



**Assam University
Silchar**

Curriculum

for

Four Year Under Graduate Programme

in

INDUSTRIAL FISH & FISHERIES

under

National Education Policy – 2020

w.e.f.

Academic Session 2023-24



Assam University, Silchar

NEP 2020 FYUGP Course Curriculum (Industrial Fish & Fisheries)

Course Structure

Sem	DSM - 1	DSM - 2	IDC	SEC
I	IFF:DSM-101 (3) Taxonomy & Physiology		IFF:IDC-101 (3) Aquaculture Systems and Management	IFF:SEC-101 (3) Fresh Water Aquaculture
II		IFF:DSM-151 (3) Aquaculture & Aquatic Environment	IFF:IDC-151 (3) Fishery Economics, Fish Marketing, Fishery Cooperative, Fish Processing, Fishery Products and By-Products	IFF:SEC-151 (3) Fishery Economics, Fish Marketing, Fishery Cooperatives, Financing in Fishery, Disaster Management
III	- IFF:DSM-201 (4) Fish Reproduction, Development, Breeding, Hatchery Management & Fish Pathology		IFF:IDC-201 (3) Aquarium Management, Modern Aquaculture & Livelihood Opportunities in Fisheries	IFF:SSEC-201 (3) Modern Aquaculture Techniques, Pearl Culture, Biostatistics, Fishery Legislation



IV	- IFF:DSM-251 (3) Practical	IFF:DSM-252 (3) Capture Fisheries & Coastal Aquaculture		
V	- IFF:DSM-301 (3) Fish Genetics, Biotechnology, Microbiology, Aquatic Toxicology & Germplasm	IFF:DSM-302 (3) Fish Genetics, Biotechnology, Microbiology, Aquatic Toxicology & Germplasm Conservation		
VI		IFF:DSM-351 (4) Practical		
VII	IFF:DSM-401 (4) Applied Fishery-I: Aquarium Management, Post-Harvest Technology, Entrepreneurship Development			
VIII		IFF:DSM-451 (4) Applied Fishery-II: Fishery Economics, Fish Marketing, Fishery Extension & Cooperatives, Financing in Fishery, Disaster Management		

Note- Figures in the parenthesis represent credits assigned to the paper.



Marks Distribution

DSM and IDC Papers: All theory papers will have 70% External evaluation and 30% internal evaluation. In practical papers, the marks distribution will be as follows:			SEC Papers	
Description	Marks		Marks	
	External Assessment (A)	Internal Assessment (B)	Theory	50
Major experiment	28	15	Practical	30
Minor experiment	21	6	Internal	20
Viva-voce	14	6	Total	100
Record and submission	7	3	* Marks distribution is as given in the previous column marked (B)	
Total	70	30		



SEMESTER - I

IFF: DSM-101

Course Title: **Taxonomy & Physiology**

Credits: 3

Contact hours: 45

Marks: 100

(All units are of equal credits)

Learning objectives: *To understand the manner in which the fishes are classified as well as get insight into their physiology*

Unit-I: Basic Taxonomy

1. Definition of taxonomy, taxonomic terms. Role of taxonomy.
2. Nomenclature and its importance. Binomial nomenclature.
3. Difference between systematics and taxonomy, purpose of classification.
4. Species concept- Biological and typological, Subspecies and Sibling species

Unit-II: Fish Taxonomy & Diversity

1. General characters and outline classification of Pisces up to order with examples.
2. Preliminary methods in fishery science study, Body measurements of a fish
3. Biodiversity of Ichthyofauna of N.E. India.
4. Major Groups of Fishes: Major Carps, Minor carps, Catfishes, Murrels, Mullet, Live Fishes, Clupeoids etc.
5. Morphological variation in body form, fins, body colouration scales, mouth, snouts, jaws, teeth & fins.
6. Scales - Types, use of scales in classification and life history

Unit-III: Fish Physiology I

1. Food and feeding habits in fishes.
2. Digestive system of any Indian major carp and Scoliodon
3. Mechanism of digestion. Role of digestive glands in digestion.
4. Respiration in fishes structure of gills, air bladder, accessory respiratory organs their functions, and mechanism of respiration.

Unit-IV: Fish Physiology II

1. Circulatory system of *Labeo rohita* & *Channa* sp.
2. Excretion and osmoregulation in fresh water and marine aquatic environment.
3. Colouration - sources of colour, colour changes, control of colour changes, significance.
4. Bioluminescence in Fishes.

Unit-V: Sense organs and Endocrine system

1. Structure of brain of any teleost fish, cranial nerves in teleost.
2. Different type of sense organs- lateral line system, olfactory, auditory and photoreceptor.
3. Electricity producing organs in fishes
4. Mechanism of sound production in fishes
5. Structure and function of endocrine glands in fishes- pituitary gland, thyroid, interrenal tissue. Chromaffin tissue, pancreatic islets, pheromones, urophysis, organs of stanius.



Course outcome: Students will be able to effectively distinguish among different fishes and understand their physiology

Suggested Readings:

1. Fish & Fisheries-Kamaleshwar Pandey and J.P. Shukla, Rastogi Publications.
2. General and Applied Ichthyology (Fish & Fisheries)-S.K. Gupta & P.C. Gupta, S. Chand Publications.
3. A Text Book of Fish Fisheries and Technology-K.P. Biswas, Narendra Publishing House.
4. Aquaculture- K.K. Jha, Daya Publishing House
5. Applied Fishery Science-S.M. Shafi, Atlantic Publishers and Distributors
6. A Textbook of Fishery Science and Indian Fisheries-C.B.L. Srivastava, Kitab Mahal.
7. Ornamental Fish and Fisheries-J. Bora & S. Chakraborty, Ashok Publications.
8. A Textbook of Fish and Fisheries-B. Singha and A. Dey, Invincible Publications.

IFF: IDC-101

Course Title: **Aquaculture Systems and Management**

Credits: 3

Contact hours: 45

Marks: 100

(All units are of equal credits)

Learning objectives: To understand the importance of aquaculture. Besides to get an idea about how aquaculture systems work and managed

Unit-I: Basics of Aquaculture

1. Aquaculture-Definition & Importance
2. Categories of Farm types and Fish Farming system
3. Cultivable freshwater fish species and their selection criteria
4. Culture of Fish & Non-fish organisms and their importance

Unit-II: Systems of Aquaculture-I

1. Composite Fish Culture
2. Integrated Fish Farming-Paddy cum fish culture, Poultry cum fish culture, Duck cum fish culture, Piggery cum Fish culture
3. Air breathing and Carnivorous fish culture, Cage Culture, Pen culture, Mono culture & Monosex culture
4. Sewage fed fish culture-Sewage treatment techniques and its use in fish pond

Unit-III: System of Aquaculture-II

1. Elementary idea of Exotic fishes, Larvivorous fishes, Hill stream fishes, Predatory fishes and weed fishes
2. Management of Aquatic weeds, Algal bloom, Aquatic insects, Predatory and Weed Fishes.
3. Culture of freshwater Prawn
4. Freshwater Pearl culture and its economic importance.

