

**A.D.M.COLLEGE FOR WOMEN (AUTONOMOUS),
NAGAPATTINAM -611001
(NATIONALLY ACCREDITED WITH “A” GRADE BY NAAC – 3rd CYCLE)**

**Bachelor of Vocational Degree Programme (B.Voc)
MARINE FOOD PROCESSING AND PRESERVATION TECHNOLOGY
(for the candidates admitted from the academic year 2019 -2020 onwards)**



**(B.Voc) MARINE FOOD PROCESSING AND PRESERVATION TECHNOLOGY
SYLLABUS**

A.D.M.COLLEGE FOR WOMEN (AUTONOMOUS), NAGAPATTINAM -

Bachelor of Vocational Degree Programme (B.Voc)

MARINE FOOD PROCESSING AND PRESERVATION TECHNOLOGY

Course structure under CBCS

(for the candidates admitted from the academic year 2019 -2020 onwards)

Programme specific outcomes:

- The B.Voc. programme is focused on universities and colleges providing undergraduate studies which would also incorporate specific job roles and their NOSs along with broad based general education.
- This would enable the graduates completing B.Voc. to make a meaningful participation in accelerating India's economy by gaining appropriate employment, becoming entrepreneurs and creating appropriate knowledge.
- Programmes Specific Outcomes (PSO's) Bachelor of Vocation (B.Voc.) Degree in Information Technology (IT) PSO1. Bachelor of Vocation (B.Voc.) Degree in Information Technology will train students in areas such as – database management, operating system, internet technology, programming, networking technology etc. Bachelor of Vocation (B.Voc.) Degree in Fashion Designing (FD).
- Bachelor of Vocation (B.Voc.) Degree in Fashion Designing will acquaint students the relevant technical expertise to step into a professional world, in skills like drawing, draping, pattern making, sewing, haute couture along with training in production.
- PSO2. The programme establishes strong technical skills required to work as an innovative practicing fashion designer. Students also develop the required technical skills in custom and commercial quality garment construction as well as pattern making both manually and using computer-based design.

SEM	PART	COURSE	TITLE	INST HOURS/ WEEK	CREDIT	EXAM HOURS	MARKS		TOTAL MARKS
							CIA	SE	
I	I	Language course I (LC)	Tamil – I	3	3	3	25	75	100
	II	English Language Course (ELC)	English-I	3	3	3	25	75	100
	III	Core Course I (CC)	Fundamentals of Marine Edible Animals	4	4	3	25	75	100
		Core Practical (CP)	Practical –I Anatomy of Marine Edible Animals **	6	6	3	40	60	100
		Core Practical (CP)	Practical –II Harvest and post harvest handling of Fishes**	6	6	3	40	60	100
		Allied Practical (AP)	Practical –I Instrumentation and computer application in Fisheries**	6	6	3	40	60	100
	IV	Value Education	Value Education	2	2	3	25	75	100
			Total	30	30	21			700

** Field work & specimen collection may be carried out anytime during the entire period of the programme

SEM	PART	COURSE	TITLE	INST HOURS/ WEEK	CREDIT	EXAM HOURS	MARKS		TOTAL MARKS
							CIA	SE	
II	I	LANGUAGE COURSE I (LC)	Tamil – II	3	3	3	25	75	100
	II	English Language Course (ELC)	English-II	3	3	3	25	75	100
	III	Core Course II (CC)	Biochemical and Microbial changes in Fish	4	4	3	25	75	100
		Core Practical (CP)	Practical –III Chilling Technology**	6	6	3	40	60	100
		Core Practical (CP)	Practical –IV Fish Canning Technology**	6	6	3	40	60	100
		Allied Practical (AP)	Practical –II General Food Chemistry**	6	6	3	40	60	100
	IV	Environmental Studies	Environmental Studies	2	2	3	25	75	100
		Non -Credit	Internship						
			Total	30	30	21			700

** Field work & specimen collection may be carried out anytime during the entire period of the programme

SEM	PART	COURSE	TITLE	INST HOURS/ WEEK	CREDIT	EXAM HOURS	MARKS		TOTAL MARKS
							CIA	SE	
III	I	LANGUAGE COURSE I (LC)	Tamil – III	3	3	3	25	75	100
	II	English Language Course (ELC)	English-III	3	3	3	25	75	100
	III	Core Couse III (CC)	Food Safety in Seafood Industry	4	4	3	25	75	100
		Core Practical (CP)	Practical –V Fish Nutrition and Feed Technology	6	6	3	40	60	100
		Core Practical (CP)	Practical –VI Fish Microbiology and Quality Assurance	6	6	3	40	60	100
		Allied Practical (AP)	Practical –III Fish Processing Technology	6	6	3	40	60	100
	IV	NME-I		2	2	3	25	75	100
			Total	30	30	21			700

SEM	PART	COURSE	TITLE	INST HOURS/ WEEK	CREDIT	EXAM HOURS	MARKS		TOTAL MARKS
							CIA	SE	
IV	I	LANGUAGE COURSE I (LC)	Tamil – IV	3	3	3	25	75	100
	II	English Language Course (ELC)	English-IV	3	3	3	25	75	100
	III	Core Course IV(CC)	Packing and Labelling of Fish and Fishery Products	4	4	3	25	75	100
		Core Practical (CP)	Practical –VII Cured and dried Fishery Products	6	6	3	40	60	100
		Core Practical (CP)	Practical –VIII Fish Products and by products Technology	6	6	3	40	60	100
		Allied Practical (AP)	Practical –IV Storage and Transportation of Fishery Products	6	6	3	40	60	100
	IV	NME-II		2	2	3	25	75	100
			Total	30	30	21			700

SEM	PART	COURSE	TITLE	INST HOURS/ WEEK	CREDIT	EXAM HOURS	MARKS		TOTAL MARKS
							CIA	SE	
V	III	Core Course V (CC)	Entrepreneurship Development	3	3	3	25	75	100
		Core Course VI (CC)	Fisheries Economics	3	3	3	25	75	100
		Core Course VII (CC)	Quality Control of fish and fishery products	4	4	3	25	75	100
		Core Practical (CP)	Practical –IX Fisheries Extension Education	6	6	3	40	60	100
		Core Practical (CP)	Practical –X Marine Biotechnology	6	6	3	40	60	100
			SSD	Soft Skills	2	2	3	25	75
		MP	Mini Project	6	6	3	40	75	100
			Total	30	30	21			700

SEM	PART	COURSE	TITLE	INST HOURS/W EEK	CREDI T	EXAM HOURS	MARKS		TOTA L MARK S
							CIA	SE	
VI	IV	Core Course VIII (CC)	Fisheries Administration and Legislation	6	6	3	25	75	100
		Project	Project	12	12	3	40	60	100
		Internship	Internship	12	12	3	40	60	100
			Total	30	30	9			300
			Grand Total	180	180				3800

CORE COURSE- I

FUNDAMENTALS OF MARINE EDIBLE ANIMALS

Internal : 25
External : 75
Exam Hours : 3

Semesters : I
No. of Hours/ Week: 6
Credit: 4

Course Objectives:

- To study planktons, the drifting life forms inhabiting water bodies that nourish the higher trophic levels in the ocean ecosystem and also act as indicator species.
- To gain knowledge of Fishery Science with regards to Population Dynamics.
- To consider the application of statistical tools to study fishery science.
- To learn about aquaculture of fin fish as well as crustaceans and molluscs.
- To attain a clear perception of the present status of sea farming in India.

UNIT I

History and definition of Taxonomy. Systematics. Binomial nomenclature. Classification of commercially important fishes, crustaceans and molluscs.

UNIT II

Morphology and Sexual dimorphism in fishes, crustaceans and molluscs. Maturation and spawning in fishes. Maturity stages, Gonado-somatic index, Fecundity, ova diameter studies, breeding cycles.

UNIT III

Life history of economically important fish species. Age and growth in fish. Methods employed for age determination, direct and indirect methods, scales, otoliths, length frequency studies, Length-weight relationships and relative condition factor. Types of migration in fishes. Breeding migration in fishes and crustaceans.

UNIT IV

Structure of digestive system in fishes, molluscs and crustaceans. Digestive glands and enzymes. Modification of digestive tract in relation to feeding habits. Food and feeding habits of fishes, molluscs and crustaceans. Feeding in relation to age, sex, season and maturity. Food analysis indices.

UNIT V

Respiration-Structure of gills, branchial glands, mechanism of ventilation, respiratory pigments, mechanism of gas exchange. Accessory respiratory organs in fishes and its significance. Endocrine system, -Pituitary gland in fishes. Pheromones in fishes. Endocrine control of reproduction in crustaceans and molluscs.

Text Books:

1. Moyle and Cech Fishes and Introduction of Ichthyology
2. Nikolsky G.V Ecology of fishes
3. Purchol R.D. The Biology of Mollusca
4. Bliss D.E. Biology of Crustacean
5. Moyle, P.B. & Cech, J.J. Fishes – An Introduction to Ichthyology
6. CMFRI. The Commercial Molluscs of India.

Course Outcomes:

- Living and non-living things in the sea - Marine flora and fauna - Basic characteristics of different sea species - The ocean zones
- Memorise the names of some sea creatures - Distinguish between sea animals and plants - Understand the relationship between species

CORE PRACTICAL (CP) -I

ANATOMY OF MARINE EDIBLE ANIMALS

Internal : 40
External : 60
Exam Hours : 3

Semesters : I
No. of Hours/ Week: 6
Credit: 6

Course Objectives:

- Course provides them comprehensive understanding about aquatic ecosystem and various economical important fishes.
- Students gain knowledge in the areas of responses characterization and classification of Ostracoderms, placoderms, acanthodians, holocephali, elasmobranchs.
- Students gain knowledge of integumentary system - basic structure of skin, dermal and epidermal pigments, fins, and scales.
- Understanding of embryogenesis - Early development and post embryonic development
- Understanding of fishes habits and habitats and their functional anatomy.

UNIT I Fish

External: Eyes, Nares, Mouth, Operculum, Fins, Vent, Scales, Barbels.

Internal: Gills, Swim bladder. Fish Senses: Eyesight, Hearing, smell, Taste, lateral line, Muscle, Spinal cord, Digestive system, Reproductive system, skeletal system.

UNIT II Shrimp and Prawn

External - Appendages: Cephalic, Thoracic and Abdominal

Internal – Digestive system – Respiration system -circulatory system- reproductive system

UNIT III Molluscs: Univalvia, Bivalvia and cuttle fish

External: shells, Operculum, Tentacles, Eyes, Foot, Propodium

Internal: Digestive system, Reproductive system

UNIT IV Oysters and Clams

External – shell structure- morphometric measurement

Internal – Mantle, Gill, Adductor muscle, Tentacle, mouth- digestive system - reproductive system

UNIT V Crustacean: crab

External – Carapace – Cephalothorax – Pleon – Appendages.

