeding techniques, Sundanese, Tjimindi, Rantjapaku and Central Sumatra methods. Methods followed in China and India. Transport of fish seed and broodfishes. Causes of mortality during transport, techniques of transport, open and closed systems, methods of transportation, use of anaesthetics. Carp seed resources in major rivers. Bundh breeding, types of bundh breeding techniques. Problems of bundh breeding.

Module 3: Seed Production of other Fishes (6 Hrs)

Seed production and nursery rearing of *Onchorhynchus mykiss*, *Clarias batrachus*, *Mugil cephalus*, *Oreochromis mossambicus*, *Lates calcarifer*, *Epinephelus tauvina*.

Module 4: Seed Production of Crustaceans and Molluscs (6Hrs)

Seed production and nursery rearing of *Penaeus indicus*, *Penaeus monodon* and *Macrobrachium rosenbergii*. Different systems. Hatchery operations of pearl oysters, clams, crabs, lobster. Remote setting. Preparation of artificial sea water.

Module 5: Design of shrimp hatcheries (6 Hrs)

Various components, equipments and infrastructure facilities required. Mechanical and biological filters.

Module 6: Hatchery Management (6 Hrs.)

Components and general design of hatcheries. Selection criteria for broodstock and brood stock management. Water quality monitoring and management. Quarantine and disease management in hatcheries. Quality assessment of seeds.

Course code – AQIF2T6

Fishing Methods

Total hours - 36

Credits – 2

Module 1: Fishing Crafts (6 Hrs.)

Different types of fishing crafts in India- inland and marine– traditional, motorized and mechanized. Recent statistics of each category- country crafts, trawlers, gill netters, purse seiners, long liners, trollers, deep sea vessels. Boat building materials - wood, steel, FRP, ferro-cement, aluminum etc.

Module 2: Fishing Gears (6 Hrs.)

Introduction, principle and evolution of fishing methods and gear. Factors affecting the design of fishing gears and fish catching methods. Fishing accessories. Introduction to netting materials - natural and synthetic fishing gear materials. Yarn numbering systems.

Module 3: Active Fishing Gears (6 Hrs.)

Classification and description of modern fishing gears.- Design and operation of – trawls, purse seines, ring seines, beach / shore seine, boat seine, pole and line, squid jigs, trolling.

Module 4: Passive and Traditional Fishing Gears (6 Hrs.)

Design and operation of- gill nets, long lines, hooks, traps, stake net, dol net, chinese dip nets, cast nets. Destructive and Prohibited fishing practices, fishing methods like electrical fishing, poisoning and use of dynamites.

Module 5: Fish Aggregating Devices and Artificial Reefs (6 Hrs.)

Fish aggregating devices and artificial reefs. Light fishing and Lantern fishing. Impact of artificial reefs on fish stock improvement.

Module 6: Fish Finding Devices and Conservation. (6 Hrs.)

Introductory information on echo-sounder, sonar, net sonde, global positioning systems, remote sensing, potential fishing zones (EEZ) Turtle Exclusion Devices (TED) - By-catch Reduction Devices (BRD).

PRACTICAL

Course code - AQIF2P2

Practical - Taxonomy, Fisheries and Fishing Technology

Credits – 2

1. Identification of larvae of cultivable fishes
2. Identification of larval stages of shrimps and prawns
3. Hatchery layout and identification of equipments
4. Analysis of catch statistics- preparation of graphs& charts
5. Identification of traditional fishing gears
6. Identification of modern gears
7. Identification of fishing accessories (Floats/sinkers/ Shackles/swivels/otter boards)
8. Identification of synthetic and natural fibres
9. Different types of hooks
10. Artificial and live baits
11. Fish detection devices and remote sensing
12. Deck arrangement of different fishing vessels
13. Knots and splicing
14. Report – Visit to Fishing Harbour/Landing centre

SEMESTER – III

No	Course	Course Code	Title	Hr/week	Credits
1	Core VII	AQIF3T7	Inland and Marine Fisheries	4	3
2	Core VIII	AQIF3T8	Biostatistics and Computer Applications	5	3
3	Core IX	AQIF3T9	Aquaculture Nutrition	4	3
4	Core Practical III	AQIF3P3	Biostatistics and Computer applications (P)	2	2
5			Fresh water hatchery training	2	1
6	Complementary Biochemistry			3	3
7	Complementary Biochemistry Practical			1	1
8	Complementary Zoology			3	3
9	Complementary Zoology Practical			1	1
			Total	25	20

Fresh water hatchery training (Credits-1)

During the third semester the student will have to attend training for a minimum of three days in a fresh water fish or prawn hatchery. A certified report of the training signed by hatchery supervisor and the concerned teacher in charge must also be submitted.

Semester III

Course code – AQIF3T7

Inland and marine Fisheries

Total Hours-54

Credits – 3

Module 1: Riverine and Coldwater Fisheries (9 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 species – problems encountered in fisheries development of rivers supporting cold water fisheries.

Module 2: Reservoir and Estuarine Fisheries (9 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

Module 3: Marine Fisheries- Pelagic Resources (9 Hrs.)

Marine fishery resources in India- important fishing zones including Wadge bank, maritime states. Major pelagic resource groups– sardines,

mackerel, anchovies, ribbon fishes, tuna, seer fishes. Methods of fishing
- Recent catch statistics of pelagic fisheries.

Module 4: Marine Fisheries- Demersal Resources (9 Hrs.)

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

Module 5: Marine Fisheries - Deep Sea Resources (9 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. Fishing regulations.

Module 6: Fishery Assessment and Regulations (9 Hrs.)

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

Semester III

Course code – AQIF3T8

Bio-statistics and Computer Applications

Total Hours-54

Credits – 3

Module 1: Basic Statistics (9 Hrs)

Origin, growth, meaning, definition and use of statistics. Methods of data collection. Biological data collection. Sampling methods. Biological sampling. Frequency distribution, tabulation and diagrammatic representation of data.

Module 2: Measures of central tendency (9hours)

Arithmetic mean, median, mode, quartiles, geometric mean and harmonic mean. Measures of dispersion and its application. Skewness and kurtosis. Definition, derivation and application of regression and correlation.

