

V TWO-YEAR POSTGRADUATE DIPLOMA IN FISHERIES SCIENCE (BOMBAY) RULES

1 Target Group

The course is designed mainly for inservice district level officers sponsored by Central and State Fisheries Departments and Senior Officers from Fisheries Corporations, Voluntary agencies and similar bodies. Few seats are reserved for foreign students and private candidates desirous of taking up fisheries as career.

2 Eligibility

- 2.1 Essential : A degree in Science, preferably Zoology as main or subsidiary subject or B.F.Sc. (relaxable in case of candidate otherwise highly experienced and holding degree in other disciplines relevant to fisheries).
- 2.2 Desirable : Experience of atleast 2 years in fisheries activities.

3 Duration

The duration of course will be two years.

First Year - 1st July to 31st May.

Second Year - 25th June to 30th June.

4 Attendance Requirement

A minimum of 90% attendance is required for a student to qualify for appearing in the final examination. Director may waive 10% of absence on valid grounds.

5 Intake

The intake capacity is 25. Applications from private candidates having B.Sc. degree with 55% marks or B.F.Sc. degree with equivalent O.G.P.A. of 3.44/5.00 or 2.06/3.00 will be called for by advertisement in leading news papers and the candidates will be selected on All India basis through interview at Bombay. One seat is reserved for SC/ST from the open advertisement.

The application of foreign students for admission shall have to be forwarded through respective Embassies at New Delhi or through the respective Indian Missions abroad to the Secretary, DARE, Govt. of India, Krishi Bahavan, New Delhi - 110 001, and their candidature shall be considered only if they are sponsored by their National Govt. or Govt. of India.

6. Course Structure

The course comprises lectures, practicals, intensive field training programmes, seminars and dissertations as per syllabus.

7. Evaluation (Examination)

First Examination will be held at the end of the first year in May and the final examination at the end of June in second year.

8. Scheme of Examination

FIRST YEAR EXAMINATION

THEORY	Time (hrs)	Maximum Marks
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FISHERY BIOLOGY

Fishery Biology Paper-I	3	100
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FISHERIES ADMINISTRATION & ECONOMICS

Paper I A—Fisheries Administration)	3	50
Paper I B—Fisheries Statistics)		50

PRACTICALS

Fishery Biology-I	3	50
Fishery Statistics	1-30	25

Total (A) 275

SECOND YEAR FINAL EXAMINATION

THEORY :

FISHERY BIOLOGY

Fishery Biology Paper II	3	100
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FISHERY TECHNOLOGY

Paper I - Craft & Gear	3	100
Paper II - Fish Processing	3	100

FISHERIES ADMINISTRATION & ECONOMICS

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Paper II A - Principles of Fisheries Economics)	3	50
Paper II B - Co-operation & Marketing)		50

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PRACTICALS

Fishery Biology-II	3	50
Fishery Technology-I	3	50
Fishery Technology-II	3	50
Dissertation		100
Field Records		100
Viva-Voce		75

Total (B) 825

Grand Total A+B = 1100 marks

Based on the total marks obtained at the First Year and Final Year Examination etc. the following credits will be awarded:

Ist class with Distinction	—	75% and above
I Class	—	60% to below 75%
II Class	—	50% to below 60%
III Class	—	40% to below 50%
Failed	—	Less than 40%

Minimum pass marks in each theory paper shall be 35% and in practicals and dissertations 40%

Candidates who fail or are unable to appear at the First Year/Final Year Examination may be permitted by the Director to appear at the next first/final examinations

9. Recognition of Diploma

The Diploma in Fishery Science awarded by the Institute has been recognised at par with M.Sc. degree in Fisheries for jobs by the Central and State Governments. The Diploma holders, subject to the fulfilment of the conditions, are also eligible for appearing at the All India Entrance Examination for Ph.D. degree programme at CIFE.