Unit-IV: Aquaculture Management-I

1. Construction of various types of ponds for fish culture



2. Pre-stocking and post-stocking management of fish pond.
3. Nutritional requirements of cultivable fish, Feeding technique and devices.
4. Feed formulation and manufacturing of Artificial Feed, Storage of Food

Unit-V: Aquaculture Management-II

1. Breeding habits of cultivable fish species.
2. Bundh breeding-types and techniques
3. Induced breeding technique- Process & Advantage
4. Fish Seed Farm & Hatchery Management

Course outcome: Students will be able gain knowledge about the different forms of aquaculture practices and their management

Suggested Readings:

1. Fish & Fisheries-Kamaleshwar Pandey and J.P. Shukla, Rastogi Publications.
2. General and Applied Ichthyology (Fish & Fisheries)-S.K. Gupta & P.C. Gupta, S. Chand Publications.
3. A Text Book of Fish Fisheries and Technology-K.P. Biswas, Narendra Publishing House.
4. Aquaculture- K.K. Jha, Daya Publishing House
5. Applied Fishery Science-S.M. Shafi, Atlantic Publishers and Distributors
6. A Textbook of Fishery Science and Indian Fisheries-C.B.L. Srivastava, Kitab Mahal.
7. Ornamental Fish and Fisheries-J. Bora & S. Chakraborty, Ashok Publications.
8. A Textbook of Fish and Fisheries-B. Singha and A. Dey, Invincible Publications.

IFF: SEC-101

Course Title: **Fresh Water Aquaculture**

Credits: 3

Contact hours: 60

Marks: 100

THEORY

Credits: 2

Contact hours: 30

Marks: 50

(All units are of equal credits)

Learning objectives: To understand in details about the fresh water aquaculture system as well as first hand practice through associated practicals.

Unit-I: Introduction to Aquaculture

1. Aquaculture-Definition, Types. Scope & Importance of Fresh Water Aquaculture
2. Categories of Farm Type and Fish Farming System
3. Biology of exotic fishes.
4. Elementary idea of Larvivorous Fishes, Hill Stream Fishes, Predatory Fishes and Weed Fishes
5. Status of Aquaculture in India.

Unit-II: Pond Construction & Management

1. Types of Ponds for Fish culture- Hatching, Nursery, Rearing & Stocking ponds
2. Construction and maintenance of fish farm



3. Pond Management: Pre-stocking (Liming, Fertilization etc.)
4. Post-stocking Management of Ponds (Feeding, Thinning, Harvesting)

Unit-III: Aquaculture Management

1. Aquatic weeds - significance & control
2. Algal bloom - types, bloom formation, effects of algal bloom on productivity of fish pond
3. Aquatic insects- control measures
4. Predatory & Weed fishes

Unit-IV: Fish Nutrition

1. Nutritional requirements of cultivable fish and shellfish. Deficiency diseases.
2. Feed formulation and manufacturing of Artificial Feed. Storage of Feed.
3. Forms of feeds: wet feeds, moist feeds, dry feeds, mashes, pelleted feeds, floating and sinking pellets.
4. Feeding techniques to fishes. Feeding Devices and Methods
5. Feed additives: binders, antioxidants, enzymes, pigments, growth promoters, feed stimulants, use of preservatives and antioxidants.
6. Feed evaluation - feed conversion ratio, feed efficiency ratio, protein efficiency ratio, net protein utilization and biological value.

Unit-V: Analysis of Soil & Water Quality

1. Principles and Methods of estimation of pH and texture and Moisture content of Soil.
2. Principles and Methods of estimation of pH, Turbidity, Dissolved Oxygen & Dissolved Carbon dioxide of water.
3. Biological Oxygen Demand (BOD) & Chemical Oxygen Demand (COD)- concept and importance in Aquaculture. Methods of Estimation of BOD & COD.
4. Principle and Methods of Estimation of Total alkalinity, Total Hardness, Salinity, Organic Carbon, Nitrogen, Phosphate, Sulphate, Chloride.

***Course outcome:** Students will be able to understand the different aspects of aquaculture practices, management, fish nutrition as well as should be able to know the importance of water quality in aquaculture and the methods to analyse soil and water quality. Besides, they will get first hand practical experience on the subject*

Suggested Readings:

1. Fish & Fisheries-Kamaleshwar Pandey and J.P. Shukla, Rastogi Publications.
2. General and Applied Ichthyology (Fish & Fisheries)-S.K. Gupta & P.C. Gupta, S. Chand Publications.
3. A Text Book of Fish Fisheries and Technology-K.P. Biswas, Narendra Publishing House.
4. Aquaculture- K.K. Jha, Daya Publishing House
5. Applied Fishery Science-S.M. Shafi, Atlantic Publishers and Distributors
6. A Textbook of Fishery Science and Indian Fisheries-C.B.L. Srivastava, Kitab Mahal.
7. Ornamental Fish and Fisheries-J. Bora & S. Chakraborty, Ashok Publications.
8. A Textbook of Fish and Fisheries-B. Singha and A. Dey, Invincible Publications.
9. A Text Book of Fish Biology and Fisheries by S.S Khanna and H R Singh, Narendra Publishing House
10. An Introduction to Fishes by S.S. Khanna, Surjeet Publications



IFF: SEC-101 - PRACTICAL

Credit: 1

Contact Hours: 30

Marks: 30

1. Identification of Larvivorous Fishes, Hill Stream Fishes, Predatory Fishes and Weed Fishes
2. Identification of Aquatic Weeds, Aquatic Insects, Predatory and Weed fishes.
3. Determination of Soil and Water Quality parameters-
 - a) Texture, Moisture, pH of soil.
 - b) pH, Turbidity, Dissolved Oxygen and Dissolved Carbon dioxide of water
4. Visit to a Fish Farm to get exposure on the process of Construction and Management of a fish farm.



SEMESTER - II

IFF: DSM-151

Course Title: **Aquaculture & Aquatic Environment**

Credits: 3

Contact hours: 45

Marks: 100

(All units are of equal credits)

***Learning objectives:** To understand the importance and different aspects of aquaculture and its management*

Unit-I: Basics of Aquaculture

1. Aquaculture – Definition, History of aquaculture
2. Importance of aquaculture. Present status of aquaculture
3. Categories of farm type and fish farming system.
4. Basic considerations in the selection of species for culture.
5. Cultivable fresh water fin fishes and non-fish organism

Unit-II: Aquatic Environment

1. Food chain, Food web & Primary productivity of aquatic ecosystem
2. Planktons, Nektons and Benthos-Definition, Types and Importance in Aquaculture
3. Water quality and soil condition of fish pond. Management of soil and water for aquaculture.
4. Limiting factors- definition & principles
5. Aquatic insects & their control
6. Dynamics of lentic and lotic environments.