Internal – Muscles – Nervous system – Sense organs – Digestive system – Circulatory system – Excretory system – Genital apparatus and reproduction – Endocrine system- Development and larvae.

Practicals

Data collection from Field:

- Visit to live fish market to know the availability of fishes and record keeping of relevant data
- Visit to dry fish market to know the preserved and processed fishes and record keeping of relevant data
- Collection of fish, molluscs and crustacean from adjacent fishing harbours to study identification, anatomy and record keeping of relevant data

Data analysis in Laboratory:

Study of External organs :

1. Mounting of scales
2. Mounting of types of Fins
3. Mounting of Barbels
4. Determination of age of fish using scales
5. Length-weight analysis
6. Study of sex ratio and differentiation

Study of internal organs :

1. Dissect and display the digestive system
2. Dissect and display the respiratory system
3. Dissect and display the Reproductive system
4. Analysis of gut contents

Course Outcome:

At the completion of this lesson students will be able to:

- Define sea animal
- Identify features of different types of sea animals
- Describe the various types of sea animal.
- To maintain fish quality, both at sea and onshore, the specification of the production, storage and delivery system should enable the levels and patterns of demand to be serviced at all times.
- It is recommended that in most circumstances this is best achieved by the provision of an ice plant at the place of landing.
- Where there is a significant supply to vessels, the plant is best located on a dedicated berth that enables direct delivery to the vessels.
- The delivery system should be able to accommodate the various hatch positions and shelter deck arrangements etc. of vessels.

CORE PRACTICAL (CP) –II

HARVEST AND POST HARVEST HANDLING OF FISHES

Internal : 40
External : 60
Exam Hours : 3

Semesters : I
No. of Hours/ Week: 6
Credit: 6

Course Objectives:

- Improvement of the processing and handling of fish in terms of quality, product range and volume results in increased economic activity and employment.
- It is also one way of stabilizing fish marketing by providing an outlet for surplus and peak catch even during emergency harvest, thereby ensuring high fishing activities and stable prices.
- It can also contribute to the efforts related to nutritional goals.

UNIT I On board handling and preservation

Hygienic handling of fish on board fishing vessel and on shore, Manufacture and storage, Quality of ice, Use of ice for handling, Quality of water to be used in fish processing, Refrigerated sea water for fish preservation. Insulated containers for fresh fish transportation. Simple mechanical refrigeration systems.

UNIT II Fishing Crafts and Gears

Classification of fishing crafts; Dimensions and design of boats; Safety and stability of fishing boats; Care and maintenance of boats; Fishing accessories and deck equipments; Types of marine engines. Fishing methods of India.

UNIT III

Modern commercial fishing methods- trawling, purse seining, gill netting and long lining. Classification of gears Care and preservation of fishing gears.

UNIT IV

Pre-treatment of fish washing, gutting, filleting, deheading, peeling, deveining etc. Anti-oxidant treatment- Glazing of fish- Types of glazing- Packaging and packaging materials for frozen fish and shrimps. Storage life, transportation and marketing.

UNIT V

Sanitary and phytosanitary requirements for maintenance of quality during post harvest handling of fish. Quality management of fish and fishery products. Processing engineering, refrigeration cycle, cold store, processing unit construction and management; Water budgeting; Waste management. Sanitation in processing plants and Quality control of fresh and processed fish and fishery products.

Text Books:

1. Balachandran, K.K. (2016) Post harvest Technology of fish and fish products. Daya publishing House, A division of Astral international pvt. Ltd., New Delhi-110 002.

References Books:

1. Clues, I.J. and Ward, A.R. (1996). Post-harvest Fisheries Development: A guide to handling, preservation, processing and quality. Chatham Maritime, Kent, ME44TB, United Kingdom.
2. Davidson, A. (1976). Seafood of south East Asia. Mac Millan, London.
3. Gopakumar, K. (1997). Tropical fisheries products, Oxford & IBH publishing co, New Delhi.
4. Mayer, V. (1965) Marinades. In fish as food, Borgstrom, G (ed.), Vol .III, Academic Press Initial neurological consultation. New York.

Course outcomes:

- Fishing craft in small-scale fisheries are generally small. They fish the area of the sea close to the shore. The gear they use often determines the fishing methods used. As the craft are small, there is very limited space onboard, which makes proper handling and preservation of the catch difficult.
- Fishing communities confront severe problems in handling, distributing and marketing fish. The lack of suitable infrastructure including transport and ice-making plants increases the problems of rapid spoilage.
- Landing sites are often remote, and it is not economic to provide the infrastructure needed to preserve fresh fish either onboard or immediately on landing. Even when landing sites and roads exist, it is often not economic to transport the catch.

ALLIED PRACTICAL (AP) - I

INSTRUMENTATION AND COMPUTER APPLICATION IN FISHERIES

Internal : 40
External : 60
Exam Hours : 3

Semesters : I
No. of Hours/ Week: 6
Credit: 6

Course Objectives:

- To learn, experiment, and explore computer applications in education
- The students will be able to: Define and explain various fundamentals of spectroscopy, qualitative and quantitative analysis.
- Differentiate between principle, instrumentation and operation of Atomic absorption and emission Spectroscopy.
- Explain the various Separation techniques and its instrumentation. Describe the principle and working of various Radiation detectors. Discuss the principle and working of various Gas analyzers.

UNIT I

Principles and its applications of pH meter – Centrifuge – Spectrophotometer - Incubator – Autoclave – Waterbath

UNIT II

Principles and its applications of BOD - Deep freezer (-20°C) – Laminar air hood –Quebec colony counter – Electric shaker

UNIT III

Principles and its applications of Microtome –Electric homogenizer – PAGE gel –Refrigerator – Soxhlet apparatus

UNIT IV

Mean -Standard Deviation Correlation Regression

UNIT V

Computer application: MS word Document – Power point- MS Excel

Practicals:

- Determination of Optical density using standard
- Incubator - Culture of microbes before and after preservation
- Pure culture technique
- Counting of microbial cell
- Estimation of protein in fish meal
- Estimation of carbohydrate in fish meal
- Histology slide preparation to observe fresh cells
- PAGE Gel to study protein profile
- Data entry in MS Excel
- Document preparation in MS word

Course outcomes:

- program Outcome: After successful completion of this course students will be able to
- Prepare presentation and report on computer system.
- Identify the components of a computer system and demonstrate basic proficiency in commonly used applications.
- Create, design, and produce professional documents using word processing software (i.e., MS Word).
- Process, manipulate, and represent numeric data using the basic functions of spreadsheet software (i.e., MS Excel).

CORE COURSE - II

BIOCHEMICAL AND MICROBIAL CHANGES IN FISH

Internal : 25
External : 75
Exam Hours : 3

Semesters : II
No. of Hours/ Week: 4
Credit: 4

Course Objectives:

- The course will provide an introduction to the various food components nutritional impact on growth, development, reproduction, health and quality of farmed fish.
- This involves learning about the fish's digestive system and the various nutrients, digestion, absorption, metabolism, and biochemical function.
- The course also covers relevant undesirable substances in feed that can be challenge for the health and for the seafood product produced.

UNIT I

Biochemical composition of Raw fish: Protein, carbohydrate, Fat, Fish oil, Minerals, Vitamins – Nutritional value of raw fish – Nutritional value of preserved and Processed fish.

UNIT II

Fish decomposition: Post-mortem changes and Rigor mortis – post-rigor decay and spoilage of fish: Enzymatic spoilage, Microbial spoilage, Bacterial flora of fish and bacterial spoilage, chemical spoilage (Rancidity, Autolysis), spoilage due to other factors.

UNIT III

Fish preservation-principles of preservation: cleaning, lowering temperature, raising temperature, dehydration, use of salt, use of fish preservatives, Exposure to low radiation of gamma rays, Electrocuting by ion wind- Methods of preservation – special problems in fish preservation: denaturation due to freezing of fish, problems arising out of industrial processes in fish preservation industries.

UNIT IV

Food poisoning, intoxications, Allergies from fish: Histamine poisoning from badly preserved fish, Food-poisoning from eating a poisonous fish species, Food-poisoning of bacterial origin(*Salmonella*, *Staphylococcus*, *Botulism*), “Pink” spoilage and “Dun” spoilage of salted fish.

UNIT V

Utilization of fish as products: Fish liver oil, methods of extraction of fish liver oil from liver – standardization of Vitamin' A potency in the extracted oil (Biological estimation, colorimetric estimation with tintometer, photoelectric spectrophotometric estimation) - Prototype of fish liver oil manufacturing plant – simple model of fish – liver oil extractor for use in small scale cottage industry – Fish body oil – Fish meal – Others(Fish flour, fish silage, fish manure & guano, fish sausage and ham, fish glue, Isinglass, Fish leather, fish macroni, fish biscuits, fish insulin)-Cooking effect on nutritional value of fish –Health hazard from fish eating.

References Books:

- Hui, Y.H. 2006.(Ed). Food Biochemistry & Food Processing. Blackwell publishing Ltd.,USA
- Brody, T. 2006. Nutritional Biochemistry 2nd Edition. Elsevier, India Pvt. Ltd. New Delhi.
- Luck, Erich, Jager, Martin 1997. Antimicrobial food additives, characteristics uses, effects – 2nd Edition, Springer – Verlag Berlin, Heidelberg – New York
- Pomeranz Yeshajahu, 1985. Functional Properties of Food Components. Academic Press , INC, London.

Course Outcomes:

- Keep track of food's quantitative importance in the production of farmed fish, which feed resources you use, and the ratios between the energizing nutrient (Protein, fat and carbohydrate) in commercial feeds.
- Possess detailed knowledge of the fish digestive system, including a deeper focus on the development of gastrointestinal tract of marine fish larvae.
- Show detailed knowledge of various energizing and micro (vitamins and nutrients digestion, absorption, metabolism and biochemical function.
- Explain the components of fish feed on fish product quality, both positive (nutrients) and negative (contaminants from food and environment).
- Have knowledge of fish reproduction and how diet affects egg and fry quality.

CORE PRACTICAL (CP) –III

CHILLING TECHNOLOGY

Internal : 40
External : 60
Exam Hours : 3

Semesters : I
No. of Hours/ Week: 6
Credit: 6

Course Objectives:

- This course with the preservation of seafoods by chilling and freezing techniques.
- At ambient temperature fish muscle undergo rapid biochemical changes and creates a favourable environment for microorganisms to grow.
- This in turn responsible for the production of foul smell and makes muscle spoiled and unsuitable for human consumption.
- The main principle of chilling by ice is, it lowers the temperature of fish body from 30°C to 5°C.
- This greatly affects the bacterial flora of fish and its growth is completely arrested by lowering of temperature and also slows down the biochemical activity, thereby preserving quality to the extended time.

UNIT I

Introduction to fish muscle function Introduction and historical developments in low temperature preservation of fish -Structure and function of fish muscle - Postmortem changes in fish - Bacteriological changes - Spoilage of fish.