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10. Discipline

10.1 General

The students are expected to maintain good discipline both in and off the campus. Any act of indiscipline such as : misbehaviour with fellow student, staff, teacher and the institutional authorities, taking part in unauthorised strikes, demonstration and like activities, violating institution rules, regulations, damaging institutional property etc; will be viewed seriously and depending upon the act and gravity of the indiscipline, the student may even be rusticated from the institution.

10.2 Unfair means in Examination

A candidate found using unfair means during the examination will be deemed to have failed in all the courses in that year. Any repetition of such offence will make the candidate disqualified from obtaining the Diploma of the University.

11 Hostel Rules

Students seeking admission to the Hostel must apply separately at the beginning of each academic year in the prescribed form available at the Institute's Office.

Students admitted to the Hostel shall abide by the decision of the Director / principal / Scientist (in-charge) / Chief Warden with respect to the Hostel Rules. Those violating the Hostel rules will be expelled from the Hostel.

SYLLABUS FOR POST-GRADUATE DIPLOMA COURSE IN FISHERIES
SCIENCE

FISHERY BIOLOGY PAPER - I

PART—I: MARINE FISHERIES

(Theory 75 hrs; Laboratory work 20 hrs; Field work 30 days; Local visit 5 hrs; and Seminars 20 hrs)

1. Introduction to Fishery Biology :

Marine fisheries in different areas; their oceanographic background. Fishery biology as a special subject. Fishery Science as an Integrated study.

2. Physical and Chemical Oceanography :

Oceanography and its relation to fishery science. Relation between sea and land. Major topographic features of ocean floor with special reference to Indian seas.

Sea water environment, physical properties of sea water—salinity, temperature, pressure, density, light penetration and sound transmission, general distribution of temperature, salinity and density.

Chemistry and fertility of sea water—composition, constituents, distribution of nutrients and dissolved gases. Food chain in the sea. Water masses and their characteristics. General ocean currents—current systems of the world with special reference to the Indian ocean, waves and tides.

Oceanographic cruises—fixing of stations, preservation of samples. Collection and processing of data, section and isopleth diagrams.

✓ Physico-chemical factors and their influence on fish behaviour and fishery—temperature, light, current, salinity and nutrients.

Synoptic oceanography and its future application. Fish location by hydrographic conditions.

3. Meteorology :

Introduction to meteorology—weather and climate-Relation between atmosphere, hydrosphere and lithosphere.

Elements of weather and observations thereon. Temperature, pressure, wind, humidity, cloud formation and classification, and atmosphere visibility.

Air masses and fronts, weather forecasting and maps, climatic features of the world with special reference to monsoon climate. Meteorology and fisheries.

4. Marine Biology :

Plankton, nekton and benthos; Classification, characteristics and fluctuation; Methods of collection and analysis; Vertical migration of plankton and associated phenomena; Biological indicators; "Red water" and related phenomenon of discoloured waters; Fish and crustacean eggs, larvae and juveniles; Seasonal and annual cycle of plankton in Indian coastal water; Plankton as fish food; Animal communities of the bottom; Bottom fauna and food of fishes. Marine sea weeds and their economic importance.

Primary production and standing crop; Methods of assessment; Factors controlling production; Plankton hydrography; Plankton production and upwelling

Fish p
Recruit

Mortality
fishing
yield.

PART II : INLAND FISHERIES

(Theory 40 hrs; Laboratory work 40 hrs; Field work 30 days; Local visits 5 hrs; Seminars 10 hrs.)

1. Introduction to Inland Fisheries :

Inland fisheries of the world; Important species constituting fisheries in different areas; Fish culture and rural economy; Limnological background; Backwaters and brackishwater environment; Chief characteristics of Inland Fisheries.

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2. Limnology :

Introduction to limnology; Classification of Inland waters; Physical and chemical characteristics; Reservoirs vertical stratification and thermal exchange.

Chemical properties : Trophogenic and Tropholytic zones; Biochemical stratification; Dissolved salts and gases. Bottom deposit.

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Rivers and streams-physical and chemical properties of water; Industrial effluents, sewage and pollution of rivers and other waters. Characteristics of brackishwaters, backwaters and estuaries; Influence of tidal currents.