Module 3: Statistical Tests (9 Hrs)

Application and use of least square method. Application of probability. Permutation and combination. Distribution- normal, binomial and poisson. Testing of hypothesis. Chi-square test, t-test, f-test, Z- test. Degrees of freedom, test of goodness of fit, test of independence. Analysis of Variance.

Module 4: Computer - History & Introduction

(9hours)

History of computing; Computer organisation; Binary system; Hardware and software; Generation of computers; Computer programming; System flowcharts.

Microprocessors, Storage devices, Memory systems and ASCII Code; Input-Output devices; Disk Operating System; Booting; Formatting; Operating Systems.

Module 5: Introduction to Office applications (9hours)

Office application software, Word Processing, Worksheet, presentation softwares, and data analysis. SQL.

Module 6: Web Development and programming (9hours)

Basics of web development using HTML. Introduction to the World Wide Web, Creation of email accounts and search for organized information.

Semester III

Course code –AQIF3T9

Aquaculture Nutrition

Total Hours-54

Credits – 3

Module 1: Nutritional Requirements of Fish (9 Hrs)

Protein and amino acid requirement, carbohydrate and lipid requirement, Essential fatty acids, Non protein nitrogen sources. Vitamin and mineral requirements, vitamin C for fish and shell fishes. Feeds and feed additives, pigments, immunostimulants, non-nutritional feed additives - chemoattractants, feeding stimulants, growth promoters, preservatives.

Module 2: Feed ingredients & quality (9 Hrs)

Different feed ingredients- animal, plant, microbial origin, SCP, silages, fermented products. Anti-nutritional factors. Compounded feeds, pellets, crumbles and

microencapsulated feed. Storage, quality standards, proximate composition & chemical evaluation. Digestibility studies and methods.

Module 3: Feed & Feed Manufacturing (9 Hrs)

Different forms of feed-fodders, mash, pellets, floating and sinking feeds. Feed formulation - methods, square method. Feed manufacturing processes, Extrusion , Pelletization , Different size and grades of fish / shrimp feeds - starter, grower and finisher feeds. Micro-bound feed, micro encapsulated feed. Storage and transportation of feeds. Quality problems- toxins, pests, rancidity. **Module 4:**

Feed Management (9 Hrs)

Practical feeding in grow-outs of fishes & shrimps. Feed ration, feed quantity estimation, feeding frequency. Check trays, demand feeders, automatic feeders, feed dispensers. Farm made feeds, factory made fish & shrimp feeds in India. Record keeping.

Module 5: Feed Quality (9Hours)

Feed energetics, feed conversion efficiency, protein efficiency ratio, feed conversion ratio, net protein utilization, leaching, water stability. Quality standards.

Module 6: Larval nutrition (9Hours)

Larval stages, nutritional requirements of fish and shellfish larvae, quality requirements of larval feeds (particle size, digestibility), natural food and its importance in aquaculture, nutritional quality of commonly used fish food organisms, bioenrichment, biofilm/periphyton and its uses.

Course code – AQIF3P3**Practical - Biostatistics and Computer Applications**

Credits – 2

1. Study of computer components
2. Formatting a document using word, use of mail merge
3. Use of internet to collect fisheries data - FAO, NACA, ICLARM etc.
4. Descriptive statistical analysis, calculation of mean, median, mode, standard deviation, standard error using computer programmes/packages.
5. t- test, Chi –square, F- test, one way ANOVA, Data analysis using computer
6. Analysis of fisheries/ biological data using computer programmes/packages
7. Accessing information from FISHBASE
8. Correlation and regression analysis using computer programmes/packages
9. Graphical representation and tabulation, of data using computer programmes/packages

SEMESTER – IV

No	Course	Course Code	Title	Hr/week	Credits
1	Core X	AQIF4T10	Genetics and Biotechnology	4	3
2	Core XI	AQIF4T11	Pathology in Aquaculture	5	3
3	Core XII	AQIF4T12	Aquariculture	4	3
4	Core Practical IV	AQIF4P4	Breeding and rearing of Aquarium fishes	2	2
5			Breeding aquarium fish*	2	1
6	Complementary Biochemistry			3	3
7	Complementary Biochemistry Practical			1	1
8	Complementary Zoology			3	3
9	Complementary Zoology Practical			1	1
			Total	25	20

***Breeding any one species of aquarium fish (Credit-1)**

Breeding and larval rearing of any one of the ornamental fish may be done in group of six under the supervision of a faculty of the Department or in any hatchery and the report may be submitted

Semester IV

Course code –AQIF4T10

Genetics and Biotechnology

Total Hours-54

Credits – 3

Module 1: Basic Genetics (9 Hrs)

Introduction- Genetics, Mendel's law of inheritance, interaction of gene, supplementary and complementary genes. Principles of fish genetics. Cytogenetics, Biochemical genetics, quantitative genetics, population genetics.

Module 2: Selection and Hybridisation (9 Hrs)

Genetic selection, mass selection, genotypic selection, family and sib selection, progeny testing and combined selection. Principles of breeding- methods and selection, selective hybridisation, intra-specific and inter-specific hybridisation. Hybrid vigor, inbreeding and cross breeding.

Module 3: Sex determination. (9 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 (9 Hrs)

Recombinant DNA technology, determinants of DNA replication, cloning, vectors, transformation. Use of PCR for the detection of white spot syndrome in shrimp.

Aquaculture biotechnology- Biotechnological tools for aquaculture, gene manipulation in fish, transgenic fish production.

Module 5: Chromosome manipulation in fish and shell fishes (9 Hrs)

Polyploidy, gynogenesis and androgenesis. Monosex production, super male and super female fish production techniques.

Module 6: Marine Biotechnology (9 Hrs)

Scope and the present status of marine biotechnology, general application of molecular biological techniques to the marine sciences. Synthetic hormones for induced breeding. 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. Cryopreservation.