UNIT II Chilling of fish

Fresh fish handling - Calculation of the ice requirement for cooling fish - Manufacturing of different types of Ice - Super chilling (0°C to - 4°C)- Application of ozone / chlorine in seafood processing.

UNIT III Freezing preservation of fish

Principle of freezing – Physical, chemical and thermodynamic properties of refrigerants-Types of freezer- Methods of protective treatments-Calculation of freezer refrigeration load -Freeze drying fish.

UNIT IV Thawing of fish & Quality changes during frozen storage

Methods of fish thawing- Quality changes in fish during freezing & frozen storage-physical changes- Microbial growth at low temperature.

UNIT V

Cold stores and containers, Packaging methods, HACCP Construction of cold store - Refrigerated containers- Good handling and shipping practices.

Practicals

- Sanitation and plant housekeeping;
- chilling and freezing equipment, instruments; packages and product styles;
- Methods of icing fish; cooling rate;
- Preservation by chilled sea water;
- Freezing and thawing curves;
- Freezing of different varieties of fish and shellfish;
- Estimation of drip;
- Determination of quality changes during frozen storage;
- Inspection of frozen fishery products;
- Visits to ice plants, cold storages and freezing plants;

Text Books:

- Freezing Technology Practical manual. 2006. Rathnakumar, K. and Velayutham, P. Dept. of Fish Processing Technology, Fisheries college and research institute, Thoothukudi.

Reference Books:

- Freezing and refrigerated storage in fisheries. 1994. W.A. Johnston, F.J. Nicholson, A. Roger and G.D. Stroud, CSL Food Science Laboratory, Torry, Aberdeen, Scotland, UK M-47 ISBN 92-5-103579-2
- Aitken, A *et al.* (eds) 1982. Fish Handling and Processing. Second Edition, Edinburgh, Her Majesty's Stationery Office, £10.
- International Institute of Refrigeration, Recommendations for the Processing and Handling of Frozen Foods. Recommendations pour la Préparation et la Distribution des Aliments Congelés. Paris, International Institute of Refrigeration, 3rd ed.

Course outcomes:

- Explain the benefits of freezing and frozen storage of foods.
- Describe and explain the importance of the typical steps in freezing and subsequent freezer storage and distribution of various liquid and solid foods.
- Describe the important processes (freezing point depression, subcooling, nucleation, growth and recrystallization) involved in freezing foods and the effects of different extrinsic and intrinsic parameters on freezing of foods.
- Apply the phase/state diagram for various foods to freezing and freezer storage, with special attention to areas of equilibrium and non equilibrium.
- Compare and contrast different freezing technologies in terms of process characteristics and quality changes during freezing of different foods.

CORE PRACTICAL (CP) –IV

CANNING TECHNOLOGY

Internal : 40
External : 60
Exam Hours : 3

Semesters : II
No. of Hours/ Week: 6
Credit: 6

Course Objectives:

- Advanced treatment of the concepts involved in the production, processing and acceptance of Fish processing – Products derived from fish – Fish waste utilization.

UNIT 1

Canning as a method of preservation & Historical developments in canning technology: Introduction to canning- definition of canning-steps involved in canning-Advantage of canning-Landmark in the development of cane manufacture- progress in thermal processing-Development in fish canning industry.

UNIT II Unit operations in canning & Thermal process for canned foods:

Different unit operation in fish canning: Preparation of raw material for canning, Filling of cans, Exhausting of filled cans, Can closing/ seaming of cans.

UNIT III Thermal process for canned foods:

Heat processing/ retorting of cans, Can cooling, labelling and storage - Thermal Processing: Classification of acidity foods, Severity of thermal process, Heat Resistance of Microorganisms.

UNIT IV Changes in canned foods & Canning of commercially important fishes and shellfishes:

Changes in canned foods and spoilage- Causes of spoilage in canned foods- Canning of individual category to fish- Tuna and tuna like fish- Canning of crustaceans- Canning of Molluscs.

UNIT V Fish Packaging & Metal Containers

Functions of Packaging- Presentation of the product- Levels of Packaging- Packaging Materials- Metal Containers- Types of metal containers.

Practicals

- Canning of commercially important fishes and shellfishes
- Preparation of Ingredients for canning
- Preparation of Raw materials and sub-materials for canning
- Can cooling, labelling and storage
- Measures of Heat resistance of Microorganisms
- Estimation of Causes of spoilage in canned foods
- .Presentation of the product

References Books

- Balachandran K.K., 2001. Post Harvest Technology of Fish and Fish Products, Daya Publishing House, New Delhi.
- Horner WFA. 1997, Canning of Fish and Fish Products, In: Fish Processing Technology, 2nd Edn. G.M.Hall (Ed), Blackie Academic and Professional, London.
- Ninawe A.S. and Rathnakumar K. 2008. Fish Processing Technology and Product development. Narendra Publishing House, Delhi – 110 006.
- Wiley Encyclopedia of Packaging Technology, 2nd Edn. John Wiley and Sons Inc. New York.

Course Outcomes:

- After completing this course students can able to, Deliver the different unit operations and its equipments involved in fish processing fishing resources.
- Develop value added products from fish. Able to know about quality control of fish processing Know about different methods of processing of fish Able to acquire a confident to get placement in any fish processing industry.

ALLIED PRACTICAL (AP) - II
GENERAL FOOD CHEMISTRY

Internal : 40
External : 60
Exam Hours : 3

Semesters : II
No. of Hours/ Week: 6
Credit: 6

Course Objectives:

- To provide an optimum environment for students to gain an understanding of the chemical bases of food component reactivity and functionality.
- To provide an opportunity for students to develop skills for experimenting with food systems and to test various approaches for manipulating the chemical and/or functional properties of foods.
- To provide students an opportunity to enhance and test their critical thinking skills through structured problem solving.

UNIT I

Composition of food and nutritional value- Factors affecting food composition - Moisture in Foods- Structure and Properties of water- Types of Water in foods- Water activity and Shelf life of Foods

UNIT II

Food lipids- Types of fat- Fish lipids- Distribution of lipids in Fish- Role of Fish Lipids in Human Nutrition- Oxidation of lipids- Types of Oxidation- Effects of Lipid Oxidation in Foods- Metabolism of lipids- Digestion and absorption of lipids- Metabolism of Fat- Biosynthesis of lipids- Synthesis of fatty acid, phospholipid- phosphotidic acid- Cholesterol.

UNIT III

Food Carbohydrates- Naturally Occurring Carbohydrates in Food- Role of Fiber in Food- Browning Reactions: Enzymatic Browning- Metabolism of Carbohydrates- Digestion and absorption of carbohydrates- Glycogenesis and Glycogenolysis- Oxidative degradation of glucose to CO₂- Gluconeogenesis- Biological oxidation.

UNIT IV

Food proteins- Native proteins and denatured proteins- Food Proteins Sources- Functional properties of food proteins: .Water-Holding Capacity (WHC):.Foam formation and foam stabilization by proteins, Viscosity, Gel formation, Factors that have an effect on the formation and properties of protein gels- Metabolism of Protein- Digestion and Absorption of proteins- Amino acid catabolism and Urea Synthesis- Protein synthesis.

UNIT V

Nutritive values of proteins- Methods for the determination of nutritional quality of proteins- Fish Muscle Proteins- Chemical changes in muscle during contraction- Chemistry of taste, flavour, and odour- Food additives- types and their chemical nature-Enzymes, vitamins and amino acids- Energy values,

Energy requirements and their estimation- Water, electrolyte and acid base balance- Assessment of quality in food by instrumental and Chemical methods

Practicals

- Estimation of moisture content in fish sample by hot air oven method,
- Estimation of total Nitrogen and Protein Content of Fish by Microkjeldahl Method
- Estimation of Crude Fat of Fish by Soxhlet Method
- Determination of Ash in Fishery Products
- Principles of Colorimeter and Spectrophotometer (Demonstration of Beer's law)
- Estimation of Starch in Food
- Estimation of crude fiber using Fibra plus
- Paper Chromatography of Amino Acids
- Estimation of Free Fatty Acid Content of Fish Fat / Oil
- Estimation of sodium chloride in fishery products(mohr's method)
- Estimation of total volatile base N &TMA in fish sample by ConwayMicrodiffusion method
- Determination of histamine by fluorometric method
- Estimation of β -carotene

Reference Books

- Belitz. H. D., and Grosch, W. 1999. Food Chemistry. 2nd Edition, Springer ,Verlag Berlin, Heidelberg, New York.
- Fennema Owen, R (Ed.). 1996. Food Chemistry, 3rd Edition, Marcel Dekker, Inc. New York.
- Garard, Ira D. 1976. Introductory Food Chemistry. The Avi Publishing Company INC. Westport, Connecticut.
- Berg J M, Tymoczko JL &Stryer L. 2002. Biochemistry. WH Freeman.
- Voet D, Voet JG & Pratt CW. 2006. Fundamentals of Biochemistry. John Wiley & Sons.

Course Outcomes:

- Students will be able to name and describe the general chemical structures of the major components foods (water, proteins, carbohydrates, and lipids).
- Students will be able to give a molecular rationalization for the observed physical properties and reactivity of major food components.
- Students will be able to provide a theoretical explanation for observed extents and rates of reactions that are common to foods
- Students will be able to predict how changes in overall composition are likely to change the reactivity of individual food components.

CORE COURSE III
FOOD SAFETY IN SEAFOOD INDUSTRY

Internal : 25
External : 75
Exam Hours : 3

Semesters : III
No. of Hours/ Week: 4
Credit: 4

Course Objectives:

- To understand the concept of safe food and types of hazards associated with food.
- To control the potential threats to safety of food.
- To familiarize with the Good Hygienic Practices, Food Safety Management Systems and Food Regulations.

UNIT I

Microbiological standards in seafood industry. Source of microorganism to fish-Sanitary measures adopted to reduce microbial load in fish. Food borne nonbacterial infections and intoxications: Aflatoxins, patulin, ochratoxin and other fungal toxins found in food, toxin producer, source, nature of toxin, toxicity and significance in foods.

UNIT II

Public health microbiology- Food borne pathogens: Emerging food-borne pathogens. Water and borne diseases. Bacteria of public health significance in fish/fishery products/environments *Salmonella*, *Clostridia*, *Staphylococcus*, *E. coli*, *Streptococcus*, *Vibrio*, *Aeromonas*, *Listeria*, *Yersinia*, *Bacillus*. Methods for Detection: Rapid detection and indirect detection methods of pathogens and parasites. Laboratory techniques for detection and identification of food poisoning bacteria.

UNIT III

Total plate count Coliforms-concept- indicator organism-MPN estimation-isolation and identification-faecal coliforms. *Salmonella*-Isolation and identification. *Vibrio*- Isolation and identification. *Streptococcus*- Isolation and identification. *Listeria* spp isolation and identification. *Pseudomonas aeruginosa*, General understanding about different microbiological methods. (FDA, CFIA, FSIS, NACMSF, AOAC).