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3. Biology of Inland Waters :

Types of fresh water and brackishwater habitats; Organisms, characteristics of particular habitats, their classification and salient characteristics; Aquatic communities; Sampling techniques and analysis; Role of food, competitors or enemies of fish.

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Common phyto and zooplankton in standing waters (small freshwater and brackishwater ponds, irrigation tanks, and reservoirs) and flowing waters (rivers, estuaries and tidal backwaters.).

Net plankton and Nonplankton-seasonal fluctuations; Benthos as dominant types in different habitats and zones in relation to substratum, depth and water qualities.

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Macrovegetation-distinguishing features of representative species in different types of waters; Seasonal abundance; Nutrient cycle and food chain; Biological productivity.

Location
Associated
season of
fish food
marine sea

COMMON TO MARINE FISHERIES AND INLAND FISHERIES

Factors
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Fish population Studies : Unit stock, distribution, migration, and tagging of fish. Recruitment, age and size composition of stocks. Age-length-weight relationship.

Mortality and survival : Catch and fishing effort. Estimates of stock density and fishing mortality rate. Selection assessment, yield curves; Estimation of optimum yield over-fishing problems; Principles of conservation of fisheries resources.

FISHERY BIOLOGY PRACTICAL - I

PART - I : MARINE FISHERIES

10-15 hrs

different
waters

Identification, working and use of common equipment for oceanographic and meteorological studies; Analysis of water samples to determine temperature, turbidity, pH, dissolved oxygen, carbon dioxide, alkalinity, salinity, nitrates and phosphates of sea water; Preparation of charts of vertical and horizontal distribution of physico-chemical properties; Identification of common groups of marine plankton.

PART - II : INLAND FISHERIES

10-15 hrs

different
waters

Identification, working and use of common equipment for limnological studies. Dissection and display of the alimentary tract and associated structure, gonads and accessory organs; Examination and report of stomach contents; Maturity estimation of reproductive organs and fecundity studies; Micrometric measurements of an ova.

Industrial
practices of

Elementary techniques of age and growth determination of fish by study of hard parts of the body such as scales, otoliths, fin rays, vertebrae etc. Tagging and Mark-recovery techniques.

PART - III : AQUACULTURE

Characteristics of
Aquatic
insects of

water and
in waters

Identification of common groups of brackishwater and freshwater plankton with special reference to their role as fish food and biological indicators. Analysis of freshwater and brackishwater samples for various physical, chemical parameters. Identification of common aquatic weeds and insects.

FISHERY BIOLOGY PAPER-II

PART - I : MARINE FISHERIES

Land types
and water

Lectures 50 hrs Laboratory work 55 hrs, Field work 25 days, Local visits 6 hrs, Seminars 12 hrs.)

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PRINCIPAL MARINE FISH AND FISHERIES OF INDIA

Ecology, life-history, feeding and breeding behaviour, migration, recruitment, fishing grounds, distributions, seasonal and annual fluctuations and fishing methods of species contributing to the following fisheries.

A. Pelagic Fisheries of India :-

1. Sardine fisheries with special reference to oil sardine, *Sardinella longiceps*.
2. Mackerel fisheries with special reference to Indian mackerel, *Rastrelliger kanagurta*.
3. Tuna fishery and allied fisheries of the high seas.
4. Bombay duck fishery.
5. Pomfret fishery.
6. Silver belly fishery.
7. Shark fishery.
8. Other Pelagic fisheries such as White-baits, Seer fishes, Anchovies, Ribbon fishes and Flying fishes.

B. Demersal Fisheries :-

1. Prawn fisheries with special reference to Penaeid and Palaemonid species.
2. Lobster and Crab fisheries.
3. Sciaenid fisheries.
4. Polynemid fisheries.
5. Sole fisheries with special reference to the Malabar sole, *Cynoglossus semifasciatus*.
6. Pearl, chank and other molluscan fisheries including fisheries of edible molluscs.
7. Other demersal fisheries of local importance such as catfishes, rays, marine eels and various groups of perches.