Semester IV

Course code –**AQIF4T11**

Pathology in Aquaculture

Total Hours-54

Credits – 3

Module 1: Pathology and Parasitology (9 Hrs)

Introduction to fish diseases –Definition and categories of diseases – Disease and environment. pathology and parasitology. Stress as a factor in the occurrence of diseases. Parasitism – host-parasite relationship

Module 2: Fungal and Viral Diseases (9 Hrs)

Fungal diseases (finfish) – Saprolegniosis, brachiomycosis, ichthyophorus diseases – Lagenidium diseases – Fusarium disease Viral diseases (finfish) – IPN, IHN, Viral Hemorrhagic Septicemia, Spring Viremia of carps – Major CCVD, Carp lymphocytes – Major shrimp viral diseases – *Baculovirus penaeii*, Monodon Baculovirus, Baculoviral midgut necrosis, IHHNV, Hepatopancreatic parvo like virus, Yellow head baculovirus, white spot baculovirus.

Module 3 Bacterial, Protozoan and Metazoan Diseases. (9 Hrs)

Common bacterial diseases (Enteric red mouth disease, Bacterial cold water disease, furunculosis, vibriosis, dropsy and Gill and fin rot) their diagnosis and treatment. Protozoan diseases- Ichthyophthiriasis, Costiasis, whirling diseases, trypanosomiasis. Metazoan Diseases- diseases caused by annelids, helminthes, crustaceans and molluscs.

Module 4: Nutritional diseases (9 Hrs)

Nutritional pathology – lipid liver degeneration, Vitamin and mineral deficiency diseases. Aflatoxin and dinoflagellates. Antibiotic and chemotherapeutics. Nutritional cataract. Genetically and environmentally induced diseases.

Module 5: Immunology (9 Hrs)

Defence mechanism in fish and shell fish, Application and development of vaccines, Diagnostic tools – immune detection- DNA/RNA techniques. General preventive methods and prophylaxis.

Module 6: Fish Health Management (9Hrs)

Good pond management practices- Eco-friendly and sustainable aquaculture. Quarantine. Methods of pathological examination of fish and infectious diseases. Production of disease-free seeds. Evaluation criteria of healthy seeds. Good Feed management for healthy organisms. Zero water exchange. Probiotics in health management.

Semester IV

Course code –AQIF4T12

Aquariculture

Total Hours-54

Credits – 3

Module 1: Introduction (9 Hrs)

Introduction to aquarium, ornamental fishes and aquarium accessories. World aquarium trade and present status. Design and construction of public fresh water and marine aquaria and oceanarium. Aerators, filters and lighting. Water quality requirements. Temperature control. Biofilters in aquarium.

Module 2: Aquarium Management (9Hrs)

Setting up of aquarium – under gravel filter, pebbles, plants, drift wood, ornamental objects and selection of fishes, Quarantine measures. Aquarium maintenance and water quality. Control of snail and algal growth. Handling, care and transportation of fish. Temperature acclimation, oxygen packing.

Module 3: Freshwater Ornamental Fishes

(9 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, multiplication of aquarium plants – different methods. Indigenous ornamental fishes of Kerala.

Module 4: Commercial Production

(9 Hrs)

Requirements and design for the commercial production units of ornamental fishes. Commercial production of goldfish, live bearers, gouramies, barbs and tetras, angel fish. Natural ponds for the mass production of ornamental fishes. Mass production of aquarium plants.

Module 5: Marine Ornamental Fishes

(9 Hrs)

Marine ornamental fishes – varieties and their habitat. Major marine ornamental fish resources of India. Method of collection of live fish. Use of anesthetics. 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

(9 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 parasites infecting ornamental fishes. Bacterial, viral, fungal diseases of ornamental fishes and their control and prophylaxis.

Breeding and Rearing of Aquarium Fishes (2-CREDITS)

Course code- AQIF4P4

Experiments:

1. Identification of common Fresh water aquarium fishes (10 Nos.)
2. Indigenous ornamental fishes of Kerala (5Nos.)
3. Construction of aquarium
4. Setting up of aquarium (maintained by students can be evaluated after one month)
5. Water quality management in aquariums
6. Aquarium plants and décor materials
7. Air pump and biological filter
8. Breeding of live bearers-Guppy
9. Breeding of egg layers- gold fishes
10. Breeding of bubble nest builder- Gourami
11. Control of snails in ornamental fish culture system
12. Ornamental fish farms- general description
13. Marine aquarium fishes and invertebrates
14. Setting up of reef aquarium
15. Diseases of aquarium fishes (Symptoms and treatments)

Field visit:

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

SEMESTER - V

No	Course	Course Code	Title	Hr/week	Credits
1	Core 13	AQIF5T13	LARVAL NUTRITION AND CULTURE OF FISH FOOD ORGANISMS	6	4
2	Core 14	AQIF5T14	Fishery microbiology	6	4
3	Core practical 5	AQIF5P5	Fishery microbiology and pathology	2	3
4	Core practical 6	AQIF5P6	Aquafarm management	2	3
5	OJT		On the job training	5	4
6	OPEN COURSE	AQIF5OC-1 AQIF5OC-2 AQIF5OC-3	1. Ornamental Fish Culture 2. Fish Preservation Techniques 3. Value Added Fishery Products	4	4
			Total	25	22

On the job training (4 credits)

In the fifth semester students will have to undergo On the job training for 21days attached to a processing plant/recognized Institute. They have to submit the OJT record signed by the supervisor along with the attendance certificate. (OJT record – 3 Credits + Viva- 1 Credit)

Semester V

Course code –AQIF5T13

LARVAL NUTRITION AND CULTURE OF FISH FOOD ORGANISMS

Total Hours-54

Credits – 4

Module 1: Live Feeds

(9 Hrs)

Different live feeds and their nutritional value. Manipulation of pond for natural feed production. Candidate species of phytoplankton and zooplankton for fish and shell fish culture - diatoms, micro algae, nano planktons, Artemia, copepods, cladocera and rotifers. Enrichment of live feed. Weaning of fish and prawn larvae.

Module 2: Culture of Phytoplankton

(9Hours)

Methods of collection, maintenance of pure culture of Phytoplankton. Different media used for culture. Batch culture and continuous culture and their application in hatcheries. Mass culture. Culture of important microalgae, Chaetoceros, Tetraselmis, Skeletonema, Spirulina and Chlorella.

Module 3 : Culture of Zooplankton

(9Hours)

Methods of collection, maintenance and rearing of rotifers, cladocerans, copepods, and insect larvae. Mass culture of zooplankton. Harvest, storage and feeding.