UNIT IV

Quality control of Laboratories. Good Laboratory Practices (GLP), ISO/IEC 17025. Types of laboratories, General requirements for a food laboratory. (Layout, Environmental requirements, Safety requirements etc) Food borne diseases-Food infection and food intoxication. Botulism. Typhoid and Paratyphoid, *Clostridium perfringens*, Listeriosis. Sources and transmission of bacteria in foods: human, animal, environmental reservoirs; cross-contamination.

UNIT V

Antimicrobial systems and food preservation: ecological concepts: Lactoperoxidase. Nisin, Lysozyme, Bacteriocins. Packaging and modified atmosphere on the microbiology and shelf life of fishery products. Norms for using antimicrobial systems in food processing and preservation. Food Safety, Risk analysis. Potential health hazards and risks associated with fish products. Predictive modeling in quality and safety assurance of fishery products.

Reference Books:

1. Chincheste, C.O and Graham, H.D. Microbial safety of Fishery products,
2. Frasier, W.C and Westhoff, D.C Food Microbiology ,
3. Jay, J.M. Van Nostrand. D. Modern Food Microbiology
4. Amerine, M.A, Pangborn, R.M Principles of sensory evaluation of food
5. Connell. J.J Control of fish Quality,
6. Sali A.J. Fundamental Principles of Bacteriology

Course Outcomes:

- Understand the concept of food safety, types of hazards and their control measures
- Identify and prevent potential sources of food contamination
- Comprehend the need of hygiene and sanitation for ensuring food safety
- Knowledge of Food Safety Management tools
- Understand National and International Food Safety Laws and Regulations
- Practical knowledge to detect and quantify microorganisms from various routes of contamination of food

CORE PRACTICAL (CP) –V

FISH NUTRITION AND FEED TECHNOLOGY

Internal : 40
External : 60
Exam Hours : 3

Semesters : III
No. of Hours/ Week: 6
Credit: 6

Course objectives:

- The purpose of cage fish culture is to economically produce crops of fish. Economic feasibility is obtained through a balance of maintaining a productive ecosystem and adding sufficient nutritional inputs to achieve optimal crop yields.
- The objective of feeding fish in cages is to economically provide proper nutrition for fish growth and good health while minimizing metabolic waste and ecosystem pollution.
- Requirements for achieving the objective are providing proper quality and quantity feed, employing an in-cage feed enclosure, and using proper feeding methods.

UNIT I Fundamentals of fish nutrition

Introduction- Nutrient and growth .Protein, Amino acids and Lipid: structure – composition-chemical properties-classification – fatty acid structure and classification-steroids-cholesterol-Bile acids.

UNIT II Carbohydrate, Vitamins, Minerals, Energy

Carbohydrates; classification- non sugars and sugars.Vitamins classification. Minerals classification and functions. Energy: Laws of thermodynamics-energy unit-forms of energy partitioning-energy metabolism.

UNIT III Nutritional requirements of cultivable fish and shell fish

Introduction - Methods of feed formulation and manufacturing: feed manufacturing- feed milling processes-extrusion pelleting. Different forms of feeds: feed based on life cycle of fish-product quality feeds-larval feeds-flakes-farm made feeds. Feed additives: Binders-antioxidants-enzymes-pigments-growth hormones-feed stimulants-immunostimulants.

UNIT IV Non-conventional feed ingredients and evaluation of feeds

Non-conventional feed ingredients and anti-nutritional factors: soya bean meal-single cell protein- Krill-poultry by products and feather meal-anti nutritional factors. Digestive enzyme, digestibility and factors affecting digestibility: digestion and absorption-characteristics of enzymes and other digestive secretions-protein, fat, carbohydrate, microbial digestion-factors affecting digestion. Evaluation of efficiency of fish feeds. Storage of fish feeds.

UNIT V Storage, Management and Nutritional deficiency

Storage of fish feeds. Feeding devices and Methods: methods of feeding-demand feeder- automatic feeder-feeding crafts. Feed Management: ration size-feeding tables-factors affecting feed consumption-growth monitor. Nutritional deficiency disorders, symptoms and diseases in fishes: due to protein, lipid, minerals.

Practicals

P1. Proximate composition analysis of feed ingredients and prepared feeds

- a) Determination of moisture
- b) Determination of Crude Protein (Kjeldahl Method)
- c) Determination of Crude Fat
- d) Determination of Crude Fibre
- e) Determination of Ash
- f) Determination of carbohydrate

P2. Preparation of formulated feeds using locally available feed ingredients

- a) Standard fish feeds
- b) Digestive enzyme based fish feeds
- c) Carotenoid based fish feeds
- d) Phytase based fish feeds

P3. Determination of sinking rate and stability of formulated feeds

- a) Sinking rate of formulated feeds
- b) Stability of formulated feeds

P4. Determination of storage effect on feed quality

- a) Protein associated changes
- b) Fat associated changes

P5. Students project work

- a) Testing and evaluation of formulated feeds on fish growth and survival

References Books:

- FAO., 1980. Aquaculture development and coordination programme. Fish feed technology. Lectures presented at the FAO/UNDP Training Course in Fish Feed Technology, Seattle, Washington, 9 October - 15 December 1978. FAO/ADCP/REP/80/11 1980: 400 pp.
- Mohanty, N. A., 2006. Nutrition of fin fishes and shellfishes. In: Hand book of Fisheries and Aquaculture. Ayyappan, S., Jena, J. K., Gopalakrishnan, A. and Pandey, A. K. Published by Indian Council of Agricultural Research, New Delhi: 488-493.
- Rath, R. K., 2000. Nutrition requirement of finfish. In: Fresh water Aquaculture. Published by Scientific Publishers (India), Jodhpur: 214-224.
- Sena S. De Silva and Trevor A. Anderson., 1995. Fish nutrition in Aquaculture. Published by Chapman and Hall, Landon, New York, Madras: 287 pp.

Course outcomes

- Have experience with processes both for design and optimizing feed production units, as well as planning and conducting experiments in feed technology.
- Practical understanding of both feed ingredients and feed processing.
- Practical experience from all types of processing commonly used in industrial production of feed.
- Experience in the selection of ingredients and processing optimized for different animals, such as production animals, fish and companion animals.
- High research-based competence within the interaction between processing and nutritional value of feed, both for production animals, fish and companion animals

CORE PRACTICAL (CP) –VI

FISH MICROBIOLOGY AND QUALITY ASSURANCE

Internal : 40

External : 60

Exam Hours : 3

Semesters : III

No. of Hours/ Week: 6

Credit: 6

Course objectives:

- Formulation of specifications for raw materials, supplies, inplant processes, containers and finished products including shelf-life.
- Development of test procedures. Quality levels and production variables are to be tested on some scale
- Forms for recording and reporting, preparation of quality control charts etc. Attending to troubles and advice stoppage of production or rectification of defect.
- Attending to special problems regarding quality and complaints.

UNIT I Role, significance and Factors affecting growth and survival of microorganisms in Seafood

Introduction to fish microbiology and history of microorganisms in foods. Role and significance of microorganisms in nature and foods – microorganisms in aquatic environment, primary sources of microorganisms found in foods. Intrinsic and extrinsic parameters affecting the growth of microorganisms in fish . Intrinsic parameters - pH, moisture content, oxidation reduction potential, nutrient content, antimicrobial substances. Extrinsic parameters - temperature of storage, relative humidity of storage environment, presence and concentration of gases, and presence and activities of other organisms.

UNIT II Enumeration of microorganisms in foods and Food preservation techniques

Study of microorganisms in foods by conventional methods – standard plate count, membrane filter and most probable number techniques. Study of microorganisms by rapid methods- thermostable nuclease, dye reduction test, limulus lysate test, ATP measurement, ELISA and PCR. Microbial principles of fish preservation and processing– by use of low temperature, high temperature and drying, radiation and chemicals. Endospores and formation of cell aggregates.

UNIT III Food borne bacterial pathogens

Study of food borne pathogens involved in infective and intoxication type of food poisoning, foodborne gastroenteritis caused by *Clostridium botulinum* and *Staphylococcus*. Foodborne gastroenteritis caused by *E. coli* , *Salmonella*- distribution, pathotypes, growth conditions, incidence and survival in foods, virulence factors, gastroenteritis syndrome, prevention of outbreak. Food borne gastroenteritis caused by *Listeria* , *Campylobacter*-

distribution, serotypes, growth conditions, incidence and survival in foods, virulence factors, gastroenteritis syndrome- listeriolysis, prevention of outbreak. Food borne gastroenteritis caused by clostridia *Vibrio cholerae* and *V. parahaemolyticus* distribution, growth conditions, incidence and survival in foods, virulence factors, food poisoning- botulism, prevention of outbreak.

UNIT IV Biological hazards in foods and Sanitation and microbiological quality

Biological hazards in foods: mycotoxins – aflatoxins- toxin production and occurrence in foods and problem associated; marine toxins: algal toxins – Paralytic shellfish poisoning (PSP), Diarrhetic shellfish poisoning (DSP), Neurotoxic shellfish poisoning (NSP), Amnesic shellfish poisoning (ASP), ciguatera toxin, pufferfish toxin and histamine poisoning. Biological hazards in foods: parasites – protozoan, flat worms and round worms associated with fish and shell fish. Food borne viruses - types, incidence in foods and food borne viral diseases. Fish plant sanitation - need for sanitation, cleaning schedule, Ciguatera Fish Poisoning (CFP), detergents, disinfectants/ sanitizers. Indices of fish sanitary quality - coliforms, E.coli and faecal streptococcus. Process water quality- water source, water quality requirement.

UNIT V Spoilage of fresh and processed fish and fishery products and Assurance and management of fish quality

Spoilage of fish - microbial, enzymatic and non enzymatic spoilage. Spoilage of semi processed and processed fishery products - spoilage of fresh, chilled, frozen fish, canned, and dried fish. Assessment of fish quality – sensory, physical, chemical, microbiological and statistical quality. Waste management in processing industries. Concept of Quality Management – Total Quality Management (TQM), Sanitation Control procedure (SCP), Sanitation Standard Operating Procedure (SSOP), Good Manufacturing Practices (GMP); Hazard Analysis and Critical Control Point (HACCP). Quality standards – Bureau of Indian Standards (BIS), Export Inspection Agency (EIA), International Organization for Standardization (ISO), United States Food and Drug Administration (USFDA), European Union (EU) and Codex Alimentarius for fish and fishery products.