PART - II : INLAND FISHERIES

(Lectures 35 hrs, Laboratory work 55 hrs, Field work 20 days, Local visits 6 hrs, Seminars 6 hrs.)

PRINCIPAL INLAND FISH AND FISHERIES

Natural habitat, food and feeding habits, growth, maturity, fecundity and breeding of Major Indian carps—*Catla catla*, *Labeo rohita*, *L. calbasu*, *L. fimbriatus*, *Cirrhinus mrigala* and *Tortor*; Common carp—*Cyprinus carpio* and its varieties; Chinese carps—*Osteopharyngodon idella* and *Hypophthalmichthys molitrix*; Cat fishes—*Wallago attu*, *Mystus seenghala* and *Pangasius pangasius*; Featherback—*Notopterus chitala*. Live fishes—*Channa striatus*, *C. marulius*, *Anabas testudineus*, *Heteropneustes fossilis* and *Claas batrachus*.

Other pond fishes—*Osphronemus gourami*, *Tilapia mossambica*, *Salmo gairdneri* and *S. trutta*.

Freshwater prawns—*Macrobrachium rosenbergii* and *M. malcolmsoni*; Important riverine fisheries—location—special characteristics; Development and management measures; Fishery of juveniles; Fish seed resources; Dams, weirs and fish passes; Behaviour of fish and types of passes; Hill stream fishes—lines of development; Lacustrine, reservoir and pond fisheries, principal species communities, special problems and lines of development with reference to important reservoirs under exploitation. Fisheries of irrigation tanks and seasonal waters.

Fisheries of Chilka and Pulicat lakes; Estuarine fisheries of India—special feature—tidal influences and monsoon discharge fluctuations in water conditions, fish food and fisheries. Backwater fisheries, characteristics—important species including prawns and clams.

Induced spawning of fish. Breeding of carps in bundh type tanks and by injection of pituitary hormones. Spawning of common carp. Techniques for hatching and spawn taking modern hatchery system. Spawn and fry transport.

PART - III : AQUACULTURE

(Lectures 50 hrs; Field work 50 days; Local visits 5 hrs; Seminars 12 hrs)

Fish culture : Fish culture the world over—species cultivated, importance and scope. Freshwater fish culture. Types of ponds required. Criteria of a suitable pond site. Pond construction—layout of a model seed production farm and a production farm. Reclamation for fish culture, water supply, drainage, aeration and other engineering aspects.

Seed production and culture of freshwater prawns.

Management of stocking ponds. Control of predators and weeds. Manuring. Compatible species—stock, density and manipulation; Survival, growth and production in various types of ponds.

Techniques of water and soil analysis. Types of soils, nutrient status; Water qualities in different soils. Water and soil qualities for optimum production.

Common fish parasites and diseases; Measure for control and eradication.

Management of nursery and rearing ponds. Eradication of predators. Manuring for enhanced food production. Predatory insect control; Stocking rates and stocking. Artificial feeding. Survival, growth and harvesting.

Fish culture in seasonal waters, irrigation tank and other medium size water bodies. Integrated fish farming.

Biology of Brackishwater fishes and prawns. Brackishwater fishes-*Hilsa ilisha*, *Chanos chanos*, *Mugil cephalus*, *M. labe*, *Liza* spp., *Etroplus suratensis* and *Lates calcarifer*. Prawns-*Penaeus indicus*, *monodon* and *merguiensis*.

Brackishwater fish culture. Tidal range and location of ponds. Sluices; Mangrove habitat, species cultivated; Backwater prawns natural seed resources; Compatible species combinations; Production; Prawn culture.

Induced spawning and seed production of brackishwater fish and prawns.

Fish culture in paddy field-Species used-Techniques and possibilities, Prawn filtration in brackishwater fields.

FISHERY BIOLOGY PRACTICAL - II

PART - I : MARINE FISHERIES

Identification by means of external characters of the common commercially important marine fish and crustaceans, their eggs, larvae and juveniles.

Field work - Analysis of experimental and commercial catches of fishes and prawns in relation to gear season.

