Fish Processing Technology				
Courses offered (V Dean)				
Sr. No.	**Semester**	**Course No.**	**Title**	**Credits**
1.	**I**	**FPT.111**	**Fish in Nutrition**	**1+0=1**
	Lecture	**THEORY :**		
	1	Composition of fish with emphasis on nutritional value.		
	2	Protein in fish muscle.		
	3	Concept of Biological value		
	4	Protein Efficiency ratio		
	5	Net protein utilization		
	6	Amino acids of fish and shellfish.		
	7	Importance of essential amino acids.		
	8	Fatty acid composition of fish lipids.		
	9	Nutritional quality of fish lipids.		
	10	Role of fish lipids in human nutrition.		
	11	Non-protein nitrogen substances in fishes.		
	12	Significance of water soluble fish vitamins in human nutrition.		
	13	Significance of fat soluble fish vitamins in human nutrition.		
	14	Minerals in fish: micro- and macro-elements, trace elements, significance in human nutrition		
	15	Other functional bio-molecules in fish (peptides, collagen and squalene) with their significance in human nutrition.		
	16	Effect of different kinds of cooking fish such curry, frying steaming, smoking and fermentation on nutrition value.		
2.	**Semester**	**Course No.**	**Title**	**Credits**
	I	**FPT.122**	**Food Chemistry**	**2+1=3**
	Lecture	**THEORY :**		
	1	Composition of food and nutritional value.		
	2	Moisture in foods.		
	3	Biological oxidation, electron transport chain, P/0 ratio; oxidative phosphorylation.		
	4	Naturally occurring polysaccharides in foods.		
	5	Seaweed polysaccharides – sources and uses.		
	6	Browning reactions – enzymatic and non-enzymatic.		
	7	Metabolism of lipids and oxidation of fatty acids		
	8	Lipoproteins; VLDL and HDL and their importance.		
	9	Proteins: metabolism, deamination, decarboxylation and metabolic fate of amino acids .		
	10	Nitrogen balance: positive nitrogen balance and negative nitrogen balance.		

	11	Deamination reactions and nitrogen excretion with special reference to fish.		
	12	Fish muscle proteins.		
	13	Chemical changes in muscle during contraction.		
	14	Proteins in foods		
	15	Role in hydration- native and denatured proteins, gel formation,		
	16	Functional properties of proteins,		
	17	Changes Occure in protein during heat treatment and processing.		
	18	Texturised proteins.		
	19	Chemistry of taste, flavour and odour components in foods.		
	20	Flavour intensifiers, synthetic flavouring substances.		
	21	The taste of fish and shellfish.		
	22	Food additives - types and their chemical nature.		
	23	Emulsifiers and antimicrobial additives and sequestrants.		
	24	Flavour potentiators, surface active agents; non-nutritive sweeteners, colour additives in food.		
	25	Assessment of quality of food by instrumental methods.		
	26	Assessment of quality of food by chemical methods.		
	27	Nutritive value of foods.		
	28	Energy value and energy requirements and their estimation.		
	29	Water, electrolytic and acid-base balance.		
	30	Nutritive value of proteins		
	31	PER, BV digestibility coefficient, NPU values, pepsin digestibility.		
	32	Role of fibre in human nutrition.		
	Practical	**PRACTICAL :**		
	1	Determination of moisture content in fish sample		
	2	Estimation of crude protein of fish tissue		
	3	Estimation of ash and sand content fish sample		
	4	Estimation of fat content fish sample.		
	5	Determination of energy value of fish		
	6	Estimation of glucose content in food.		
	7	Estimation of salt content in foods		
	8	Colorimetric method of estimation of proteins.		
	9	Colorimetric method of estimation of carbohydrates.		
	10	Use of pH meter		
	11	Estimation of freshness quality indices: TMA and TVBN.		
	12	Determination of free fatty acids.		
	14	Determination of peroxide value.		
	15	Determination of TBA value of fish.		
	16	Estimation of fibre in foods.		
3.	**Semester**	**Course No.**	**Title**	**Credits**
	II	**FPT.213**	**Freezing Technology**	**1+1=2**