Module 4: Artemia culture

(9 Hours)

Different strains of Artemia. Artemia culture. Cyst production. Enrichment of Artemia cyst and larvae. Decapsulation of Artemia cysts. Hatching, storage and feeding.

Module 5: Alternative live feeds. (9 Hours)

Culture methods of Infusoria, Chironomids, white worms, earthworms, mosquito larvae. Nutritional qualities of alternative live feeds. Applications

Module 6: Periphyton culture (9Hours)

Importance of periphyton in aquaculture. Species composition and nutritional quality. Methods for the development and maintenance of periphyton.

Semester V

Course code –AQIF5T14

Fishery Microbiology

Total Hours-54

Credits – 4

Module 1: Introduction (9 Hrs.)

History and development of microbiology – Contributions of Louis Pasteur, Koch and Winogradsky –Diversity of microbial community – General characteristics of bacteria, fungi, viruses, algae and protozoans. .

Module 2: Structure of microbes (9 Hrs.)

Structure of prokaryotic cell, Structure and function of bacterial cell wall, plasma membrane, capsule, flagella and endospore. Structure of fungi and yeast cell.

Structure of virus. Classification of viruses. Life cycle bacteriophages - lytic and lysogenic cycle.

Module 3: Isolation and culture of microbes (9 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 cultivation of microorganisms from water and sediment. Different culture techniques.

Module 4: Aquatic Microbiology (9 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. Autochthonous and allochthonous microorganisms in aquatic environment.

Module 5: Bacteria in culture pond (9 Hrs.)

Health significant bacteria in culture pond. Culture characteristics and epidemiology of *E. coli*, pathogenic *Vibrios*, *Salmonella*, *Aeromonas hydrophila*, and *Pseudomonas*.

Module 6: Fish Microbiology (9 Hrs.)

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.

OPEN COURSE

Semester V

Course code – AQIFOC1

Ornamental Fish Culture

Total Hours-54

Credits – 4

Module 1: Introduction (9 Hrs)

Introduction to Aquarium and ornamental fishes. World aquarium trade and present status. Accessories- Aerators, filters, lights, heaters. Water quality requirements. Different kinds of feeds. Culture of fish food organisms; preparation of dry feeds; feeding methods.

Module 2: Freshwater Ornamental Fishes (9 Hrs)

Different varieties of Ornamental fishes- Live bearers, Gold fish and koi, Gourami, Barbs and Tetras, angel fish and cichlids. Broodstock development, breeding, larval rearing and grow out. Larval feeds and feeding. Induced breeding. Indigenous ornamental fishes of Kerala

Module 3: Commercial Production of Freshwater Ornamental Fishes and plants (9 Hrs)

Requirements and design for the commercial production units of ornamental fishes. Commercial production of goldfish, live bearers, gouramies, barbs and tetras, angel fish. Mass production of aquarium plants. Natural ponds for the mass production of ornamental fishes. Marketing of aquarium fishes, retail outlets, export of ornamental fishes.

Module 4: Marine Ornamental Fishes (9 Hrs)

Marine ornamental fishes – varieties and their habitat. Major marine ornamental fish resources of India. Method of collection and transportation of live fish. Use of anesthetics. Quarantine measures. Breeding of marine ornamental fishes.

Other ornamental organisms – anemones, worms, lobsters, shrimps, octopus, starfish.

Module 5: Aquarium Management (9 Hrs)

Setting up of Fresh water, Marine and reef aquariums. Maintenance of water quality. Common diseases of aquarium fishes, their diagnosis and treatment. Handling, care & transportation of fish. Temperature acclimatisation, oxygen packing. .

Module 6: Marketing of Aquarium Fishes (9 Hrs)

Marketing of aquarium fishes. Whole-sale markets of aquarium fish. Design of retail outlet. Export of ornamental fishes, procedures for export. Training and promotion schemes for the entrepreneurs involved in ornamental fish breeding and marketing by governmental agencies. Regulations on export/import of ornamental fishes.

Semester V

Course code – AQIFOC2

Fish Preservation Techniques

Total Hours-54

Credits – 4

Module 1: Fish handling (9 Hrs.)

Common fishes, shrimps and molluscs landed and processed in Kerala. Handling of fish on board, in the landing center and processing centre. Design and layout of preprocessing and processing centers.

Module 2: Chilling and Freezing (9 Hrs.)

Icing of fish, different types of ice, quality of ice. Fundamental principles involved in chilling and freezing of fish and fishery products. Various freezing methods. RSW/CSW systems. Changes during freezing and frozen storage.

Module 3: Drying, Smoking, Canning and Freeze-Drying (9 Hrs.)

Principles of drying and salting of fish, factors affecting drying. Traditional drying / curing methods. Packing and storage of dried products. Principles of freeze drying and canning of fish. Different stages of canning of fish/prawn. Retortable pouch processing. Spoilage of canned products. Cut open test and commercial sterility and quality examination of canned products.

Module 4: Quality Control in Sea Food Processing (9 Hrs.)

Concept of quality in fish and fishery products. Organoleptic analysis of fish and fishery products. Microbiological analysis of fish and fishery products. TPC and MPN of coliforms in sea food. *Salmonella*, *Vibrio*, *Staphylococcus* and *E. coli* in sea food. Quality standards for sea food. Concept of HACCP.

Module 5: Fishery By-products (9 Hrs.)

Fish meal and fish oil. Different methods of production of fish oils and their uses. Different grades of fish meal. Nutritional significance of fish oil. Chitin and chitosan. Fish silage- production and uses. Shark fin rays, FPC, Pearl essence, isinglass, gelatin, squalene, beche-de-mer, carrageenan, agar, ambergris.

Module 6: Packing, Cold Storage and Export of Fishery Products (9 Hrs.)

Functions of packing. Different types of packing materials and its quality evaluation. Packing requirements for frozen and cured products. Statutory

requirements for packing. Labelling requirements. Different types of cold storages. Requirements in retail outlet. Insulated and refrigerated vehicles. Export of marine products. Role of MPEDA and EIA in export promotion and quality control.

Semester V

Course code – AQIFOC3

Value Added Fishery Products

Total Hours-54

Credits – 4

Module 1: Value Addition in Sea Foods

(9 Hrs)

Different types of value added products from fish and shell fish – status of value addition in Indian seafood sector. Advantages of value addition. Significance of value addition in the seafood industry.