Practicals

- Enumeration of total bacterial load in fish and shellfish by plate count method.E
- Enumeration of total fungal load in cured fish and shellfish
- Enumeration of total spoilage organism in fish and shellfish
- Enumeration of anaerobic sulphate reducers in seafood
- Isolation and identification of *E. coli* from fish and fishery products by MPN and membrane filter methods
- Isolation and identification of fecal streptococci from fish and fishery products
- Isolation and identification of *Staphylococcus aureus* from fish and fishery Products
- Isolation and identification of *Vibrio cholerae* and *Vibrio parahaemolyticus* in fish and fishery products.
- Isolation and identification of *Salmonella* from fish and fishery products
- Isolation and identification of *Listeria* from fish and fishery products
- Isolation and identification of Clostridia in fish and fishery products
- Isolation and identification of *Campylobacter* from fish and fishery products
- Determination of MIC and MCC of chemical preservatives
- Enumeration of microorganisms by dye reduction test.
- PCR detection of pathogenic microorganisms associated with fish.
- Biochemical tests for the characterization of microorganisms – oxidase test, indole test, methyl red test , Vogues-Proskauer test, catalae test, citrate utilization, TSI, sugar fermentation test, aminoaciddecorboxylase test etc
- Sensory method for assessing quality of fish
- Physical method for assessing quality of fish.
- Chemical method of assessing fish quality
- Determination of available chlorine in process water.
- Visit to fish processing plant and study of implementation of HACCP.]

References Books:

- Food Microbiology 4th Edition (2008), William C. Frazer, The McGraw Hill publishers, India
- Food Microbiology: Fundamentals and Frontiers (1997). Doyle, M. P., Beuchat, L. R. and Montville, T. J. (Editors). ASM Press, Washington.
- Foodborne Diseases (2007). ShabbirSimjee (Editor). Humana Press Inc. New Jersey.
- Principles of Food sanitation (2006). 5th Edition. Marriott, N G and Gravani, R. B. Springer Science Inc. New York.

- Microorganisms in Foods 7: Microbiological Testing in Food Safety Management (2002). 2nd Edition. International Commission on Microbiological Specifications for Foods. Plenum Publishing Corporation.

Course outcomes:

- Explain the interactions between microorganisms and the food environment, and factors influencing their growth and survival.
- Describe the characteristics of foodborne, waterborne and spoilage microorganisms, and methods for their isolation, detection and identification.
- Explain why microbiological quality control programmes are necessary in food production
- Explain the effects of fermentation in food production and how it influences the microbiological quality and status of the food product.
- Discuss the rationale for the use of standard methods and procedures for the microbiological analysis of food.

ALLIED PRACTICAL (AP) –III
FISH PROCESSING TECHNOLOGY

Internal : 40
External : 60
Exam Hours : 3

Semesters : III
No. of Hours/ Week: 6
Credit: 6

Course objectives:

- To understand in detail the spoilage of fish along with associated factors
- To understand the principles and practices associated with various methods of fish preservation
- To introduce the bacterial quality of fish with an overview of the current quality assurance regimen

UNIT I

Importance of fish in human diet.Nutritional quality of Fish.Proximate composition of fish.Spoilage of fish, Rigor mortis.

UNIT II

Drying: Basic principles, natural drying packing and storage of dried fish. Salting: principles, quality of salt, Kench salting, brine sailing. Smoking: Principles of smoking, cold smoking, hot smoking, fuel, packing and storage of smoked fish. Chilling: Manufacture and storage of ice, quality of ice, methods of chilling. Freezing: Basic principles, methods and application of chilling, Block freezing, Individual quick freezing (IQF), storage of chilled and frozen fish. Thermal processing.Canning.Other methods of processing and preservation.Spoilage in preserved seafood.

UNIT III

Fundamental aspects of quality control in sea food. Inspection of sea food quality.Different aspects of sea food quality.National agencies for sea food inspection.HACCP.Hygiene in processing plants.

UNIT IV

Miscellaneous fishery products.Fishery by-products.

UNIT V

Bacteriology of fish and shellfish. Spoilage Bacteria.Bacteria of human health significance in seafood.

Practicals

1. Visits to fish processing plant, ice plant and fish landing centre.
2. Proximate analysis of fish
3. Preparation of fishery products

References Books

1. Bremmer, H.A. 2002. Safety and Quality Issues in Fish Processing. Woodhead Publ. Ltd., England, 507 pp.
2. Curting, C.L. 1999. Processing and Preservation. Agro Botanical Publ., Bikaner, India, 372 pp.
3. Gopakumar, K. 2002. Textbook of Fish Processing Technology. Indian Council of Agricultural Research, New Delhi, 491 pp.
4. Hall, G.M. 1992. Fish Processing Technology. Chapman & Hall India, Madras, India, 309 pp.
5. ICAR 2006. Handbook of Fisheries and Aquaculture. Directorate of Information and Publication of Agriculture, ICAR, New Delhi, 755 pp.
6. Long, A.C. 2008. Fish Processing Technology. Cybertech Publ., New Delhi, 312 pp.
8. Moorjani, M.N. 1984. Fish Processing in India. Publ. Infor. Div., ICAR, New Delhi, 82 pp.

Course outcome:

- List marine and marine based products
- Recognize the fish processing and methods
- Locate the aquaculture and its functions
- Carryout the fish processing
- Interpret the fish and its economics
- Describe fish processing with various adoptive methods

NON MAJOR ELECTIVE -I

FINANCING AND MARKETING MANAGEMENT IN SEAFOOD

Internal : 25

External : 75

Exam Hours : 3

Semesters : III

No. of Hours/ Week: 2

Credit: 2

Course objectives:

- Improve the development of seafood markets by focusing on analyses of new marketing themes, and alternative seafood products.
- Enhance fishery and aquaculture production by developing decision support tools to integrate management and marketing.
- Increase the organizational and institutional efficiency of the aquaculture and fishery sectors by analyzing the regulatory environment and developing ideas to support the sectors.
- Improve the understanding of how infrastructure investment, location, and sector organization affects the stability of both the aquaculture and capture fishery industries.

UNIT I

Cooperation: Evolution of co-operative movement in India- Objectives of cooperatives- Principles of cooperatives- Democratic Member Control- Members' Economic Participation- Cooperative Education, Training and Information- Need for co-operation- Benefits- Weakness of the cooperative movement- Causes which have retarded the growth of the movement.

Cooperative movement in fisheries in India: Genesis of cooperative movement in fishery sector- Formation of a Co-operative Society- Status of Indian fishery co-operative movement- Fishery cooperatives in India- Organizational Structure of Co-operative Societies- Status and problems of fisheries co-operatives.

UNIT II

Fishery Financial Management and Insurance: Capital and credit requirements of fishery sector at macro and micro levels- Role of co-operatives in fish marketing- Broad classification of sources of finance- World Bank. Principles of financial management- R's of credit: Returns, Repayment Capacity and Risk bearing ability- Undiscounted Measures- Project Evaluation or Capital Budgeting or Investment evaluation- Time value of Money- Discounted Measures- Discounted Pay Back Period. Role of NABARD in fisheries development: History- Functions- . Interest Rate and beneficiaries- NABARDs collaboration with other agencies- Area of financing in fisheries sector- Monitoring ongoing project- Lending operations- Problems in fisheries financing- Remedial measures to improve fisheries finance- Commercial

Banks- Various loan schemes of commercial banks- Specialized financing organization.

UNIT III

Basic Accounting procedures or analysis of business performance: Basic Accounting Procedures or Analysis of Business Performance - The Income Statement / Profit and Loss Account- The Balance Sheet- The Cash Flow Statement- Ratio analysis. The Core concepts of marketing: Introduction- Need, Wants and Demands- Products- Exchange, Transactions and Relationships. Markets: Introduction- Approaches- Marketing and Marketers. Introduction to marketing management: Introduction to marketing management- Demand States and Marketing Tasks- Pure monopoly. Market Structure and Types: Different types of market structure- Pure competition- Pure monopoly- Monopsony- Monopolistic competition- Oligopoly, Oligopsony, Price discrimination.

UNIT IV

Elasticity: Meaning of elasticity- Price elasticity of demand- Income elasticity of demand- Cross elasticity- Determinants of Elasticity- Uses or importance of Elasticity. Approaches for studying the problems in marketing: Approaches for studying the problems in marketing- Marketing Channels and Supply Chain- Marketing channels for small-scale fisheries products. Marketing Channel Functions and Flows: Introduction-Number of Channel Levels. Marketing Environment-Consumer Behaviour: Marketing Environment- Consumer Behavior- A Model of Consumer Behaviour- Major factors influencing Consumer Behaviour- Cultural factors- Social factors- Personal factors- Selective Attention- Selective Distortion- Selective Retention- Learning- Beliefs and Attitudes- The Buying Decision Process- Types of buying behaviour.

UNIT V

Product Management: The Product Life Cycle- New Product Development. New Product Development Process: Managing Product Life Cycle- Product and Product Mix- Product Levels. Types of Marketing Strategy: General Marketing Strategies- Decision Area Strategies. **Domestic Fish Marketing in India:** Marketing of fish and fishery products. Trade liberalization and fisheries markets: Subsidies in Indian fisheries- Future trends.

References Books

- Aquaculture Economics and Financing management and Analysis. Carole R. Wiley-Blackwell (2010). ISBN-13: 978-0813813011, ISBN-10: 9780813813011.
- Market-Based Fisheries Management Private fish and captains of finance. Authors: Host, Jeppe. MARE Publication Series.2015.

Course outcomes:

- This course examines the production, management and markets for captured and farmed fish.
- Be able to analyse and discuss how different types of regulations affect economic behavior.
- Understand the production process in intensive and extensive aquaculture.
- Be familiar with the various externalities affecting both aquaculture production and capture fisheries, and know how to value them.
- Know the relevant markets for fish and aquaculture products, how these markets work, and how they affect production.

CORE COURSE - IV

PACKING AND LABELING OF FISH AND FISHERY PRODUCTS

Internal : 25

External : 75

Exam Hours : 3

Semesters : IV

No. of Hours/ Week: 4

Credit: 4

Course Objectives:

- Packaging may be defined as the means of ensuring the safe delivery of a product to the end consumer in sound condition at the minimum overall cost.
- Foodpackaging is an external means of preservation of food during storage transportation and distribution.
- They should facilitate storage, effective chilling, internal and long distance transport, easy determination of quantities and display in whole sale and retail markets.
- Packaging materials protect the product from contamination or loss. The printing on the exterior of the package helps to identify the brand and attract the buyer's attention.

UNIT I

Food packaging, its purposes and procedures; technological aspects of packaging fisheryproducts; packing of fresh and frozen fish for consumers; packaging for transport, shipping and Institutional supplies; packaging standards for domestic and international trade.

UNIT II

Packaging materials; basic films and laminates, their manufacture and identification; resistance of packaging materials; development of protective packaging for fishery products.

UNIT III

Methods of testing for packaging materials for their physical properties; containers and their testing and evaluation; package designs; resistance of packages to hazards in handling; transport and storage.