PART - II : INLAND FISHERIES AND AQUACULTURE

Identification by means of external distinguishing characteristics of the common commercially important freshwater and brackishwater fishes and crustaceans, their eggs, larvae and juveniles.

Field work : Experience in fish farms in breeding and seed production, rearing seed and production of marketable crops.

FISHERY TECHNOLOGY PAPER - I : CRAFT AND GEAR

(Lecture 115 hrs Laboratory work 110 hrs; Fishing experience 30 days; Field visits/Boat building yard visit 10 days; Seminar 30 hrs.)

1. Fishing Craft-General : Factors determining selection of fishing craft, Systematics of fishing boats, Indian boat types-sailing, motorised and others. Detailed description of selected types such as trawlers, drifters, seiners, long liners, combination vessels and carrier boards. Fishing boat mechanisation in India.

2. Boat design and specification : Principal dimensions of boats, description of hull-tonnage of vessels. Principles of boat designing-considerations of low resistance high propulsive efficiency and static and dynamic stability. Fishing boat layout based on fishing methods, fish storage, accommodation, fishing equipment and handling arrangements.
3. Boat Materials : Selection, seasoning, storage and use of timber in boat building, Indian timbers used in boat building. Treatment of timber, Boat fastening and fitting-ferrous and non-ferrous. Modern material used in boat building.
4. Boat building Inspection and Maintenance : Boat building yard, it's layout, machines and tools. Principles of construction of fishing boats from designs. Inspection of fishing boats under construction and in operation. Care and maintenance of fishing boats.
5. Engines and Equipments : Principles of marine engines and types. Choice, care, maintenance and repair of engines; Fuel saving devices; Deck gear; Mechanical and hydraulic equipment. Refrigeration equipment and insulation. Fish finding equipments.
6. Fishing Gear-General: Modern trends in fishing gear technology. Factors determining selection of fishing gear. Fishing gear types in India.
7. Gear Materials : Natural and synthetic materials in fishing gear; Properties of fibres; Numbering of yarn; Construction of twines and ropes; Different types of ropes. Properties and types of floats, sinkers, buoys and anchors used in fishing.
8. Design and fabrication of fishing gear : Design considerations of fishing. Reading of knot designs, knots, hitches and bends in fishing gear. Making, cutting and mounting of webbings for bag nets. Principles of mending of nets; Splicing of ropes used in fishing gear.
9. Operation, care and maintenance of fishing gear : Gill netting, shore seines, purse-seines, ring nets and Danish seines; Trawling; Long lining and trolling. Treatment and preservation of fishing gear.
10. Elementary principles of navigation and seamanship. Rules for life saving appliances; Regulations for fishing vessels.
11. Exploratory and commercial fishing : Exploratory fishing operations in Indian seas-Planning exploratory fishing cruises. Principles of commercial fishing. Manning of commercial fishing cruises.
12. Fishing Harbour and Shore Facilities: Principles involved in construction of fishing harbours. Layout of typical fishing harbours. Fishing harbours in India and in other countries. Shore facilities provided in fishing harbours.

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FISHERY TECHNOLOGY PRACTICAL-I : CRAFT AND GEAR

LABORATORY PRACTICALS AND WORKSHOP PRACTICE

Drawing practice and blue print reading; Design exercise; Calculation practice; Projection of fishing boat types and construction details; Mould lofting; Preparation of Mould and templates; Measurement and projection of lines of a fishing vessel; Engine installation; Deck and navigational equipments; Identification and treatment of materials; Lamination; Painting and fishing.

Handling of different types of Marine engines; General principles of dismantling engine parts clearing and assemblage; Maintenance and overhauling schedules.

Chart reading and fixing position. Handling of electronic equipments.

Reading of gear designs-design exercises. Projections of drawings of principal fishing gear. Knots and splices and making of simple gill nets. Mounting of nets and webbing. Tailoring of webbing; Mending of nets; Treatment of nets.