Unit-III: System of Aquaculture I

1. Cold water and Raceway Fish Culture
2. Cage culture of fishes and its importance
3. Pen culture of fishes and its importance
4. Mono culture and mono sex culture
5. Culture of fresh water prawn and pearl

Unit-IV: System of Aquaculture II

1. Composite fish culture
2. Integrated fish farming- definition paddy cum fish culture, poultry cum fish culture, duck cum fish culture, piggery cum fish culture.
3. Air breathing and carnivorous fish culture
4. Sewage Fed Fish Culture, Sewage treatment techniques for fish culture and its use in Fish ponds.
5. Organic aquaculture – elementary knowledge & its significance.

Unit-V: Fresh Water Aquaculture

1. Types of Ponds for Fish culture. Construction and maintenance of fish farm (Hatching, Nursery, Rearing & Stocking ponds).



2. Pond Management-Prestocking (Liming , Fertilization etc.) and Post-stocking Management of Ponds (Feeding, Thinning, Harvesting)
3. Aquatic weeds & their control & importance
4. Algal bloom – types, bloom formation effects of algal bloom on fish.
5. Fish feed: Definition, classification, live and artificial feed, Nutritional requirements of fish, Principles of feed formulation, Types and preparation of artificial feed.
6. Elementary idea of Exotic Fishes, Larvivorous Fishes, Hill Stream Fishes, Predatory Fishes, predatory insects and Weed Fishes

Course outcome: *Students will be able to get basic information and specific aspects of aquaculture. Besides, they will be able to understand the different forms of aquaculture practices and their advantages and disadvantages*

Suggested Readings:

1. Fish & Fisheries-Kamleshwar Pandey and J.P. Shukla, Rastogi Publications.
2. General and Applied Ichthyology (Fish & Fisheries)-S.K. Gupta & P.C. Gupta, S. Chand Publications.
3. A Text Book of Fish Fisheries and Technology-K.P. Biswas, Narendra Publishing House.
4. A Textbook of Fishery Science and Indian Fisheries-C.B.L. Srivastava, Kitab Mahal.
5. Ornamental Fish and Fisheries-J. Bora & S. Chakraborty, Ashok Publications.
6. A Textbook of Fish and Fisheries-B. Singha and A. Dey, Invincible Publications.
7. A Text Book of Fish Biology and Fisheries by S.S Khanna and H R Singh, Narendra Publishing House
8. An Introduction to Fishes by S.S. Khanna, Surjeet Publications

IFF: IDC–151

Course Title: **Fishery Economics, Fish Marketing, Fishery Cooperative, Fish Processing, Fishery Products and By-Products**

Credits: 3

Contact hours: 45

Marks: 100

(All units are of equal credits)

Learning objectives: *To understand the economics of fishery such as marketing, processing and the products and by-products of the industry.*

Unit-I: Fishery Economics

1. Principles of economics: Definition, Law of diminishing returns, laws of increasing, constant and decreasing utility and returns.
2. Importance of economics in aquaculture development.
3. Economic value of fishes
4. Maximum Sustainable Yield (MSY), Maximum Economic Yield (MEY), Optimum, Sustainable Yield (OSY)

Unit-II: Fish Marketing

1. Fish marketing- definition, Aim, Characteristic, Types and Stages of fish marketing.
2. Marketing channels and supply chain, Marketing margins, Marketing environment, Marketing strategies



3. Methods of selling fish, Price Determination marketing organization and improvement.
4. Cold storage and other marketing infrastructure in India.

Unit-III: Fishery Cooperatives & Fishing Community

1. Fishery co-operative- Aim and role of co-operative in fishery economy. Organization of fishermen co-operatives.
2. Fisheries extension- Definition, extension philosophy and Methodology
3. Fishing community and their socio- economic problems.
4. Fish farmers development Agencies (FFDA)

Unit-IV: Fish Processing & Preservation

1. Preservation- Definition, principles, merits and demerits of preservation.
2. Causes of spoilage of fish. Use of fish preservations and problems in fish preservation
3. Methods of preservation chilling, freezing, canning, semidrying, salting, smoking, brining
4. Advantages and Disadvantages of preservation with chemicals.

Unit-V: Fishery Products and By-products

1. Processing and preservation of fish by product - fish liver and body oil, fish meal, fish silage, fish manure, fish sauce and guano, fish guano and isinglass and fish leather.
2. Nutritional Value of fishery by-products and processed fish food.
3. Entrepreneurship/Business opportunities with processed fish products

Course outcome: Students will be able to get deeper insights into the commercial aspects of fishery and aquaculture which may motivate their entrepreneurial faculties

Suggested Readings:

1. Fish & Fisheries-Kamaleshwar Pandey and J.P. Shukla, Rastogi Publications.
2. General and Applied Ichthyology (Fish & Fisheries)-S.K. Gupta & P.C. Gupta, S. Chand Publications.
3. A Text Book of Fish Fisheries and Technology-K.P. Biswas, Narendra Publishing House.
4. Applied Fishery Science-S.M. Shafi, Atlantic Publishers and Distributors
5. A Textbook of Fishery Science and Indian Fisheries-C.B.L. Srivastava, Kitab Mahal.
6. Ornamental Fish and Fisheries-J. Bora & S. Chakraborty, Ashok Publications.
7. A Textbook of Fish and Fisheries-B. Singha and A. Dey, Invincible Publications.



IFF: SEC-151

Course Title: **Fishery Economics, Fish Marketing, Fishery Cooperatives, Financing in Fishery, Disaster Management**

Credits: 3

Contact hours: 60

Marks: 100

THEORY

Credits: 2

Contact hours: 30

Marks: 50

(All units are of equal credits)

Learning objectives: *To understand the economics of fishery such as marketing, processing and the products and by-products of the industry.*

Unit-I: Fishery Economics

1. Principles of economics: Definition, Law of diminishing returns, laws of increasing, constant and decreasing utility and returns.
2. Importance of economics in aquaculture development.
3. Economic value of fishes,
4. Maximum Sustainable Yield (MSY), Maximum Economic Yield (MEY), Optimum Sustainable Yield (OSY)

Unit-II: Fish Marketing

1. Fish marketing- definition, Aim, Characteristic, Types and Stages of fish marketing.
2. Marketing channels and supply chain, Marketing margins, Marketing environment, Marketing strategies,
3. Fish marketing : Characteristics of fish marketing channels & stages of fish marketing. Factors affecting fish marketing patterns
4. Cold storage and other marketing infrastructure in India.
5. Methods of selling fish, Price Determination marketing organization and improvement.
6. Exports of fish and fishery products, trends and problems therein. Role of MPEDA in exports of fish and fishery products.

Unit-III: Fishery Extension & Co-operatives

1. Fishery co-operative- Aim and role of co-operative in fishery economy. Organization of fishermen co-operatives.
2. Fisheries extension- Definition, extension philosophy and Methodology
3. Fishing community and their socio- economic problems.
4. Fish farmers development Agencies (FFDA)
5. Rational Fishery: Introduction organization of rational fishery management Fishery survey and statistics

Unit-IV: Scopes & Financing in Fishery Management

1. Study, training & research opportunities in Fisheries in India with reference to NER
2. Credit Requirements & Role of credit for fisheries
3. Schemes of National Fishery Development Board (NFDB) & NABARD
4. Role of District Fishery Development Office.
5. Role of insurance in Fish Farming Industry.