Module 2: Fish Mince Based Products

(9 Hrs)

Fish mince and Surimi. Production of fish mince – merits and demerits. Analog and fabricated products. Quality assessment of surimi,.. Equipment, raw material for surimi, Role of cryoprotectants in surimi production.

Module 3: Coated Fishery Products

(9 Hrs)

Preparation of coated fishery products – Different types of batter and breading and its applications – Packaging and storing of coated products – Quality evaluation.

Module 4: Other Value Added Products

(9 Hrs)

Preparation of products- fish / prawn pickle, fish wafers, prawn chutney powder, fish soup powder, fish protein hydrolysate, fish sticks, extruded fish products, fillets, fish curry, fish cutlet, mussel products, marinated products

Module 5: By-Products

(9 Hrs)

Production of chitin, chitosan and glucosamine hydrochloride from shrimp shell waste. Preparation of fish silage. Uses of silage. Isingless, shark fin rays, gelatin from fish waste, Ambergris, beche-de-mer, squalene, fish meal and oil

Module 6: Spoilage and quality

(9 Hrs)

Spoilage in thermal processed products – Quality evaluation of thermal processed products – Curing and drying of fish – Spoilage in dry fish products.

Fishery Microbiology and Pathology

Course code –AQ IF5P5

Credits- 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 coli forms
7. Identification of various finfish / shellfish disease
8. parasite in fishes, protozoan, helminths, crustaceans
9. Prophylaxis for the prevention of outbreak of fish disease
10. Larval diseases

PRACTICALS**Aqua Farm Management (2-CREDITS)****Course code- AQIF5P6**

1. Identification of cultivable aquatic organisms (Fin fish-6, Prawn-3, Crab – 2, Lobster- 1, Molluscs -3)
2. Identification of common weed and predatory fishes (3each)
3. Collection and identification of phytoplanktons and zooplanktons in an aquaculture pond (any 3 each)
4. Identification of different larval stages of shrimp
5. Identification and working of various equipments in farm and hatchery
6. Eradication of aquatic weeds, insects, weeds and predatory fishes from aquaculture pond.
7. Identification of different live feed organisms (6Nos)
8. Enumeration of micro algae using haemocytometer
9. Decapsulation and hatching of artemia cyst
10. Calculation of feed requirement
11. Feed formulation techniques
12. Preparation of artificial feed for aqua cultured organism
13. Earthwork calculation (Field study)
14. Economic analysis of carp farming & shrimp farming

BSc. AQUACULTURE

SEMESTER – VI

No	Course	Course Code	Title	Hr/week	Credits
1	Core 15	AQ6T15	Aquaculture Management	6	4
2	Core 16	AQ6T16	Aquaculture Engineering	6	4
3	Core 17	AQ6T17	Fisheries Economics and extension	6	4
4	Core practical - 7	AQ6P7	Fish processing technology and quality control	2	2
5	Core Practical - 8	AQ6P8	Water and Soil Quality Parameters	2	2
6	Project work*				3
7	Study tour**				1
8		AQIF6CB1 AQIF6CB2	CORE- CHOICE BASED COURSE 1. Fishery by products 2. Aquaculture and Management of Ecosystems	4	4
			Total	25	24

*Project work must be done under a faculty of the Department. The project supervisors may be allocated during the end of second semester. Project may also be done at any research/educational institutions under the combined guidance of a regular staff of the research Institution and a faculty from the Department. Completed project report may be submitted at the end of Semester VI in standard format.

** Study tour extending not less than six days may be conducted during the sixth semester. The tour should include National Fishery research and educational Institutions, harbours, visit to shrimp/fish hatchery, aquariums, farms etc., Few lecture classes may also be arranged during the tour. Visit to a natural coral/mangrove/ estuarine/riverine ecosystem and its fauna study must also be included. A tour report may be submitted at the end of the Semester VI, certified by the Head of the Department and the tour coordinator in bound form.

Semester VI

Course code – AQ6T15

AQUACULTURE MANAGEMENT

Total Hours-54

Credits – 4

Module 1: Principle of Aquaculture Systems (9 hrs.)

Definition, Principles and need for Aquaculture, Organisational systems, Operational systems and Degree of Intensification. Principles of culture systems and management, Scope of Aquaculture Management.

Module 2: Human Resource, Water and health management (9 hrs.)

Management skills, Motivation, Productivity, Water Quality Management, Aeration, Water Injection, Effluent- environmental impacts and treatment. Management of water supply.

Module3: Environmental Ethics (9 hrs.)

Management of scarce Natural Resources to commodity production for human consumption, Moral standing, animal rights.

Module 4: Production Economics (9 hrs.)

Microeconomic principles, Fixed and variable costs, Marginal analysis, cost concept, Taxes, Interest, Maintenance, Insurance, Depreciation, Total ownership costs.

Module 5: Records for managerial analyses, Production system limits(9 hrs.)

Management Principles, Definition, Scope, Principles, Henry Fayol Scientific Management - Application to Aquaculture, Capacity estimates, Production capacity assessment (PCA), Procedure for PCA.

Module 6: Decision making tools (9 hrs.)

Partial Budgeting, The Delphi Technique, Benefit-cost analysis, Present value analysis, Sensitivity analysis, decision trees.

Semester VI

Course code – AQ 6T16

AQUACULTURE ENGINEERING

Total Hours-54

Credits – 4

Module 1: Introduction (9 hrs.)

Technical components of farm designing, recent trends in aquaculture engineering.

Module 2: Aquaculture facilities (9 hrs.)

Planning process, site selection and evaluation, design, components and construction of tanks, ponds, cages and hatcheries.

Module 3: Water intake and outlet, treatment (9 hrs.)

Pipe line, water flow and head loss, pumps-different types. Equipment used for water treatment, filters, ultraviolet light, ozone, heating and cooling and other processes of disinfection.

Module 4: Aeration, oxygenation and Recirculation (9 hrs.)

Design and fabrication of aerators, compressors, blowers, paddle wheel aerators, oxygen injection system. Recirculation and water use systems Definition, components and design.

Module 5: Feeding system (9 hrs.)

Different types of feeding equipment, feed control systems, dynamic feeding systems.