UNIT IV

Modified atmosphere packaging, controlled packaging and aseptic packaging. Flexible packing, retort pouch processing of fish and fishery products principles and techniques. Combination and synergistic effects.

UNIT V

Labelling and printing of packaging materials. Labeling requirements - national and international, legislation on labeling. Labeling for product traceability. Type of labeling for organic foods, specific foods like organic foods, GM foods, irradiated foods, vegetarian and nonvegetarian foods. Label design specification – size, colour.

References Books

1. Balachandran K.K. Post Harvest Technology of Fish and Fishery Products
2. Desrosier N.W. and Treasler D.K Fundamentals of Food Freezing
3. Govindan T.K. Fish Processing Technology
4. Moorjani M.N. Fish Processing in India
5. Brody J. Fishery Byproduct Technology
6. Chicheste C.O. and Graham H.D. Microbial Safety of fishery Products
7. Amerien M.A. *et.al.* Principles of sensory evaluation of Food

Course Outcomes:

- Identifies packing materials like Glass containers, Metal cans, Types of paper packages, Cellophane, LDPE, HDPE, Aluminium foil and Retort pouch
- Practises packing of Frozen Material like IQF products, Block frozen Products.
- Practises packing methods like, packing on stand pouch, packing in polythene covers.
- Categorises the packing of various value added fishery products and by products.
- Classifies the packaging of canned fish and fish pickle
- Evaluates modern packing methods like MAP, CAP, and Vacuum packing.

CORE PRACTICAL (CP) –VI

CURED AND DRIED FISHERY PRODUCTS

Internal : 40
External : 60
Exam Hours : 3

Semesters : IV
No. of Hours/ Week: 6
Credit: 6

Course objectives:

- Discuss on methods of production of cured and smoked products.
- Summarise the process of salting and drying .
- explain the packaging methods of such products.
- Describe storage and shelf life of these products.

UNIT I

Free and bound water in foods, water activity and sorption behaviours of foods, storage characteristics, microbial spoilage, effects of water activity on chemical deterioration, enzymatic reaction, non-enzymatic browning, lipid oxidation, reaction between lipids and proteins, dry fish, control of micro-organisms.

UNIT II

Principles of drying and dehydration: Psychometrics, drying calculation, constant rate and falling rate, drying time in air, moisture transport mechanism, natural drying, solar drying and mechanical drying. Different types of dryers: tunnel drier, vacuum drier, drum drier, solar drier etc. Freeze drying, preparation and its nutritive value. Dehydration of fish products: dehydration ratio, precautions to be taken in fish drying; denaturation of fish protein.

UNIT III

Cured fish, types of salt curing, use of salt, factors affecting salt uptake by fish, lean and fatty fish, whole, gutted or split open, type and size of salt crystals, source of salts and impurities in salts, effect of impurities on salt penetration, temperature of salting.

UNIT IV

Smoke curing, chemistry of smoke, composition and properties, smoking methods: cold and hot method, use of smoke liquids, production of smoke, type of wood used, methods of smoke generation, carcinogens in smoke, smoke kilns.

UNIT V

Fermented products: different methods of fermentation, indigenous products and their principles of preservation. Marinades: Principles; processing of cold, cooked and fried marinades, shelf life and spoilage. Fish and shellfish pickles: production, shelf life Packaging requirements for dry, cured and fermented products.

Suggested readings

1. Gopakumar K. Text Book of Fish Processing Technology
2. Hall, G.M. Fish Processing Technology.
3. Hui, Y.H., Merle D.P., & J R. Gorham Food borne Disease Handbook.
4. Oefjen, G.W., Haseky & Peter Freeze drying.
5. Sen D. P. Advances in Fish Processing Technology.
6. Wheaton & Lawson Processing Aquatic Food Products

Practicals

- Biochemical analysis of dry fish products
- Microbial analysis of dry fish products
- Smoking method cold and hot method
- Processing of cold, cooked and fried marinades
- Principles; processing of cold, cooked and fried marinades
- Fish and shellfish pickles: production,
- Shelf life Packaging requirements for dry, cured and fermented products

Course outcome:

- Polyester polyethylene laminated pouches have been found to be highly suitable for hygienic retail packaging of cured fish products.
- Preservation, nevertheless, is still the prime objective of fish smoking in most parts of the world.
- Hard woods, such as oak, hickory, cherry, apple and beech, burn to give a smoke with the more phenols, which both preserve and give a characteristic, 'medicated' flavours to the product. Dried, Cured and Smoked Products.
- Colour impaired to the fish by the smoking process is due to carbonyl amino reactions of the Maillard type.
- These are splitting and cleaning, salting and hanging.
- In the process, fish is hung to drip either on racks or in the kiln.

CORE PRACTICAL (CP) –VII

FISH PRODUCTS AND BY PRODUCTS TECHNOLOGY

Internal : 40
External : 60
Exam Hours : 3

Semesters : IV
No. of Hours/ Week: 6
Credit: 6

Course objectives:

- Principle of fish preservation and processing. Processing of fish by traditional methods – salting, sun drying, smoking, marinating and fermentation.
- Theory of salting, methods of salting –wet salting and dry salting.
- Drying and dehydration- theory, importance of water activity in relation to microbial growth .Sun drying and artificial drying- solar dryer.
- Packaging and storage of salted and dried fish. Different types of spoilage in salt cured fish. Quality standard for salted and dry fish.
- Fish preservation by smoking- chemical composition of wood smoke and their role in preservation. Methods of smoking and equipments used for smoking.

UNIT I

Principles of Fish Preservation:Composition of fish - Proximate composition - Seafood spoilage - Fish preservation. Fish preservation methods and principles : Chilling- Freezing - MAP (Modified Atmospheric Packaging) - Curing (drying, salting and smoking) - Canning and Retort pouch packaging - Marinating- Boiling- Fermentation- Irradiation - Freeze-drying - Hurdle technology.

UNIT II

Extrusion: Extrusion- Extruder- Extrusion cooking- Extruded products- Extrusion processing steps. Types of extruders: Single screw extruder- Twin screw extruder. Difference between the single screw and twine screw extruder.Advantages of extrusion cooking.

UNIT III

Fish protein concentrate: Fish protein concentrate- Methods used for preparation of Fish Protein Concentrate- Types of FPC- Proximate composition of FPC- Use of FPC. Fish Protein Hydrolysate: Fish protein hydrolysates. Methods of protein hydrolysis: Acid hydrolysis- Alkali Hydrolysis- Biochemical methods. Critical parameters while preparing Fish protein hydrolysate. Proximate composition and Nutritional value. Autolysis assisted hydrolysis of fish protein hydrolysate. Application of fish Protein Hydrolysate.Advantages of preparation of protein hydrolysates.

UNIT IV

Fish meal and fish oil:Fish meal- Use of fish meal as feed ingredient- Raw materials used in fish meal. Processing Method: Wet reduction/rendering

process- Dry reduction/rendering process. Equipments used in fish meal plant- Fish meal quality. Fish oil: Production of fish oil- Wet Reduction Process- Dry reduction Process- Processing of fish oil. Unsaturated Fatty acids.

UNIT V

Fish By- products: Isinglass- Shark leather- Fish glue- Pearl Essence- Beche-de-mer. Chitin and Chitosan: Characteristics of chitin and chitosan- Preparation of Chitin and Chitosan- Uses of Chitin and chitosan. Seaweeds: Types of seaweeds- Species of seaweeds cultured- Seaweed resources of India- Utilization of seaweeds- Agar agar- Carrageenan- Other hydrocolloids. Diversified fish products/ value addition: Breaded and Battered Products Imitation products- HACCP in product preparation- Determination of CCPs- Specification of criteria for control- Monitoring and checking system- Corrective action, verification and documentation- Training of Personnel.

Practicals:

- Fish preservation methods
- Modified Atmospheric packaging(MAP)
- Traditional method of fish preservation
- Methods of fish drying: Natural, Solar, Artificial, Mechanical dryer
- Preparation of extruded products using single screw and twin screw extruder.
- Fish protein hydrolysate preparation
- Production of fish oil by soxhlet extraction method.
- Extraction of chitosan from shrimp shell waste by conventional chemical method
- Culturing of sea weed
- Preparation of any fish product/value addition
- Document preparation for any product.

References Books:

- Fish Preservation and Processing Technique. Author: UgochukwuNwaigwe, Department of Food science and Technology, Michael Okpara University of Agriculture, Umudike :<https://www.researchgate.net/publication/316918904> (All content following this page was uploaded by UgochukwuNwaigwe on 14 May 2017.)
- Fisheries Technologies for Developing Countries. 1988. Washington, DC: The National Academies Press. <https://doi.org/10.17226/1024>. Publication Info 176 pages, ISBN: 978-0-309-03788-4 DOI: <https://doi.org/10.17226/1024>
- Nutrient Requirements of Fish and Shrimp (2011) The National Academies Press, Washington DC. ISBN-13:978-0-309-16338-5. www.nap.edu

Course outcomes:

- Has profound and detailed scientific knowledge and understanding of the (bio)chemical processes in biological raw materials during postharvest storage and their transformation into food products.
- Has profound and detailed scientific knowledge and understanding of ecology, physiology, detection, use and combat microorganisms in food systems.
- Has profound and detailed scientific knowledge in different fields of product technology such as vegetable products, dairy products, meat products, fish products, cereal derived products and fermented products including aspects of product development in relation to consumer behavior.

ALLIED PRACTICAL (AP) –IV

STORAGE AND TRANSPORTATION OF FISHERY PRODUCTS

Internal : 40

External : 60

Exam Hours : 3

Semesters : IV

No. of Hours/ Week: 6

Credit: 6

Course objectives:

- The transport vehicle should be examined for overall hygienic condition.
- Products subject to fifth, taint or contamination should be rejected.
- The transport vehicle should be examined for possible cross contamination of ready-to-eat fish and fishery products by raw fish and fishery products.
- Determine that cooked-ready-to-eat product has not been exposed to raw product or juices or live molluscan shellfish and that raw molluscan shellfish have not been exposed to other raw fish or shellfish.

UNIT I

Fish as raw material for processing: Body structure, physical properties, shape, specific weight, bulk weight, angle of slip, weight composition. Factors affecting quality of fresh fish: intrinsic and extrinsic factors. Post-harvest Fishery losses, Methods to reduce losses during storage and transportation.

UNIT II

Changes in Fish muscle during freezing and in the cold storage- ice crystal formation, shrinkage, drip loss, organoleptic changes, freezer burn, texture, protein denaturation, nutritional changes, enzyme denaturation, declining of bacterial load, discoloration.

UNIT III

Layout and factors to be considered during storage- Chute, raw material receiving room, chill room, processing hall, working table and utensiles, freezers, cold storage, machinery, ventilation, measures for controlling flies and animals, lighting, potable water and ice, toilet facilities, laboratory etc.