Unit-V: Disaster Management in Fisheries

1. Basic concepts: Hazard, risk, vulnerability, disaster, capacity building
2. Types of natural and manmade hazards in fisheries and aquaculture - cyclones, floods, droughts, tsunami, El-nino, habitat destruction, over fishing, introduction of exotic species
3. Management strategies: pre-disaster, during disaster and post-disaster, early warning, communication and dissemination, community based disaster preparedness, structural and non- structural mitigation measures.

Course outcome: Students will be able to get deeper insights into the commercial aspects of fishery and aquaculture which may motivate their entrepreneurial faculties and the access to resources for such endeavours

Suggested Readings:

1. Fish & Fisheries-Kamleshwar Pandey and J.P. Shukla, Rastogi Publications.
2. General and Applied Ichthyology (Fish & Fisheries)-S.K. Gupta & P.C. Gupta, S. Chand Publications.
3. A Text Book of Fish Fisheries and Technology-K.P. Biswas, Narendra Publishing House.
4. Aquaculture- K.K. Jha, Daya Publishing House
5. Applied Fishery Science-S.M. Shafi, Atlantic Publishers and Distributors
6. A Textbook of Fishery Science and Indian Fisheries-C.B.L. Srivastava, Kitab Mahal.
7. A Text Book of Fish Biology and Fisheries by S.S Khanna and H R Singh, Narendra Publishing House
8. An Introduction to Fishes by S.S. Khanna, Surjeet Publications

IFF: SEC 151 - PRACTICAL

Credit: 1

Contact Hours: 30

Marks: 30

1. Survey of local Fish Markets and Preparation of Project Report on Demand and Supply, Supply Chain, Marketing Management, Pricing of various Fishes, Transportation and Storage of Fishes, other Market strategies, Consumer Behaviour etc.
2. Organising Lectures/Interaction Programmes/Students' Exposure Programme on Study and Training Opportunities/ Financing in Fisheries/Disaster management in Fisheries by engaging People from District and State Fisheries Development Offices/NABARD/NFDB/Bank Officers/Established Fisherman Community/any other Related person and Experts in the Field
3. A Report on the various Govt. Schemes, and Bank Loans, Procedure for applying for Loans, Survey on various Activities successful Fishery Cooperatives or other related topic is to be submitted based on Lectures/Interaction



SEMESTER - III

IFF: DSM-201

Course Title: **Fish Reproduction, Development, Breeding, Hatchery Management & Fish Pathology**

Credits: 4

Contact hours: 60

Marks: 100

(All units are of equal credits)

***Learning objectives:** To understand the advance aspects of fishery science such as their reproduction, breeding, hatchery management as well as get knowledge about fish pathology*

Unit-I: Fish Reproduction

1. Male reproductive organ and its seasonal histomorphological changes and GSI (Gonado somatic index)
2. Female reproductive organs- different stages in the maturation of an oocyte
3. Maturation and spawning, Factors affecting spawning in fishes.
4. Sexual dimorphism, Courtship and Migration in fishes for spawning

Unit-II: Larval Development

1. Types of Eggs, ovulation & fertilization
2. Gastrulation in fishes- early development
3. Fecundity – definition, types, Methods of estimation of fecundity.
4. Parental care in fishes.
5. Growth and age studies of fish- Introduction, length weight relationship, linear growth Characteristics, age determination

Unit-III: Selection & Breeding in Fishes

1. Brood selection and its principle
2. Breeding habits of cultivable Fish species
3. Different Methods of Breeding-Inbreeding, Outbreeding, Cross Breeding, Selective Breeding and Random Breeding
4. Bundh Breeding-Types, Technique. Collection and Hatching of Eggs. Improvement and Problems of Bundh Breeding
5. Induced Breeding with reference to carp, Hypophysation technique, use of Natural and Synthetic Hormones

Unit-IV: Fish Seed Rearing & Hatchery Management

1. Different stages of seed: Spawn, Fry and Fingerlings
2. Fish Seed Collection from Natural Resurces
3. Hatchery Technology
4. Transport of Fish Seed, Fry, Fingerlings and Brood Fishes

Unit-V: Fish Diseases & Immunology

1. Disease types- infections and Non infections
2. Infection fish disease with their remedial measure- Bacterial, Viral, Fungal, EUS, protozoon, Metazoan (Helminths, Annelids and Crustacean)
3. Non infections disease- Environmental, Nutritional.



4. Significance of fish disease in relation to aquaculture practices and fish farm management.
5. Pathological changes in organs and tissues of fishes and diagnosis of fish disease.
6. Fish immunization and vaccine

Course outcome: *Students will be able to effectively understand the details of fishery including fish development, breeding, hatchery management and fish diseases to make them able to take informed decisions.*

Suggested Readings:

1. Fish & Fisheries-Kamaleshwar Pandey and J.P. Shukla, Rastogi Publications.
2. A Text Book of Fish Fisheries and Technology-K.P. Biswas, Narendra Publishing House.
3. Aquaculture- K.K. Jha, Daya Publishing House
4. Applied Fishery Science-S.M. Shafi, Atlantic Publishers and Distributors
5. A Textbook of Fishery Science and Indian Fisheries-C.B.L. Srivastava, Kitab Mahal.
6. Ornamental Fish and Fisheries-J. Bora & S. Chakraborty, Ashok Publications.
7. A Textbook of Fish and Fisheries-B. Singha and A. Dey, Invincible Publications.

IFF: IDC–201

Course Title: **Aquarium Management, Modern Aquaculture & Livelihood Opportunities in Fisheries**

Credits: 3

Contact hours: 45

Marks: 100

(All units are of equal credits)

Learning objectives: *To understand about aquarium management, modern aquaculture practices as well as livelihood opportunities in fisheries*

Unit-I: Aquarium Management I

1. Aquarium- Definition and types.
2. Aquarium design and Construction: Design and construction of home and public aquaria (Freshwater and Marine)
3. Aquarium fishes - live bearers and egg layers.
4. Aquarium maintenance and water quality management. Control of snail and algal growth, Temperature acclimation. Food and feeding for aquarium fishes

Unit-II: Aquarium Management II

1. Freshwater Ornamental Fishes & Aquarium Plants
2. Breeding of ornamental fishes. Selection and conditioning of fishes for breeding
3. Common diseases of aquarium fishes and treatment.
4. Indigenous ornamental fishes of North East India.

Unit-III: Modern Fish Culture Techniques-I

1. Breeding and Culture of Clarias and Pabda.



2. Chinese Eco-hatchery: Establishment, Management and Advantages
3. Culture of Tilapias: Cultivated species of tilapia, Culture systems, Spawning and production of seed stock
4. Culture of fresh water prawn.