Module 6: Instrumentation and monitoring (9 hrs.)

Instruments for measuring water quality.

Semester VI

Course code – AQ6T17

Fisheries Economics and Extension

Total Hours-54

Credits – 4

Module 1: Introduction (6 Hrs)

Economics- definition, meaning and scope of economics with reference to fisheries. Basic concepts of economics- goods, services, wants, utility. Demand and supply, value price, individual demand and market demand, elasticity of demand, law of diminishing marginal utility. Theory of production- the production function, the laws of returns, returns to scale, production function in a fishery. Average, marginal and total revenues. Pricing-various factors influencing the price of a product.

Module 2: Basics of Business (6 Hrs)

Nature and scope of business, meaning, definition, characteristics and functions of business. Requisites of a successful business, essential qualities of a good business man, different economic systems in operation- capitalism, communist economy and mixed economy. Classification of companies- sole, proprietorship, partnership, co-operative society, charter companies, public corporations and registered companies.

Module 3: Marketing and Economic Analysis

(6 Hrs)

Marketing – Introduction, basic marketing functions, consumer behavior and demand concepts, different types of market, identifying and selecting markets, regulation of markets, advertising and sales promotion, organizing market surveys and test marketing of a new product. Fish marketing – prices and price determination of fishes. Marketing institutions – Primary institutions- producer fishermen, fishermen cooperatives and fisheries corporations. Secondary institutions – merchant middlemen, agent middlemen and speculative middlemen. Methods of economic analysis of business organizations – pay-back period, average rate of return, discounting method, net present value method, benefit cost ratio method and internal rate of return. Preparation of project report and appraisal of project.

Module 4: Fisheries Economics

(6 Hrs)

Aquaculture economics – Application of economic principles to culture operations. Various inputs. Production function - its assumptions in aquaculture analysis. Least cost combination of inputs, laws of variable proportions.. Cost and earnings of aquaculture systems – carp culture, different shrimp farming systems

and hatcheries. Cost and earnings of mechanized and non mechanized fishing units and freezing plants. Socio- economic conditions of fishermen in India and Kerala. Contributions of fisheries to the national economy. Budget allocation for fisheries in Union and State budget

Module 5: Fisheries Co-operatives

(6 Hrs)

Co operation- basic principles, co operative legislation and its administrative structure. Fishermen co operatives, its functions, village societies, producing and marketing apex societies. Financing and special problems of fishermen co operatives and remedial measures. Role of National Co operative Development Corporation, Matsyafed and NABARD in uplifting the socio economic conditions of fishermen.

Module 6: Fisheries Extension

(6 Hrs)

Extension education – its meaning, importance and scope in fisheries. Various methods of extension – individual, group and mass methods, farm and home visits, seminars, discussions, exhibition and personal contacts. Extension and rural development – rural sociology, social structure and stratification, social institutions and community organizations.

OPEN COURSE- CORE – Choice Based

Semester VI

Course code – AQIF6CB1

FISHERY BY - PRODUCTS

Total Hours-72

Credits – 4

Module 1: Value Addition in Sea Foods (12 Hrs)

Value addition in sea food. Different types of value added products from fish and shell fish – status of value addition in Indian seafood sector. Advantages of value addition. Significance of value addition in the seafood industry.

Module 2: Fish Mince Based Products (12 Hrs)

Fish mince and Surimi. Production of fish mince – merits and demerits. Analog and fabricated products. Quality assessment of surimi,.. Equipment, raw material for surimi, Role of cryoprotectants in surimi production

Module 3: Coated Fishery Products (12 Hrs)

Preparation of coated fishery products – Different types of batter and breading and its applications – Packaging and storing of coated products – Quality evaluation.

Module 4: Other Value Added Products (12Hrs)

Preparation of products viz. fish / prawn pickle, fish wafers, prawn chutney powder, fish soup powder, fish protein hydrolysate, fish stacks, fillets, fish curry, mussel products, marinated products

Module 5: Fishery By-Products (12 Hrs.)

Fish meal, fish protein concentrate, shark fin rays, fish maws, isinglass, fish liver oil, fish body oil, fish hydrolysates, chitin, chitosan, glucosamine hydrochloride, squalene, pearl essence, ambergris, gelatin, beche-de-mer, fish silage, fish ensilage and seaweed products like agar, alginic acid and carragenan.

Module 6: Spoilage and quality (12 Hrs)

Spoilage in thermal processed products – Quality evaluation of thermal processed products – Curing and drying of fish – Spoilage in dry fish products.

Semester VI

Course code – AQIF6CB2

AQUACULTURE AND MANAGEMENT OF ECOSYSTEM

Total Hours-72

Credits – 4

Module 1: Aquaculture and ecosystem relationship (12 Hrs)

Ecosystems and productivity, biotic interaction within ecosystems and ecological homeostasis.

Module 2: Climate (12 Hrs)

Weather elements of concern in aquaculture, Green house gases, global warming and their impact.

Module 3: Impact of environment on aquaculture (12 Hrs)

Raw water source, physical and chemical characteristics, contaminants and pollutants (algae, pathogens, heavy metals, pesticides) and their effect on productivity.

Module 4: Impact of aquaculture on environment (12 Hrs)

Waste water discharge, its quality and quantity; impacts of effluents on ecosystems, chemical degradation of soil and water.

Module 5: Environment monitoring (12 Hrs)

Problems and preventive measures of antibiotic and drug residues, salination of soil and water, Eutrophication, Environment impact assessment and environmental audit, Biosensors in aquatic environment, toxicity assessment, Ecolabelling and traceability.

Module 6: Environment management (12 Hrs)

Introduction of exotics and escape of farmed fish, Pathogens in aquatic environment, Safety of aquaculture products, Role of microbes in aquatic environment; assessment of probiotic impact in aquaculture. Bioremediation.