FIELD WORK

Fishing practice; Different types of trawls for fish and for shrimps; Drift netting; Bottom set netting; Long lining and trolling. Operation of gill net and other fishing gears in inland reservoirs and lakes; Dol net; Rampani nets; and other indigenous fishing gears. Commercial fishing practices.

FISHERY TECHNOLOGY PAPER - II : FISH PROCESSING

(Lecture 115 hrs; Laboratory work 110 hrs; Workshops Practice 30 days; Field visits/Processing establishments 10 days; Seminar 30 hrs.)

1. Introduction : Place of preservation and processing technology in fisheries.
2. Biochemistry : Chief components of food-carbohydrates, fats, proteins; Structure of protein, amino acids; Classification of protein. Chemical nature of Vitamins. General metabolism.
3. Microbiology : Bacterial mode of life influence of food, temperature, pH, etc. Isolation and identification of bacteria. Bacteria of sanitary significance. Marine and freshwater bacteria. Molds importance in food spoilage.
4. Fish in Nutrition : Chemical composition of fish and shell fish. Role of proteins, fats and carbohydrates (Calorific) requirement of man. Balanced diet. Contribution of fish to the nutritive value of the diet. Vitamins in nutrition. Fish in Indian diet. Fish products as animal food.
5. Fresh Fish Handling and Preservation : Mechanism of fish spoilage-autolysis and bacterial action. Rigor mortis-its significance. Handling of fresh fish on board and on shore; use of antibiotics and chemicals. Principles of mechanical refrigeration. Production of ice-different types of ice.

6. Freezing of fish : Physico-chemical changes in fish during freezing and storage of fish, refrigeration requirements in freezing and frozen storage of fish. Freezing techniques—sharp freezing, contact-plate and airblast freezing; immersion freezing; preparation and handling of fish for freezing. Spoilage of frozen fish—denaturation and oxidative; its prevention. Freezing of shrimp, headless, raw, peeled and deveined, cooked, frozen. Unit operations involved in freezing. Fish-sticks production; breaded-shrimp, deboned fish meat etc. and other products.
7. Canning of fish : History and principles of canning preservation of foods; unit operations in fish canning; thermal processing requirements; spore resistance. Can corrosion. Spoilage of canned fish. Significance of botulism hazard. Handling and preparation of fish and shrimp for canning.
8. Salting, drying, smoking of fish : Principles of preservation by salting, drying; dry and pickle salting; light salted fish products. Indian fish curing methods. Sun-drying with and without salting. Mechanical dehydration of foods; tunnel drying. Accelerated freeze-drying; quality of salt for fish curing; bacteriology of salted fish—Red halophiles in dried fish. Hot and cold smoking of fish. Marinated fish products.
9. Fish meal, fish oils, and other by-products : Production methods for fish meal from lean and fatty fish; use of fish offal as raw material; factors affecting quality of fish meal and its value in animal feeds; recovery of fish body oil; use of fish body oils. Fish liver oils and their medicinal use. Fish for human consumption—production methods and use.
Utilization of seaweeds for food, manure; production of agar and alginic acid. Pearl essence, Isinglass, Leather products from fish.
10. Quality Control, Commodity Standards and Inspection of Fishery Products :
Quality and freshness tests for fish, organoleptic and objective; International standards for quality, and commodity; containers for fish products. Inspection to fish products for export trade. Taste panel studies.
11. Lay out of processing plants. Packaging, storage and transport of fish.

FISHERY TECHNOLOGY PRACTICAL - II

FISH PROCESSING

Laboratory practicals : Preparation of bacteriological media such as nutrient agar, peptone broth, and their sterilization, sterilization of glasswares for bacteriology work, Determination of bacterial plate count for fish skin, flesh and gut. Examination of bacterial colonies—isolation of pure culture of bacteria from fish. Study of morphology of bacteria under microscope. The gram-staining procedure. Bacterial reactions in different culture media. Tentative identification of bacterial isolates. Determination of the most probable number of coliforms in samples of water and fish.