Unit-IV: Modern Fish Culture Techniques-II

1. Aquaponics: Techniques and Management
2. Biofloc culture system: Requirements, Advantages and Disadvantages
3. Concept of Recirculatory Aquaculture system (RAS), Raceway & IPRS culture
4. Integrated Multi-trophic Aquaculture (IMTA) and Periphyton culture

Unit-V: Scopes and Financing in Fisheries

1. Study, training and Research opportunities in Fisheries in India with special reference to NER.
2. Fishery Schemes under Govt. of India as well as Govt. of Assam. Schemes of NFDB, & NABARD.
3. Role of District Fishery Development Office in facilitating livelihood through fisheries
4. Entrepreneurship opportunities in fisheries and aquaculture.

Course outcome: *Students will be able to understand the modern aquarium management practices as well as motivate them to work towards using these as a source of livelihood.*

Suggested Readings:

1. Ornamental Fish and Fisheries-J. Bora & S. Chakraborty, Ashok Publications.
2. Fish & Fisheries-Kamleshwar Pandey and J.P. Shukla, Rastogi Publications.
3. General and Applied Ichthyology (Fish & Fisheries)-S.K. Gupta & P.C. Gupta, S. Chand Publications.
4. A Text Book of Fish Fisheries and Technology-K.P. Biswas, Narendra Publishing House.
5. Aquaculture- K.K. Jha, Daya Publishing House
6. Applied Fishery Science-S.M. Shafi, Atlantic Publishers and Distributors
7. A Textbook of Fishery Science and Indian Fisheries-C.B.L. Srivastava, Kitab Mahal.



IFF: SEC-201

Course Title: **Modern Aquaculture Techniques, Pearl Culture, Biostatistics, Fishery Legislation**

Credits: 3

Contact hours: 60

Marks: 100

THEORY

Credits: 2

Contact hours: 30

Marks: 50

(All units are of equal credits)

Learning objectives: *To understand Modern Aquaculture Techniques, Pearl Culture, Biostatistics, Fishery Legislation*

Unit-I: Modern Aquaculture Techniques-I

1. Breeding and Culture of Clarias and Pabda.
2. Chinese Eco-hatchery: Establishment, Management and Advantages
3. Culture of Tilapias: Cultivated species of tilapia, Culture systems, Spawning and production of seed stock
4. Culture of fresh water prawn.

Unit-II: Modern Aquaculture Techniques-II

1. Aquaponics: Techniques and Management
2. Biofloc culture system: Requirements, Advantages and Disadvantages
3. Concept of Recirculatory Aquaculture system (RAS), Raceway & IPRS culture
4. Integrated Multi-trophic Aquaculture (IMTA) and Periphyton culture

Unit-III: Pearl Culture

1. Morphology and anatomy of Pearl oyster. Life cycle of pearl oyster.
2. Structure and Histology of mantle. Natural Process of Pearl formation. Chemical composition of Pearls.
3. Pearl oyster culture: Techniques of pearl oyster culture (Fresh water and Marine water) for artificial production of pearls. Pearl culture techniques -Rafts, long lines, Pearls oyster baskets, under water platforms, mother oyster culture/Collection of oysters, rearing of oysters,
4. Diseases and Predators of Pearl oysters.

Unit-IV: Statistical Methods in Fisheries

1. Preliminary concept, Measures of Central Tendency- Mean, Median, Mode.
2. Measures of variation-Range, mean deviation, standard deviation, coefficient of variation.
3. Correlation & Regression.
4. Application of statistics in Fishery

Unit-V: Fisheries Administration and Legislation

1. Introduction to public administration, principles of organization and management of public enterprise.
2. Central and State responsibilities for fisheries development, organizational set up of



fisheries administration at the Centre and state levels. Fishery corporations and cooperatives.

3. Different central and state level fisheries institutions. Role of Central and State Government in the regulatory activities of Aquaculture and fisheries.
4. Fisheries legislation: Overview of fisheries and aquaculture legislations in India. Indian Fisheries Act, 1897.

Course outcome: *Students will be able to understand pearl culture as an alternative to fishery. Besides, they should understand the basics of biostatistics so that they can analyse basic data to take informed decisions*

Suggested Readings:

1. Aquaculture- K.K. Jha, Daya Publishing House
2. Applied Fishery Science-S.M. Shafi, Atlantic Publishers and Distributors
3. A Textbook of Fishery Science and Indian Fisheries-C.B.L. Srivastava, Kitab Mahal.
4. Ornamental Fish and Fisheries-J. Bora & S. Chakraborty, Ashok Publications.
5. A Textbook of Fish and Fisheries-B. Singha and A. Dey, Invincible Publications.
6. A Text Book of Fish Biology and Fisheries by S.S Khanna and H R Singh, Narendra Publishing House
7. An Introduction to Fishes by S.S. Khanna, Surjeet Publications

. IFF: sec 201 - PRACTICAL

Credit: 1

Contact Hours: 30

Marks: 30

1. Study of Life cycle of Pearl Oyster and Formation of Pearl
2. Identification of freshwater Prawn and Pearl
3. Exposure visit to any of the modern Aquaculture Farm, Pearl culture Farm and submission of a Report
4. Applications of statistical methods Mean, Median, Mode, Standard Deviation, Correlation and Regression in Fisheries Management



SEMESTER - IV

IFF: DSM-251

Course Title: **Practical**

Credits: 3

Contact hours: 60

Marks: 100

Learning objectives: To get hands on practice on selected aspects of fishery science and aquaculture

Part-A

1. Visual aids/ display/ model of
 - i) Nervous system of Prawn
 - ii) Digestive and reproductive system of any Indian major carp.
 - iii) Afferent and efferent branchial vessels of any common teleost
 - iv) Digestive system of any air breathing fish.
 - v) Accessory respiratory organ of *Clarias batrachus*, *Heteropneustes fossilis*, *Anabas sp.*, *Channa sp.*
 - vi) Internal ear and cranial nerves of teleost.
2. Study of prepared slides of the T.S. of stomach, intestine, gill, liver, kidney, and endocrine glands of fish.
3. Permanent slide preparation: Students are to be familiar about the basic principle of narcotisation, fixation, staining, dehydration and mounting of the Cycloid and ctenoid scale, daphnia, cyclops, mysis, spirogyra, volvox etc.
4. Qualitative and quantitative estimation of stomach content of clarias/ any Indian major carp
5. Study of museum specimens: Prawn, crab, unio, *Labeo rohita*, *Catla catla*, *Labeo calbasu*, *Labeo gonius*, *Cirrhinus mrigala*, *Ctenopharyngodon idella*, *Hypopthalmichthys molitrix*, *Notopterus notopterus*, *Notopterus chitala*, *Amblypharyngodon mola*, *Channa punctatus*, *Clarias batrachus*, *Anabas testudineus*, *Heteropneustes fossilis*, *Xenentodon cancila*, *Mastocembalus armatus*, *Amphipnous cuchia*, *Puntius sarana*, *P. ticto*, *P. sophore*, *Chanda sp*, *Nandus sp*, *Tilapia sp*, *Rita rita*, *Ailia coilia*, *Eutropichthys vacha*, *Gudusia chapra*, *Cyprinus carpio*, *Mystus vittatus*, *Aorichthys aor*, *Wallago altu*, *Colisa sp*, *Ompok bimaculatus*, *Botia dario*, *Hippocampus*