UNIT IV

Types of fish storage. Functions of cold storage, Types of cold storage. Chill storage and frozen storage. Heat load calculation, storage methods. Insulated boxes and insulation thickness, different types of ice, physical, chemical, microbiological and sensory changes during chill storage, iced storage shelf life, cold shock, physical, chemical and sensory methods of analysis.

UNIT V

Various types of fish transport systems. Transportation: Live fish/shell fish, Transportation of raw fish to local markets and processing centres, Improvements needed in transportation, Refrigerated transport systems, Classification of transport vehicles, Cold chain.

References Books:

- Aitken, A., *et al.* Fish handling and processing.
- Balachandran, K. K. Post harvest technology of fish and fish products.
- Connell, J. J. Advances in fish sciences and technology.
- George, M. Hall. Fish processing technology.
- Gopakumar K. Text Book of Fish Processing Technology.
- Sen D. P. Advances in Fish Processing Technology.

Practicals

- Chill storage and frozen storage
- Transportation of raw fish to local markets and processing centres,
- Refrigerated transport systems
- Methods to reduce losses during storage and transportation
- Types of fish storage. Functions of cold storage, Types of cold storage
- Physical, chemical and sensory methods of analysis
- Various types of fish transport systems. Transportation: Live fish/shell fish.

Course Outcomes:

- To maintain fish quality, both at sea and onshore, the specification of the production, storage and delivery system should enable the levels and patterns of demand to be serviced at all times.
- It is recommended that in most circumstances this is best achieved by the provision of an ice plant at the place of landing.
- Where there is a significant supply to vessels, the plant is best located on a dedicated berth that enables direct delivery to the vessels.
- The delivery system should be able to accommodate the various hatch positions and shelter deck arrangements etc. of vessels.

NON MAJOR ELECTIVE -II

OPERATION MANAGEMENT OF FISH PROCESSING PLANTS

Internal : 25
External : 75
Exam Hours : 3

Semesters : IV
No. of Hours/ Week: 2
Credit: 2

Course objectives:

- Vapour compression and vapour absorption cycles.
- The importance of refrigeration and cold chain in the processing and preservation of foods.
- The utilization of cold storage rooms for food storage, thereby improving the shelf life of foods.
- The equipments used for chilling and freezing foods.
- The importance of cold storage- about the microorganisms involved in contamination of chilled foods and their prevention methods.

UNIT I Plant design

Fundamentals of processing plant design: Site selection, design and preparation of layout of processing plants - freezing plant, cold storage, canning plant, dryers etc. Site building, water supply, equipments and clothing.

UNIT II Functions and construction of refrigeration system

Tests and inspection, Operation and handling, P-H diagram and basic calculation - Application of P-H diagram, size and required power of compressor, maintenance of refrigerating machine, troubles and causes. Preventive maintenance of machinery and equipment of fish processing plants, IQF, Canning plant, sausage plant, artificial dryers, smoking chambers etc., safety controls for freezing and canning plant.

UNIT III Effluent treatment

Legislation and standards of effluent discharge, water pollution control measures in the food industry, waste water treatment process; dissolved air floatation, sedimentation, chemical treatment, biological treatment, aeration, carbon adsorption, granular media filtration and sludge handling. Boilers - Classification and selection of boilers, Boiler mounting and accessories.

UNIT IV Measurement techniques

Sensors, active and passive sensors, characteristic sensors for the measurement of temperature, relative humidity, aw value, gel strength, moisture, freshness, pH, conductivity, DO, redox potential, salinity, air velocity, solar energy and brine concentration. Instrumentation techniques: General configuration of instrumentation system. Instrumentation for measurement of aw value, temperature, pH, freshness, gel strength, salinity, brine concentration. Thermometers: Different types of thermometers, characteristics and application.

UNIT V Principles of fisheries extension

Mechanisms and modes of extension and their impact on capture fisheries and fisher livelihoods. National and international organisation, institutions and agencies in fisheries extension. Seafood export promotion and organisations involved. Role of co-operatives in fisheries.

References Books:

- Chupakhim and Dormenko. Fish processing equipments. MIR Publishers.
- Heid & Joslyn. Food processing operations.
- Slade. Food processing plants.
- Wheaton & Lawson. Processing Aquatic Food Products.
-

Course Outcomes:

- Evaluates the quality of raw material in a processing plant.
- Records temperature maintenance during processing.
- Experiments on freezing and packing related to production and process control.
- Experiments on packing and storage of frozen foods.
- Estimates available chlorine in process water
- Practices cleaning schedule in a processing plant

CORE COURSE -VIII

FISHERIES ECONOMICS

Internal : 25
External : 75
Exam Hours : 3

Semesters : V
No. of Hours/ Week: 3
Credit: 3

Course objectives :

- It is also one way the profit maximization.
- To enable the knowledge and the students can get about world trade organization process.
- To study the GMO s in fisheries in fisheries environment.

UNIT I

Introduction to economics- Micro economics- Demand, -Elasticity of demand –Supply & market Prices-law of diminishing marginal utility.

UNIT II

Production- Production function- Costs & Returns of scale and Break-even analysis in fish production system.

UNIT III

Profit maximization- Farm planning and budgeting- Preparation of Enterprise budget for Integrated fish farming. Macroeconomics: National Economy- Contribution of fisheries in GNP and employment- International trade and exchange.

UNIT IV

Introduction to General Agreement on Tariffs and Trade (GATT) & World Trade Organization (WTO), WTO-Framework- Intellectual property rights (IPRs) and different forms- Agreement on Trade – Related Aspects of Intellectual Property Rights (TRIPS)- Biopiracy.

UNIT V

Economic Growth - Fisheries Trade and Environment- Patents in Indian Fisheries Sector- GMOs in fisheries- Concepts of externality and social cost

Text Books:

1. **Fisheries Economics**, Rajagopalan and Vellyutham.s

Course outcomes:

- Students can get knowledge about fish farming methods.
- To study the living and non living things in the sea animals.
- Students can about intellectual property rights in fish farming and different foms of agreement.
- The economic growth of the fish can about patents in Indian sector landing sites are often remote, profit maximization.

CORE COURSE -IX

QUALITY CONTROL OF FISH AND FISHERY PRODUCTS

Internal : 25

External : 75

Exam Hours : 3

Semesters : V

No. of Hours/ Week: 4

Credit: 4

Course Objectives :

- To enable the knowledge can get students about the experiment , fresh fish quality, fish spoilage process.
- the microbiological quality methods in determination of spoilage.
- The course will provide cured fish quality crystal formation process and methodology.
- This involves learning about sea food production methods HACCP in biological methods.
- To study the topics protective hand covering and personal permitted in processing are and living things in the HACCP method.

UNIT I

Fresh fish quality: Maintenance of quality-intrinsic quality- fish spoilage-sanitation- assessment of quality-HACCP in processing raw shrimp. Frozen fish quality: crystal formation- freezing rate-deterioration- rancidity-processing specification and checking-inspection of raw material and product- recording, reporting and action

UNIT II

Cured fish quality: schedule of quality control in the production of sun dried fish- salted fish-type of salt-quality of salt- schedule of quality control in the production of salted fishes- schedule of quality control in the production of hot smoked fish.

UNIT III

Canned fish quality: schedule of quality control in the production of fishery products-defects and rejection of canned fish product- quality defect in canned fish products-cut out test for canned fishery products.

UNIT IV

Microbiological quality: method for determination of the content of bacteria in fish- determination of spoilage.

UNIT V

Sanitation: Hygienic practices- cleaning procedures- hygienic practices check list- phases of good cleaning procedures Hazard Analysis Critical Control Point (HACCP)- introduction- definition-hazard analysis of food-critical control point- rules in applying HACCP- reason for applying HACCP- Developing HACCP plan- Biological hazards-chemical hazards.Hygienic practices: Employee health-employee appearance- finger nailpolish- jewellery-smoking/spitting/gum or tobacco chewing- handwashing-head gear- Beared

employee- outer garments- protective hand covering- toilet areas- personnel permitted in processing area- foot dips.

References Books

- Quality control of fish and fishery products. 1999. CBT rajagopalan and P Velayutham. Fisheries college and research institute, TANVASU, Thoothukkudi.

Course Outcomes

- Possess knowledge of the fish quality and intrinsic quality.
- Fish preservation methods.
- Modified Atmospheric packaging(MAP)
- Traditional method of fish preservation
- Methods of fish drying: Natural, Solar, Artificial, Mechanical dryer
- Preparation of extruded products using single screw and twin screw extruder.

CORE COURSE -X
ENTREPRENEURSHIP DEVELOPMENT

Internal : 25

External : 75

Exam Hours : 3

Semesters : V

No. of Hours/ Week: 3

Credit: 3

Course objectives:

- Principle of fish preservation and processing. Processing of fish by traditional methods – salting, sun drying, smoking, marinating and fermentation.
- Theory of salting, methods of salting –wet salting and dry salting.
- Drying and dehydration- theory, importance of water activity in relation to microbial growth .Sun drying and artificial drying- solar dryer.
- Packaging and storage of salted and dried fish. Different types of spoilage in salt cured fish. Quality standard for salted and dry fish.
- Fish preservation by smoking- chemical composition of wood smoke and their role in preservation. Methods of smoking and equipments used for smoking.

UNIT I

Entrepreneurial development: Environmental factors influencing entrepreneurship- Social Factors- Psychological environment- Governmental Influence- Factors Influencing entrepreneurship.

UNIT II

Entrepreneurship: Concept of Entrepreneur- characteristics, profile and importance of Entrepreneurship - Kinds of entrepreneurs- Role and Functions of an Entrepreneur- Qualities of a Successful Entrepreneur- Circumstances Favouring Entrepreneurship.

UNIT III

Managing an enterprise – Motivation and entrepreneurship development: Motivation concepts - Categories of Motivation- Types of motivation- Motivation is important to an individual as.

UNIT IV

Entrepreneurs Development Programmes (EDPs) and SWOT Analysis- Government Schemes and Incentives for Promotion of Entrepreneurship.

UNIT V

Government policy on Small and Medium Enterprises- Export and Import policies of Fisheries Sector- Joint ventures, sub contracting, venture capital and public and private partnerships

References Books:

- Bartlett C &Piramal G. 2000. World Class in India: A Case Book of Companies in Transformation. Penguin India.
- FICCI. 2000. A Pictorial History of Indian Business. Oxford University Press
- Krueger NF. 2002. Entrepreneurship – Critical Perspectives on Business Management. Taylor & Francis.

Course Outcomes :

- Has profound and detailed scientific knowledge and understanding of the (bio)chemical processes in biological raw materials during postharvest storage and their transformation into food products.
- Has profound and detailed scientific knowledge and understanding of ecology, physiology, detection, use and combat microorganisms in food systems.
- Has profound and detailed scientific knowledge in different fields of product technology such as vegetable products, dairy products, meat products, fish products, cereal derived products and fermented products including aspects of product development in relation to consumer behavior.