Determination of proximate composition of fish fat, protein, ash and moisture contents; Trimethylamine and total volatile base in fish muscle by the Conway Diffusion Method; Volatile reducing substances in fresh and spoilage fish by aeration methods; Free amino acid, nitrogen in fish and prawns; Peroxide value in fish lipids. Determination of salt contents in cured fish products; Calcium and phosphorus in fish meal; Proximate composition of fish meal samples. Routine inspection of canned fish and shrimp.

Pilot plant practice : Study of mechanical refrigeration cycle (ammonia system) study of psychosomatic chart. Handling of fresh fish-Icing—Preparation of fish for freezing, filletting, packaging and freezing. Handling of fresh shrimps—preparation for freezing. Preparation of deboned fish meat, fish cutlets, fish fritters.

Preparation of fish for canning. Canning practice for different varieties of fish. Different types of packs. Examination of cans for defects.

Mechanical drying of fish—Kiln drying. Practice in different types of salting and smoke curing of fish; fish pickles.

FISHERIES ADMINISTRATION AND ECONOMICS PAPER - IA :

FISHERIES ADMINISTRATION

(Lectures 55 hrs; Seminars 9; Tutorials 50)

1. Indian Fisheries : History of Indian fisheries. Development trends. Production and utilization in different States. Central and State responsibility for fisheries development, conservation and exploitation—ownership of resources. Administrative set up at Centre and State.
2. Fishery Legislation :
Need for Legislation—Central legislation, protective legislation, legislation for rational exploitation. Craft and gear regulation; Restrictions on destructive practices; Sanctuaries—closed seasons. Regulations on industrial effluents and pollution. Legislation concerning fishing vessels; their operation and processing plants. Food laws relating to fish and other aquatic products. Indian fisheries Act and rules thereunder. Conventions and proclamations.
3. International laws. Treaties and Organizations : Laws of the sea relating to fisheries. International conventions on fisheries—International Organisations for promotion and development of fisheries. International Commissions and Expeditions.
4. Planning in Fisheries : Basic requirements for planning. Estimation of resources and potentialities. Project preparation. Fixation of Targets, means for attaining targets. Administrative and technical man-power-research and training. Economic consideration in decision on development programmes. Impact of development plans; International co-operation programmes.

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5. Fisheries Extension Principles of Fisheries Extension; Extension methods and techniques; Extension organisation system; Planning, execution of extension programmes; Extension and Administration system; Rural sociology as applied to fisheries extension; Education programmes for fishermen; Training and Personnel Management for fisheries development; Electronic media in fisheries extension; Technology Transfer; Human relations; Recent trends in fisheries extension.
6. Computer Programming Computer organisation and programming; Applications of computerised information and data analysis in fisheries.
7. Personnel Management : Managerial principles-Office management. Managerial aspects of reservoirs, fish farms; Seed collection/production centres, fishing operation, fishing boats, workshops, cold storage, processing plants, wholesale and retail.

FISHERIES ADMINISTRATION AND ECONOMICS PAPER - IB STATISTICS

(Lectures 60 hrs; Laboratory work 60 hrs; Field works 30 days; Seminars 12 hrs)

Orientation in statistical background : Basic statistical concepts. Scope and objectives of fisheries statistics. Collection, presentation and interpretation of data-Inland and Marine.

Frequency distribution-Chart and diagrams, histograms and frequency curves.

Mean, median, mode, variance and standard error, concept of sample and population; Characteristics of a sample; Probability calculations; Normal and binomial distribution.

Census and sample survey-sampling techniques (simple random, stratified, cluster and two-stage sampling with equal number of units)-method of collection and interpretation of data on manpower requirement; Fishing operations, catches, processing, marketing, prices, costs, earnings, etc. Design of experiment (simple random, randomised block and latin square) and analysis of variance. Estimation of fish populations.

FISHERIES ADMINISTRATION AND ECONOMICS PRACTICAL - I STATISTICS

Laboratory Practicals : Preparation of frequency distribution charts, histograms, frequency polygon and frequency curves from fish landing and production figures. Calculation of mean, median, mode, variance and standard deviation from samples studies. Tests of significance by t, F and χ^2 tests; Calculation of coefficient of correlation; Test of independence from a contingency table. Fitting of a linear curve. Calculation of standard error of data from sampling designs. Analysis of variance in the design of experiments.