Part-B

1. Dissection of Pituitary gland and Preparation of pituitary extract from any Indian major carp.
2. Identification from Slide/ Visual Aid: T.S. of Testis and Ovary of any IMC, Blastula, Gastrula, Spawn, Fry and Fingerlings
3. Identification of Fish Diseases and Disease Causing Organisms: Dropsy, Furunculosis, Gill-rot, Tailrot, Argulus, Lernaea etc.
4. Model/ Display/ Visual presentation of Parental care in fish.
5. Field study: Students are to visit any wet land or fish farm. They are to observe fishing and collecting field data regarding species composition, crafts and gears and field problems. Submission of field report giving analysis of data drawing of graph, Photograph etc. indicating their distribution, abundance concerned teacher.



Part-C

1. On the Job Training (OJT):- Students are to participate in any training programme of atleast One Week duration conducted by any central or state government or recognized private institute within or outside the state concerning fisheries/ post harvest technology/ fresh water fish farm/ prawn or shrimp farm or any other fisheries institute. They have to submit a detailed report of their training programme, along with photograph data, certificate etc & duly signed by teacher- in charge.
2. Identification of Ornamental Fishes and Aquatic/Aquarium Plants
3. Identification of Microbes associated with Fish
4. Demonstration of Post-Harvest technology using visual Aids

Course outcome: The practical work will complement the theoretical knowledge gained so far on different aspects of fishery science and aquaculture

IFF: DSM–252

Course Title: **Capture Fisheries & Coastal Aquaculture**

Credits: 3

Contact hours: 45

Marks: 100

(All units are of equal credits)

Learning objectives: To understand in details about capture fishery and aquaculture

Unit-I: Inland Capture Fisheries

1. Inland capture fishery resources of India.
2. Riverine fisheries of India- Brahmaputra, Ganga, Indus, East coast and west coast river system, Fisheries of Barak & Surma Rivers
3. Reservoir and Lacustrine fisheries-types & principal fisheries
4. Beel fisheries of Assam.
5. Fishing Crafts and Gears

Unit-II: Marine Capture Fisheries I

1. Marine Capture Fishery Resources of India
2. Major Pelagic and Demersal Fin Fishes
3. Fishing Crafts and Gears used in Marine Fish Capture

Unit-III: Marine Capture Fisheries II

1. The EEZ Concept & its Implementation.
2. Coastal Regulation Zone (CRZ), Integrated Coastal Zone Management (ICZM).
3. Fisheries of Elasmobranchs, Oil Sardine, Bombay Duck, Prawn and Shrimp, Crab and Molluscs

Unit-IV: Coastal Aquaculture I

1. Brackish water fisheries – Types of estuary, ecological characteristics of brackish water
2. principal estuaries & Principal brackish water fisheries
3. Chilka lake – its fisheries.
4. Bheries- definition, fish species cultured in bheries.



Unit-V: Coastal Aquaculture II

1. Culture of brackish water prawn
2. Eye stalk ablation & its role in prawn culture
3. Natural feed for brackish water Prawn
4. Sea weed culture- Definition, important species of seaweeds, Benefits of seaweeds culture.
5. Culture of marine edible & pearl oyster

Course outcome: Students will be able to understand aquaculture practices in marine environment.

Suggested Readings:

1. Fish & Fisheries-Kamleshwar Pandey and J.P. Shukla, Rastogi Publications.
2. A Text Book of Fish Fisheries and Technology-K.P. Biswas, Narendra Publishing House.
3. Aquaculture- K.K. Jha, Daya Publishing House
4. Applied Fishery Science-S.M. Shafi, Atlantic Publishers and Distributors
5. A Textbook of Fishery Science and Indian Fisheries-C.B.L. Srivastava, Kitab Mahal.
6. Ornamental Fish and Fisheries-J. Bora & S. Chakraborty, Ashok Publications.



SEMESTER - V

IFF: DSM-301

Course Title: **Fish Genetics, Biotechnology, Microbiology, Aquatic Toxicology & Germplasm Conservation**

Credits: 3

Contact hours: 45

Marks: 100

(All units are of equal credits)

Learning objectives: To make students understand other aspects of fishery science such as fish genetics, biotechnology, microbiology etc.

Unit-I: Fish Genetics

1. Chromosomes- Morphology, chemical structure & kinds of chromosomal
2. Sex Chromosomes and sex determination, polyploidy, Sex reversal in fishes
3. Interaction of gene- complementary, supplementary, inhibitory (epistasis) and duplicate type.
4. Mutation- Gene and chromosomal
5. Different methods of breeding- inbreeding, crossbreeding & selective breeding.

Unit-II: Fish Biotechnology

1. Molecular hybridization- PCR technique, Blotting techniques- Southern, Northern and Western blotting, DNA sequencing.
2. Chromosomal manipulation in fish: Hybridization. Polyploidy, Transgenic fishes, Androgenesis and Gynogenesis
3. Production of monosex and sterile fishes and their significance in aquaculture
4. Fish Barcoding- Concept, Method & Application

Unit-III: Fish Microbiology

1. Aquatic Microbiology: Microflora of aquatic environment.
2. Autotrophic and heterotrophic microorganisms in aquatic environment, Autochthonous and allochthonous microorganisms in aquatic environment.
3. Bacteria in culture pond: Health significant bacteria in culture ponds.
4. Epidemiology of E. coli, pathogenic Vibrio, Salmonella, Aeromonas hydrophila, and Pseudomonas.

Unit-IV: Aquatic Toxicology

1. Adverse effects of oxygen demanding wastes: importance of dissolved oxygen; Oxygen demand; BOD; COD; Oxygen budget; Biological effects of organic matter.
2. Excessive plant nutrients: Eutrophication; Red tides and fish kills.
3. Pesticide types and categories; inorganic pesticides, Organo-chlorine compounds, Organo- phosphorous compounds; Polychlorinated biphenyls (PCBs);
4. Bioaccumulation and impact on aquatic fauna and human health; toxicology. Heavy metals: Interaction of heavy metals with water and aquatic organisms.
5. Bioremediation and Phytoremediation.
6. Oil pollution, Ecological Impact of Oil pollution- Case studies.



Unit V: Conservation of Fish Germplasm

1. Fish Genetic Resources-Concept and its Conservation
2. Cryopreservation of gametes (gene banking) and its technique.
3. Live Gene Bank and its role in Conservation of Fish Fauna
4. Role of Government and Community in Conservation Initiative.
5. Definition and principle of remote sensing and GIS. Sensing mechanism.
6. Application of remote sensing and GIS in fisheries conservation and management of fish faunal diversity and exploitation of capture fisheries.