CORE PRACTICAL MARINE BIOTECHNOLOGY

Internal : 40
External : 60
Exam Hours : 3

Semesters : V
No. of Hours/ Week: 6
Credit: 6

Course Objectives :

- To understand in detail the spoilage of fish along with associated factors
- To understand the principles and practices associated with various methods of fish preservation
- To introduce the bacterial quality of fish with an overview of the current quality assurance regimen

UNIT I

Bioactive compounds from marine organisms: Introduction-marine bacteria-fungi- microalgae—sponges and sea anemone.

UNIT II

Waste water treatment: characteristics of aquaculture waste water-Effect of aquaculture wastewaters-treatment of aquaculture wastewater-Oxidation and synthesis-Nitrogen removal-Nitrification-Denitrification-Heterotrophic denitrification-Autotrophic denitrification- Phosphate removal- Recent studies on treatment of aquaculture waste water-. Bioremediation in aquaculture systems: Bioremediation of organic detritus, Nitrogenous compounds, Hydrogen Sulphide. Bioremediators as disease controlling agents.Bioremediation of aquaculture effluent using microbial mat-Wastewater related from seafood processing plant.

UNIT III

Biofilters in aquaculture: General water quality maintenance principles-Aeration or oxygenating systems-Particulate Filters-Foam fractionators-Ozone-UV light-Carbon dioxide strippers-Characteristics of the "Ideal" biofilter- Fluidized bed sand filters-Bead filters-Biodisks or RBC (Rotating Biological Contactors)- Trickling filters-Submerged bed filters-Submerged filters.

UNIT IV

Biofertilizers: Introduction- Potentials of Azolla-Application of Azolla in aquatic system-Cultivation of Azolla-Applications in fish farming.

UNIT V

Probiotics: The use of probiotics in aquaculture-Rationale for the use of probiotics in aquaculture-Probiotic preparation-Bacillus spp.- Saccharomyces cerevisiae-Safety and evaluation of probiotics-Prebiotics.Biosensor: Introduction- Advantages (bioavailability, etc) and concept-Prokaryotic biosensors-Eukaryotic biosensors-Components of a biosensor-Applications- Biosensors in food analysis.

Practicals:

- Isolation of Bioactive compounds from marine organisms
- Waste water treatment
- Cultivation of Azolla
- Isolation of bacteria from commercial probiotic products
- Decomposition of organic waste by vermiculture technology

References Books:

- Sadasivam. S. and A. Manickam. 1992. Biochemical methods for agricultural sciences. Wiley Eastern limited and TNAU. 246pp.
- Antony , S.P. and Philip. R., 2006. Bioremediation of shrimp culture systems, NAGA World Fish Centre, 29: (3 & 4).
- Beaumont , A.R., Boudry, P. and Hoare, K. 2010. Biotechnology and Genetics in Fisheries and Aquaculture. 2nd edition. Wiley-blackwell. Singapore. 202p

Course Outcomes :

- To maintain fish quality, both at sea and onshore, the specification of the production, storage and delivery system should enable the levels and patterns of demand to be serviced at all times.
- It is recommended that in most circumstances this is best achieved by the provision of an ice plant at the place of landing.
- Where there is a significant supply to vessels, the plant is best located on a dedicated berth that enables direct delivery to the vessels.
- The delivery system should be able to accommodate the various hatch positions and shelter deck arrangements etc. of vessels.

CORE PRACTICAL FISHERIES EXTENSION EDUCATION

Internal : 40
External : 60
Exam Hours : 3

Semesters : V
No. of Hours/ Week: 6
Credit: 6

Course objectives:

- Vapour compression and vapour absorption cycles.
- The importance of refrigeration and cold chain in the processing and preservation of foods.
- The utilization of cold storage rooms for food storage, thereby improving the shelf life of foods.
- The equipments used for chilling and freezing foods.
- The importance of cold storage- about the microorganisms involved in contamination of chilled foods and their prevention methods.

UNIT I

Extension Education , meaning ,definitions and concepts, objective of extension. Principles of extension: fisheries extension- scope- history of fisheries extension in India.

UNIT II

Extension Teaching Methods and their classification: Individual contact methods 1 : farm and Home visit – office calls- personal letters- phone call. Method-II: conducting demonstration. Group contact method 1: demonstration, field trip and tours. Group contact method-II: general meeting-group discussion-lectures- seminars- forum- workshop-role playing. Mass contact method-I: Campaign- Exhibition- Mass contact method-II: Radio talk-Public Address system- Audio visual Aid- Television telecast.

UNIT III

Technology Transfer: Technology – definitions and characters- Role of N.G.O.s and Voluntary Organizations and Self Help Groups in TOT in Fisheries. Role of researches and extension organizations in co-management – advantages of co-management-limitations of co-management.

UNIT IV

Adoption and Diffusion of Innovations: communication 1: definition-meaning- importance and types. Communication-II: introduction-Aristotle model of communication-Lasswell's model-Shannon and weaver model – David Berlo's model. Communication-III: messages/content-treatment of messages-channels of communication- receiver/audience- audience response. Adopter categories: introduction-Innovators-laggards. Innovation and Decision process: knowledge-persuasion-decision-implementation-confirmation-over adoption-diffusion effect- consequences of innovations. Barriers to diffusion of fisheries innovations.

UNIT V

Extension programme planning-: introduction-extension programme-programme planning- objectives- principles-nature of programme planning. Steps in extension programme planning; introduction-collection of facts and analysis of situation-identification of problems- developing plan of work and calendar operation-evaluation of progress-revision of programme. Participatory programme planning: planning process- purpose.

Practicals

1. Visit to the State Department of Fisheries- To Learn any on technique & Document preparation
2. Visit to Marine Products Export Development Authority - To Learn any on technique & Document preparation
3. Visit to KVKs to study the activities and extension approaches of the KVKs - To Learn any on technique & Document preparation
4. Visit to state Agriculture Department to study the extension approaches adopted by the organisation
5. Visit to an NGO to study their extension works and approaches in fisheries
6. Conducting field studies on village institutions and organizations and their role in the village development
7. Field study on participation of women in fisheries
8. Field studies an impact of extension programmes
9. Practical exercise on conducting method demonstration
10. Practical exercise on preparation of charts, posters and flash cards

References Books

- Das Gupta, D., Extension education.Core contents and emerging areas.Agrobios (India) , Jodhpur.2006.
- Dahama, O.P., and O.P. Bhatnagar. Education and communication for development. Oxford & IBH Publishing House, New Delhi. 1980.

Course Outcomes:

- Visit to live fish market to know the availability of fishes and record keeping of relevant data
- Visit to dry fish market to know the preserved and processed fishes and record keeping of relevant data
- Collection of fish, molluscs and crustacean from adjacent fishing harbours to study identification, anatomy and record keeping of relevant data

**CORE COURSE -XIV
FISHERIES ADMINISTRATION AND LEGISLATION**

Internal : 25
External : 75
Exam Hours : 3

Semesters : VI
No. of Hours/ Week: 6
Credit: 6

Course Objectives :

- To maintain fish quality, both at sea and onshore, the specification of the production, storage and delivery system should enable the levels and patterns of demand to be serviced at all times.
- It is recommended that in most circumstances this is best achieved by the provision of an ice plant at the place of landing.
- Where there is a significant supply to vessels, the plant is best located on a dedicated berth that enables direct delivery to the vessels.
- The delivery system should be able to accommodate the various hatch positions and shelter deck arrangements etc. of vessels.

UNIT I

Public administration: Principles of organization- Public sector enterprises- Current scenario- Public sector enterprises- Forms of organization of enterprises- Importance of public sector enterprises- Producer companies & Trusts. Legal and organizational framework: Fisheries administration in India- Work allocation- Key State Government Organizations- Fisheries administration in Tamilnadu.

UNIT II

Fisheries development over five year plans: Sectoral Growth- Marine fisheries: Contributions to state economy- Development of marine fisheries during Five Year Plans- Investment in fisheries sector- An analysis of growth in production and fishing capacity- The 2002 Tenth Five Year Plan and the 2004 India Marine Fishing Policy.

UNIT III

General background on law: Introduction- M.C. Mehta v. Kamal Nath- 'Span Motel Case'- Legislations covering IPRs in India- Indian constitution. Marine fisheries legislations: The Indian Fisheries Act, No. 4 of 1897- The Maritime Zones of India (Regulation of fishing by foreign vessels) Rules, 1982.

UNIT IV

Laws and policies related to the environment: The Environment Protection Act, 1986- The Water (Prevention and Control of Pollution) Act, 1974- The Air (Prevention and Control of Pollution) act, 1981- National Environment Policy 2006- Protected area Management- Integrated coastal and ocean

management (ICM)- Legislations Related to Protected Area Management- CITES- Biological Diversity Act 2002 (No. 18 of 2003).

UNIT V

Laws relating to fish products and fish marketing: Introduction- Some important acts regulating fish products- Trade and other matters- Consumer Protection and Regulations. International law of the sea: Introduction- Shared fish Stocks- Prohibition of Driftnet Fishing- Sustainable Fishing- European Union Fish Labeling Requirements- Shrimp-turtle case-WTO- Code of conduct for responsible fisheries- SEZ Law(s) and India's Coastal Areas

ReferencesBooks

- Anon. 1998. Maritime Law of India in the International Context. Bhadarkar Publ.
- Brahtz JFP. 1972. Coastal Zone Management. U.N. International Economic and Social Affairs, New York
- Churchill RR & Lowe AV. 1988. Law of the Sea. Manchester University Press.
- Henkin L, Pugh RC & Smit H. 1993. International Law: Cases and Materials. West Publ. Co.
- Sinha RK. (Ed.). 1996. Marine Resources and Applicable Laws (World Environmental Series - 009). Commonwealth Publ.
- Verghese CP. 1989. Fishing Regulation in India's Territorial Waters. World Fishing.
- Cairns J Jr. 1994. Implementing Integrated Environmental Management. Virginia Tech. University.
- Clark JR. 1992. Integrated Management of Coastal Zones. FAO Fisheries Tech. Paper No. 327, Rome.
- Coastal Area Management and Development. 1982 U. N. Department of International Economic and Social Affairs, New York.
- David S & Jeremy P. 2001. Inshore Fisheries Management. Methods and Technologies in Fish Biology and Fisheries. Vol. II. Kluwer.
- Khanna BK. 2000. All You Wanted to Know About Disasters. New India Publ. Agency.

Course Outcomes:

- To maintain fish quality, both at sea and onshore, the specification of the production, storage and delivery system should enable the levels and patterns of demand to be serviced at all times.
- It is recommended that in most circumstances this is best achieved by the provision of an ice plant at the place of landing.
- Where there is a significant supply to vessels, the plant is best located on a dedicated berth that enables direct delivery to the vessels.
- The delivery system should be able to accommodate the various hatch positions and shelter deck arrangements etc. of vessels.