Field work : Short-term survey from collection of statistics of fish landings, including biological data, fishing efforts, socio-economic conditions and fish processing in selected areas.

FISHERIES ADMINISTRATION AND ECONOMICS PAPER-IIA

PRINCIPLES OF FISHERY ECONOMICS

(Lectures 60 hrs; Field work 30 days; Seminar 15; Tutorials 50)

1. Introduction to Fishery Economics : Fishery economics as an integrated study-Geographic and systematic groupings of world fisheries; Recent trends in world fisheries developments-marine and inland fisheries in different countries.
2. Principles of Economics : Definition; Economics in fishery development; Wants and their classifications; Important laws of economics as applicable to fisheries; Law of diminishing utility; Laws of returns, consumer's surplus; Elasticity. Factors of production; Theory of distribution. Fiscal system, Exchange rates, Inflation and Deflation.
3. Fishery Economics in India : National income from fisheries; General classification of fishery and ancillary industries, their dynamics, history, structure, composition and organisations; Special economic features of fishery industry with particular reference to employment. Economics of fishing vessels, fishing operations, fish processing and fish culture; Economics of fish seed industry; Economic features of riverine and lacustrine fisheries and aquatic products. Rationalization in different phases of fishery industry; Case studies from India and abroad.
4. Finance and Investment in Indian Fisheries : Main features of finance in Indian fisheries; Investment by private sector, Co-operatives and public sector; Institutional finance and government credit (loans and grants); Financial systems relevant to fishing industry in selected countries such as Japan, Norway, U.K. U.S. etc.

Field work : Assessment of economic conditions of fishing, fish processing, reservoir management and fish culture by participation in field operation at selected centres for specified durations.

FISHERIES ADMINISTRATION AND ECONOMICS PAPER - IIB

CO-OPERATION AND MARKETING

(Lectures 60 hrs; Field work 30 hrs; Visits to Co-op. Societies/Markets 20; Tutorials 50)

1. Co-operative Movement : General Co-operative principles; A brief review of Co-operative movement in world and in India; Co-operative legislation.

2. Fishery Co-operatives : Review of Fishery Co-operation in important countries; Fishery co-operatives in India; Multipurpose and specialised production and consumers Co-operatives; Marketing and Products Co-operatives; Co-operatives in relation to other sectors; State undertaking, Corporations; Fish farmers development agencies and private enterprises.
 3. Socio-economics : Manpower as a factor of production; Review of living conditions of fishermen-health, housing, income, education and social amenities. Standard of living of fishermen in India and abroad; Schemes to improve the economic conditions of fishermen; Social and other insurance schemes; Indebtedness and other problems of fishermen. Role of Co-operatives and economic prosperity of fishermen. Educational and training facilities.
 4. Fish Marketing : General principles of marketing; Law of demand and supply; Fish markets; Physical facilities for marketing; Fresh and processed fish trade; Assembling, grading, processing, transportation and distribution; Sales procedures-wholesale and retail trade of fish Regulation of markets; Marketing legislation; Regulation of fish marketing in other countries such as Japan, Norway, U.K., U.S.A., etc. Price and price support measures; Marketing schemes in Government programmes. Fish in international trade: Trends in imports and export of fish to and from India; Import of fresh and processed fish; Export of fish and fish products, fresh, iced, dried, frozen, chilled, canned, others; Quality control; Selected foreign markets and their demands; Marketing management.
 5. Business Management : Principles of book keeping and accountancy. Cost accounting, working out of estimates and preparation of final accounts and auditing; Stock taking and stores accounts; Depreciation and its application in fishing; Fish processing and fish marketing industry; Costs and earnings analysis; Cost benefit ratio; Periodical returns and their format.
- Field work: Study and survey of socio-economic conditions; Marketing arrangements at selected fishing centres for specified durations, Marketing experience of commercial landings.

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