Course outcome: *The paper will further the understanding of the students on fish and fisheries.*

Suggested Readings:

1. Fish & Fisheries-Kamaleshwar Pandey and J.P. Shukla, Rastogi Publications.
2. General and Applied Ichthyology (Fish & Fisheries)-S.K. Gupta & P.C. Gupta, S. Chand Publications.
3. A Text Book of Fish Fisheries and Technology-K.P. Biswas, Narendra Publishing House.
4. Aquaculture- K.K. Jha, Daya Publishing House
5. Applied Fishery Science-S.M. Shafi, Atlantic Publishers and Distributors
6. A Textbook of Fishery Science and Indian Fisheries-C.B.L. Srivastava, Kitab Mahal.
7. Ornamental Fish and Fisheries-J. Bora & S. Chakraborty, Ashok Publications.

IFF: DSM-302

Course Title: **Fish Genetics, Biotechnology, Microbiology, Aquatic Toxicology & Germplasm Conservation**

Credits: 3

Contact hours: 45

Marks: 100

(All units are of equal credits)

Learning objectives: *To make students understand other aspects of fishery science such as fish genetics, biotechnology, microbiology etc.*

Unit-I: Fish Genetics

1. Chromosomes- Morphology, chemical structure & kinds of chromosomal
2. Sex Chromosomes and sex determination, polyploidy, Sex reversal in fishes
3. Interaction of gene- complementary, supplementary, inhibitory (epistasis) and duplicate type.
4. Mutation- Gene and chromosomal
5. Different methods of breeding- inbreeding, crossbreeding & selective breeding.

Unit-II: Fish Biotechnology

1. Molecular hybridization- PCR technique, Blotting techniques- Southern, Northern and Western blotting, DNA sequencing.
2. Chromosomal manipulation in fish: Hybridization. Polyploidy, Transgenic fishes, Androgenesis and Gynogenesis
3. Production of monosex and sterile fishes and their significance in aquaculture
4. Fish Barcoding- Concept, Method & Application



Unit-III: Fish Microbiology

1. Aquatic Microbiology: Microflora of aquatic environment.
2. Autotrophic and heterotrophic microorganisms in aquatic environment, Autochthonous and allochthonous microorganisms in aquatic environment.
3. Bacteria in culture pond: Health significant bacteria in culture ponds.
4. Epidemiology of E. coli, pathogenic Vibrio, Salmonella, Aeromonas hydrophila, and Pseudomonas.

Unit-IV: Aquatic Toxicology

1. Adverse effects of oxygen demanding wastes: importance of dissolved oxygen; Oxygen demand; BOD; COD; Oxygen budget; Biological effects of organic matter.
2. Excessive plant nutrients: Eutrophication; Red tides and fish kills.
3. Pesticide types and categories; inorganic pesticides, Organo-chlorine compounds, Organo- phosphorous compounds; Polychlorinated biphenyls (PCBs);
4. Bioaccumulation and impact on aquatic fauna and human health; toxicology. Heavy metals: Interaction of heavy metals with water and aquatic organisms.
5. Bioremediation and Phytoremediation.
6. Oil pollution, Ecological Impact of Oil pollution- Case studies.

Unit V: Conservation of Fish Germplasm

1. Fish Genetic Resources-Concept and its Conservation
2. Cryopreservation of gametes (gene banking) and its technique.
3. Live Gene Bank and its role in Conservation of Fish Fauna
4. Role of Government and Community in Conservation Initiative.
5. Definition and principle of remote sensing and GIS. Sensing mechanism.
6. Application of remote sensing and GIS in fisheries conservation and management of fish faunal diversity and exploitation of capture fisheries.

Course outcome: The paper will further the understanding of the students on fish and fisheries.

Suggested Readings:

1. Fish & Fisheries-Kamleshwar Pandey and J.P. Shukla, Rastogi Publications.
2. General and Applied Ichthyology (Fish & Fisheries)-S.K. Gupta & P.C. Gupta, S. Chand Publications.
3. A Text Book of Fish Fisheries and Technology-K.P. Biswas, Narendra Publishing House.
4. Aquaculture- K.K. Jha, Daya Publishing House
5. A Textbook of Fish and Fisheries-B. Singha and A. Dey, Invincible Publications.
6. A Text Book of Fish Biology and Fisheries by S.S Khanna and H R Singh, Narendra Publishing House
7. An Introduction to Fishes by S.S. Khanna, Surjeet Publications



SEMESTER - VI

IFF: DSM-351

Course Title: **Practical**

Credits: 4

Contact hours: 60

Marks: 100

Learning objectives: To impart students with practical knowledge on the subject

Part-A

1. Visual aid/ display/ model Aquaculture of different types:- Fresh water, brackish water and marine water. Integrated Fish farming, composite fish culture, case culture, air breathing fish culture.
2. Physico-chemical analysis of soil and water:- Temperature, moisture, texture & pH of soil Temperature, turbidity, PH, dissolved oxygen (DO), Free Ccarbondioxide of water
3. Collection and Identification of Phytoplanktons & Zooplanktons
4. Identification of predatory insects:- Dragon fly nymph, Ranatra, Corixa, Cybister, Notonecta, lithocerus, Hydaticus, Anisops, Belostoma.
5. Identification of Fish predator- Reptilia, Aves and Mammalia (At least two predators from each class)

Part - B

1. Identification of the following : Paeneus monodon, Sting ray, Torpedo, Bombay duck, Lates calcariffer, Pomfret, Scoliodon, Chanos SP. Hilasa, Stegostoma, sardinella, Pristis, Ssphyrna,
1. Visual Display/Models of Cold Water Fishes, Pearl Oyster, Clupeids. Mulletts, Catfishes, Peches, Threadfishes, Milk Fishes
2. Visual Display of Pearl Culture, Brackish water fish & Prawn Culture, Chilka Lake and its Aquaculture Practices
3. Identification of Fishing Gear and Crafts used in Marine and Fresh Water Capture

Part-C

1. On the Job Training (OJT):- Students are to participate in any training programme of at least One Week duration conducted by any central or state government or recognized private institute within or outside the state concerning fisheries/ post-harvest technology/ fresh water fish farm/ prawn or shrimp farm or any other fisheries institute. They have to submit a detailed report of their training programme, along with photograph data, certificate etc & duly signed by teacher- in charge.
2. Identification of Ornamental Fishes and Aquatic/Aquarium Plants
3. Identification of Microbes associated with Fish

Course outcome: This will help the understanding and skills of the students on various facets of industrial fish and fisheris



SEMESTER - VII

IFF: DSM-401

Course Title: **Applied Fishery-I: Aquarium Management, Post-Harvest Technology, Entrepreneurship Development**

Credits: 4

Contact hours: 60

Marks: 100

(All units are of equal credits)

Learning objectives: Aimed to impart students on applied aspects of fishery science.