Practical

Fish Processing Technology and Quality Control

Course code –AQ6P7 (CREDITS 2)

1. Determination of moisture content in fish and fishery products
2. General description – freezing
3. Processing shrimp
4. Filleting of fish
5. Drying of fish
6. Organoleptic analysis of fish
7. Preparation of fishery byproducts
8. Preparation of shark fin rays, fish maws, chitin and fish wafer
9. Fish pickling
10. Value added fishery products, fish curry, cutlets, fish finger.
11. Preparation of surimi

Course code – AQ6P8

Water and Soil Quality Parameters

Total hours - 36

Credits – 2

Experiments:

1. Determination of salinity
2. Determination of water pH
3. Determination of alkalinity
4. Determination of hardness of water
5. Determination of dissolved oxygen
6. Estimation of primary productivity
7. Determination of organic carbon in pond soil
8. Determination of nitrite / nitrate - demonstration
9. Determination of phosphate in pond water - demonstration
10. Determination of soil pH
11. Calculation of lime requirement
12. Grain size analysis of soil
13. Determination of Secchi disc transparency of water

BSc. INDUSTRIAL FISH & FISHERIES

SEMESTER – VI

No	Course	Course Code	Title	Hr/week	Credits
1	Core 15	IF6T15	Fisheries Management	6	4
2	Core 16	IF6T16	Fish processing technology and quality control	6	4
3	Core 17	IF6T17	Fishery Economics and marketing	5	4
4	Core practical 7	IF6P7	Fish processing technology and quality control	2	2
5	Core practical 8	IF6P8	Water and Soil Quality Parameters	2	2
6	Project work				2
7	Study tour				1
8	CORE- CHOICE BASED COURSE 1. Fishery by products 2. Aquaculture and Management of Ecosystems	AQIF6CB1 AQIF6CB2		4	4
			Total	25	23

*Project work must be done under a faculty of the Department. The project supervisors may be allocated during the end of second semester. Project may also be done at any research/educational institutions under the combined guidance of a regular staff of the research Institution and a faculty from the Department. Completed project report may be submitted at the end of Semester VI in standard format.

** Study tour extending not less than six days may be conducted during the sixth semester. The tour should include National Fishery research and educational Institutions, harbours, visit to shrimp/fish hatchery, aquariums, farms, seaweed culture etc., Few lecture classes may also be arranged during the tour. Visit to a natural coral/mangrove/ estuarine/riverine ecosystem and its fauna study must also be

included. A tour report must be submitted at the end of the Semester VI, certified by the Head of the Department and the tour coordinator in bound form.

Semester VI

Course code IF6T15

FISHERIES MANAGEMENT

Total Hours-54

Credits – 4

Module 1: Introduction

6hrs

Definitions and approaches, Scope and importance of Management, Management as an art of Science- Comparative Management.

Functions of Managers- Environment Impact management, Functions of Managers- Planning, Organising, Staffing, Directing and Controlling .

Contributions of Henry Fayol to the Scientific Techniques of management.

Module 2: Human resource Management

6hrs

Manpower planning and recruitment- Organisational Development- Training, Motivation, Morale and Productivity, Leadership, Organizational communication, Conflicts and Decision making. Human resource development and its role in the context of fisheries sector. Important Institutions involved in human resource development in Fisheries sector.

Module 3: Processing Sector Management

6Hrs

Organisational setup in processing Industries, State Fisheries Department. Role of EIA, MPEDA and CIFT in the processing Industry. Trade and exports- Export of Marine products- trends and present status - India's share In the International trade of sea foods.

Module 4: Fisheries Acts

6hrs

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

6hrs

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 sale promotion.

Module 6: Cooperatives and Agencies in Fisheries

6hrs

Definition, Principles of co-operatives, Role of National Cooperative development Corporation (NCDC), Matsyafed, National Federation of Fishermen cooperatives, FFDA, BFFDA, ADAK, FIRMA, Kerala Fishermen Welfare Fund Board, Kerala State Reservoir Fisheries Project. Problems of Fishery Cooperatives. Cooperatives and their importance in fish production and marketing. Role of NABARD and SIDBI.

Module 7: Fisheries Resource Management

6hrs

Population Dynamics: Methods used in the study of estimation of fish landing. Resource management measures- Conservation and Regulation of Fishing pressure, closed seasons, EEZ, sea ranching, artificial reefs, mesh size regulations, BRD/TED.

Module 9: Project formulation

6hrs

Project formulation, Process identification, Pre feasibility- technical, Economical and Social feasibility. Concept of capital budgeting and Its importance. Socially and financially viable indicators- Cash income , employment generation, rate of Return, DCF, NPV, IRR, and sensitivity analysis. Budgeting appraisal techniques- CPM, PERT, Schedule graphing and Decision making.

Semester VI

Course code IF6T16

Fish Processing Technology and Quality Control

Total Hours-54

Credits –

Module 1: Introduction (9 Hrs)

Principles of fish preservation. Precautions taken in handling fish in the fishing vessel, landing center and processing plant. Importance of hygiene and sanitation in fish handling. Quality of water and ice in fish handling and processing. Common equipments and utensils used in the processing plant. Preparation of ice. Different types of ice used in the seafood industry and their merits. Preservation by refrigerated seawater and chilled sea water

Module 2: Freezing and Canning

(9 Hrs)

Fundamental principles involved in chilling and freezing of fish and fishery products. Various freezing methods. Freezing of shrimps and fishes. Preparation of fish fillets. Changes during the cold storage of fish and fishery products. Principles involved in canning of fish. Different types of containers. Different stages of canning of Tuna. Retortable pouch processing. Constant pressure autoclave and study of F-value. Spoilage of canned products. Cut open test and commercial sterility.

Module 3: Drying, Smoking and Freeze-drying

(9 Hrs)

Principles of smoking, drying and salting of fish, factors affecting drying. Traditional drying / curing methods. Different types of drying. Drying of fish and prawns. Packing and storage of dried products. Spoilage of dried products. Preventive measures. Standards for dry fish products. Cold smoking. Principles of freeze drying. Accelerated freeze drying and packing of freeze dried products. Modern methods of preservation by irradiation and modified atmospheric storage.

Module 4: Quality Control

(9 Hrs)

Different types of spoilage in fishery products – chemical, physical and biological spoilage. Waste management in fish processing industries. Sanitation procedures in sea food processing plants. Quality control – basic concepts, quality and quality control. Necessity for quality control and factors controlling quality parameters. Salient features of sea food quality, quality factors. Risk factors in sea food-

biotoxins, sea food pathogens, endogenous parasites, physical, chemical and biological hazards.