Unit-I: Aquarium Management

1. Aquarium- Definition and types, Design and construction of home and public aquaria (freshwater and marine)
2. Aquarium fishes - live bearers and egg layers, Freshwater Ornamental Fishes of India & Aquarium Plants
3. Aquarium maintenance and water quality management. Control of snail and algal growth, Temperature acclimation. Food and feeding for aquarium fishes
4. Breeding of ornamental fishes. Selection and conditioning of fishes for breeding
5. Common diseases of aquarium fishes and treatment.
6. Culture of fish food organism with reference to Diatoms and rotifers and copepods.

Unit-II: Post Harvest Technology

1. Preservation- Definition, principles, merits and demerits of preservation.
2. Causes of spoilage of fish. Use of fish preservations and problems in fish preservation
3. Methods of preservation chilling, freezing, canning semidrying, salting, smoking, brining and preservation with chemicals.
4. Processing and preservation of fish by product - fish liver and body oil, fish meal,
5. fish silage, fish manure, fish sauce and guano, fish guano and isinglass and fish leather.

Unit-III: Entrepreneurship Development-I: Ornamental Fish Production

1. Entrepreneurship Building: Meaning, Importance, Need, scope, characteristics and types of Entrepreneurship. STED.
2. Social responsibility and business ethics.
3. Commercial Production: Requirements and design for the commercial production of ornamental fishes- goldfish, live bearers, gouramies, barbs and tetras, angel fish.
4. Natural ponds for the mass production of ornamental fishes.
5. Mass production of aquarium plants.

Unit-IV: Entrepreneurship Development-II: Crab Culture & Fish Feed Production

1. Biology of Crabs-Morphology, Anatomy and Life Cycle, Economically important species of crabs.
2. Techniques of Crabs culture. Crabs fattening.
3. Prospect, problems and development of crab culture in India.
4. Candidate species of phytoplankton and zoo-plankton as live food organisms of freshwater and marine species.
5. Biology and culture requirements of important live food organisms. Green algae,



bluegreen algae, spirulina, diatoms, infusoria, rotifers, cladocerans, tubifex, brine shrimp, chironomids.

6. Culture of earthworms, bait fish and forage fish.

Unit-V: Entrepreneurship Development-III: Production and Marketing of Processed Fish

1. Fish and prawn pickles, fish sauce and Fish paste, traditional Indian fermented products. Principles and methods of preparation of various fish paste products like fish sausage, fish ham, surimi, fish cake.
2. Fish protein concentrate. Fish hydrolysate, partially hydrolyzed and deodorized fish meat, functional fish protein concentrate and their incorporation to various products.
3. Fish meal and oil. Dry reduction and wet reduction methods. Fish maws, shark leather, Chitin, chitosan, fish glue, fish gelatin, isinglass, pearl essence, shark fin rays, beach de mer, and biochemical and pharmaceutical products. Utilization of seaweeds: agar agar, algin, carrageenan
4. Diversified fish products: battered and braided products-fish finger, fish cutlet, fish wafer, and fish soup powder etc. and imitation products. Value addition, HACCP in safe products production

Course outcome: The knowledge gained will help boost the entrepreneurial skills of the students

Suggested Readings:

1. General and Applied Ichthyology (Fish & Fisheries)-S.K. Gupta & P.C. Gupta, S. Chand Publications.
2. Aquaculture- K.K. Jha, Daya Publishing House
3. Applied Fishery Science-S.M. Shafi, Atlantic Publishers and Distributors
4. Ornamental Fish and Fisheries-J. Bora & S. Chakraborty, Ashok Publications.
5. A Textbook of Fish and Fisheries-B. Singha and A. Dey, Invincible Publications.
6. A Text Book of Fish Biology and Fisheries by S.S Khanna and H R Singh, Narendra Publishing House
7. An Introduction to Fishes by S.S. Khanna, Surjeet Publications



SEMESTER - VIII

IFF: DSM-451

Course Title: **Applied Fishery-II: Fishery Economics, Fish Marketing, Fishery Extension & Cooperatives, Financing in Fishery, Disaster Management**

Credits: 4

Contact hours: 60

Marks: 100

(All units are of equal credits)

Learning objectives: Aimed to impart students on applied aspects of fishery science.

Unit-I: Fishery Economics

1. Principles of economics: Definition, Law of diminishing returns, laws of increasing, constant and decreasing utility and returns.
2. Importance of economics in aquaculture development.
3. Economic value of fishes,
4. Maximum Sustainable Yield (MSY), Maximum Economic Yield (MEY), Optimum Sustainable Yield (OSY)

Unit-II: Fish Marketing

1. Fish marketing- definition, Aim, Characteristic, Types and Stages of fish marketing.
2. Marketing channels and supply chain, Marketing margins, Marketing environment, Marketing strategies,
3. Fish marketing: Characteristics of fish marketing channels & stages of fish marketing. Factors affecting fish marketing patterns
4. Cold storage and other marketing infrastructure in India.
5. Methods of selling fish, Price Determination marketing organization and improvement.
6. Exports of fish and fishery products, trends and problems therein. Role of MPEDA in exports of fish and fishery products.

Unit-III: Fishery Extension & Co-operatives

1. Fishery co-operative- Aim and role of co-operative in fishery economy. Organization of fishermen co- operatives.
2. Fisheries extension- Definition, extension philosophy and Methodology
3. Fishing community and their socio- economic problems.
4. Fish farmers development Agencies (FFDA)
5. Rational Fishery: Introduction organization of rational fishery management
Fishery survey and statistics

Unit-IV: Scopes & Financing in Fishery Management

1. Study, Training & Research opportunities in Fisheries in India with special reference to NER
2. Credit Requirements & Role of credit for fisheries
3. Schemes of National Fishery Development Board (NFDB) & NABARD
4. Role of District Fishery Development Office.
5. Role of insurance in Fish Farming Industry.



Unit-V: Disaster Management in Fisheries

1. Basic concepts: Hazard, risk, vulnerability, disaster, capacity building
2. Types of natural and manmade hazards in fisheries and aquaculture - cyclones, floods, droughts, tsunami, El-nino, habitat destruction, over fishing, introduction of exotic species
3. Management strategies: pre-disaster, during disaster and post-disaster, early warning, communication and dissemination, community based disaster preparedness, structural and non- structural mitigation measures.

***Course outcome:** The knowledge gained will help boost the entrepreneurial skills of the students*

Suggested Readings:

1. Fish & Fisheries-Kamleshwar Pandey and J.P. Shukla, Rastogi Publications.
2. General and Applied Ichthyology (Fish & Fisheries)-S.K. Gupta & P.C. Gupta, S. Chand Publications.
3. A Text Book of Fish Fisheries and Technology-K.P. Biswas, Narendra Publishing House.
4. Aquaculture- K.K. Jha, Daya Publishing House
5. Applied Fishery Science-S.M. Shafi, Atlantic Publishers and Distributors
6. A Textbook of Fishery Science and Indian Fisheries-C.B.L. Srivastava, Kitab Mahal.
7. Ornamental Fish and Fisheries-J. Bora & S. Chakraborty, Ashok Publications.