Module 5: Quality Assurance

(9 Hrs)

Methods of evaluating fish freshness and quality – organoleptic, sensory, physical, chemical, microbiological and instrumental methods. Sampling systems followed in processing plants for testing the quality. Quality control programmes - pre-shipment inspection, IPQC, MIPQC and HACCP. Principles involved in HACCP system, HACCP team. Implementation of HACCP- hazard analysis, critical control point, critical limit. Good manufacturing practice (GMP) Sanitary standard operating procedure (SSOP) – monitoring system. Legislation on export inspection in India. Quality standards in India and major importing countries like USA, Japan and EU.

Module 6: Packing, Cold Storage and Export of Fishery Products

(9 Hrs)

Functions of packing. Different types of packing materials and its quality evaluation. Packing requirements for frozen and cured products. Statutory requirements for packing. Labeling requirements. Different types of cold storages. Requirements in retail outlet. Insulated and refrigerated vehicles. Distribution of frozen products by cold chain. Export of fishery products from India - major countries, important products, export documents and procedures. Prospects and constraints in export including tariff and non- tariff barriers, marine insurance, export incentives, registered exporters

Semester VI

Course code IF6T17

FISHERIES ECONOMICS AND MARKETING

Total Hours-54

Credits – 4

Module 1: Principles of economics (9hrs.)

Definition, subject matter and scope of economics. Law of diminishing returns, laws of increasing, constant and decreasing utility and returns. Law of equi-marginal returns. Importance of economics in aquaculture development.

Module 2: Economy of fishermen (9hrs.)

Fishermen populations, GDP from fisheries sector, foreign exchange earnings and employment potential of fishing industry.

Module 3: Prospective of Aquaculture in Socio-Economic impact & Rural Development (9hrs.)

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 4: Marketing (9hrs.)

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. Role of MPEDA in exports of fish and fishery products.

Module 5: Planning and extension

(9hrs.)

Fishery development plans and various schemes, with particular reference to Fish Farmer's Development Agencies, their achievements.

Module 6: Fishery co-operatives

(9hrs.)

Functions, financial assistance, input supplies, marketing of fish. Socio-economic development. Role of fisheries corporations and Missionary Organizations in fisheries development.

OPEN COURSE- CORE – Choice Based

Semester VI

Course code – AQIF6CB1

FISHERY BY - PRODUCTS

Total Hours-72

Credits – 4

Module 1: Value Addition in Sea Foods (12 Hrs)

Value addition in sea food. Different types of value added products from fish and shell fish – status of value addition in Indian seafood sector. Advantages of value addition. Significance of value addition in the seafood industry.

Module 2: Fish Mince Based Products (12 Hrs)

Fish mince and Surimi. Production of fish mince – merits and demerits. Analog and fabricated products. Quality assessment of surimi,.. Equipment, raw material for surimi, Role of cryo protectants in surimi production

Module 3: Coated Fishery Products (12 Hrs)

Preparation of coated fishery products – Different types of batter and breading and its applications – Packaging and storing of coated products – Quality evaluation.

Module 4: Other Value Added Products (12Hrs)

Preparation of products viz. fish / prawn pickle, fish wafers, prawn chutney powder, fish soup powder, fish protein hydrolysate, fish sticks, fillets, fish curry, mussel products, marinated products

Module 5: Fishery By-Products (12 Hrs.)

Fish meal, fish protein concentrate, shark fin rays, fish maws, isinglass, fish liver oil, fish body oil, fish hydrolysates, chitin, chitosan, glucosamine hydrochloride, squalene, pearl essence, ambergris, gelatin, beche-de-mer, fish silage, fish ensilage and seaweed products like agar, alginic acid and carragenan.

Module 6: Spoilage and quality (12 Hrs)

Spoilage in thermal processed products – Quality evaluation of thermal processed products – Curing and drying of fish – Spoilage in dry fish products – Masmin, Bombay duck

Semester VI

Course code – AQIF6CB2

AQUACULTURE AND MANAGEMENT OF ECOSYSTEM

Total Hours-72

Credits – 4

Module 1: Aquaculture and ecosystem relationship (12 Hrs)

Ecosystems and productivity, biotic interaction within ecosystems and ecological homeostasis.

Module 2: Climate (12 Hrs)

Weather elements of concern in aquaculture, Green house gases, global warming and their impact.

Module 3: Impact of environment on aquaculture (12 Hrs)

Raw water source, physical and chemical characteristics, contaminants and pollutants (algae, pathogens, heavy metals, pesticides) and their effect on productivity.

Module 4: Impact of aquaculture on environment (12 Hrs)

Waste water discharge, its quality and quantity; impacts of effluents on ecosystems, chemical degradation of soil and water.

Module 5: Environment monitoring (12 Hrs)

Problems and preventive measures of antibiotic and drug residues, salination of soil and water, Eutrophication, Environment impact assessment and environmental audit, Biosensors in aquatic environment, toxicity assessment, Ecolabelling and traceability.

Module 6: Environment management (12 Hrs)

Introduction of exotics and escape of farmed fish, Pathogens in aquatic environment, Safety of aquaculture products, Role of microbes in aquatic environment; assessment of probiotic impact in aquaculture.

Practical

Fish Processing Technology and Quality Control

Course code – IF6P7

(2CREDITS)

1. Determination of moisture content in fish and fishery products
2. General description – freezing
3. Processing shrimp
4. Filleting of fish
5. Drying of fish
6. Organoleptic analysis of fish
7. Preparation of fishery by products
8. Preparation of shark fin rays fish maws, chitin, fish wafer
9. Fish pickling
10. Value added fishery products, fish curry, cutlets fish finger.
11. Preparation of surimi

Course code – IF6P8

Water and Soil Quality Parameters

Total hours - 36

Credits – 2

Experiments:

1. Determination of salinity
2. Determination of water pH
3. Determination of alkalinity
4. Determination of hardness of water
5. Determination of dissolved oxygen
6. Estimation of primary productivity
7. Determination of organic carbon in pond soil
8. Determination of nitrite / nitrate - demonstration
9. Determination of phosphate in pond water - demonstration
10. Determination of soil pH
11. Calculation of lime requirement
12. Grain size analysis of soil
13. Determination of Secchi disc transparency of water