	Lecture	**THEORY :**		
	1	Introduction to freezing technology		
	2	Characteristics of fish and shellfish; changes in fish after death, spoilage of fish, spoilage and pathogenic microorganism.		
	3	Handling of fresh fish;		
	4	Sanitation in processing plants		
	5	Principles of low temperature preservations. Chilling of fish - methods and equipment for chilling.		
	6	Icing – quality of ice, ice making; refrigerated or chilled sea water, chilling rate; spoilage of fish during chilled storage		
	7	Use of antibiotics and chemicals.		
	8	Freezing of fish fundamental aspects; heat units; freezing point depression, eutectic point; freezing rate.		
	9	Methods of freezing.		
	10	Physico– chemical changes that occur during freezing and mechanism of ice crystal formation.		
	11	Preparation of fish for freezing.		
	12	Changes that occur during frozen storage – microbiological, physical and chemical changes, protein denaturation, fat oxidation, dehydration, drip		
	13	Protective treatments – polyphosphate, glazing, antioxidants, packaging;		
	14	Thawing of frozen fish – methods of thawing		
	15	Transportation of frozen fish and cold chain.		
	16	Quality control, HACCP in freezing industry.		
	Practical	**PRACTICAL :**		
	1	Sanitation and plant housekeeping.		
	2	Chilling and freezing equipment.		
	3	Packages and product styles.		
	4	Methods of icing fish		
	5	Calculation of cooling rate		
	6	Preservation of by chilled sea water		
	7	Drawing freezing curve of fish.		
	8	Drawing thawing curve of fish.		
	9	Freezing of whole fish		
	10	Freezing of whole prawn		
	11	Freezing of different varieties of fish and shellfish		
	12	Estimation of driploss.		
	14	Determination of quality changes during frozen storage.		
	15	Inspection of frozen fishery products		
	16	Visits to ice plants, cold storages and freezing plants		
4.	**Semester**	**Course No.**	**Title**	**Credits**

	II	**FPT. 224**	**Fish Canning Technology**	**1+1=2**
	Lectures	**THEORY :**		
	1	Introduction to canning and its historical developments.		
	2	Advantages of canning in relation to other preservation methods.		
	3	Raw materials and sub materials, their characteristics and suitability for canning.		
	4	Classification of foods based on pH		
	5	commercial sterility, Absolute sterility, pasteurisation and sterilization.		
	6	Canning process, process flow steps involved HTST and aseptic canning.		
	7-8	General steps in canning procedure and importance, preparation of raw material, packing, pre-cooking, exhausting, seaming, retorting, cooling labelling and storage.		
	9	Principles of thermal processing. Heat resistance of micro organisms, heat penetration studies, mechanism of heat transfer		
	10	Cold spot and its importance, convection and conduction type of packs.		
	11	Estimation of Fo value of the process (D-value, Z-Value TDT, F-value, lethal rate).		
	12	Commercial sterilization, 12-D concept		
	13	Canning of commercially important fin fishes, shell fishes and cephalopods.		
	14	Spoilage of canned foods, types, causes and preventive measures		
	15	Quality standards, plant layout, hygiene and sanitation and waste disposal.		
	16	Types of packaging materials for canned foods, metal containers (Tin Plate, TFS, Aluminium cans) and retortable pouches		
	Practical	**PRACTICALS:**		
	1	Types of cans		
	2	Canning equipments		
	3	Layout of cannery		
	4	Canning of different varieties of fish and shellfish		
	5	Cutout test of canned product.		
	6	Examination of can double seam.		
	7	Heat resistance of bacteria		
	8	Heat penetration in canned food		
	9 -12	Thermal process calculation by general method		
	13	Study of spoilage condition in canned products		
	14-16	Familiarization with various packaging materials and container for fish products.		
5.	**Semester**	**Course No.**	**Title**	**Credits**

	II	**FPT. 225**	**Fish Packaging Technology**	**1+1=2**
	Lecture	**THEORY :**		
	1	Introduction to packaging, Importance of packaging in fish processing, functions, objectives and requirements.		
	2	Packaging materials, basic and laminates, principles of their manufacture and their identification		
	3	Properties of packaging materials and their use in protective packaging with special reference to food.		
	4	Printing for packaging and print identification.		
	5	Closures of packaging, heat seals bottle closure.		
	6	Principles of packaging fresh produce handling and transportation.		
	7	Packaging for retail sale and storage.		
	8	Packaging equipment and machinery.		
	9	Package design, evaluation and testing		
	10	Flexible packaging materials, rigid containers, thermoform containers, glass containers, corrugated fiber boards, duplex cartons, edible packaging materials.		
	11	Laminations and co-extrusions		
	12	Retort pouch packaging - advantages and disadvantages. Biodegradable films, vacuum packaging, active packaging		
	13	MAP, Polymeric Packaging.Packaging requirements of fresh fish, Frozen fish, Canned Fish		
	14	Transport worthiness of packaging materials, accelerated shelf testing		
	15	Materials and their safe use in food contact application.		
	16	Safety and legislation aspects of packing. Labeling and bar coding.		
	Practical	**PRACTICAL:**		
	1	Determination of grammage of paper and board.		
	2	Bursting strength, burst factor.		
	3	Punctures resistance.		
	4	Water proofness,		
	5	Stiffness of the board, ring stiffness of paper and board		
	6	Flat crush,		
	7	Tensile strength and elongation at break of plastic films		
	8	Density of plastic films		
	9	Breaking length, impact strength of plastic films		
	10	Tearing strength of paper and plastic films,		
	11	Water vapour transmission rate		
	12	Oxygen transmission rate		
	13	Heat seal strength		
	14	Suitability of plastic films for food contact applications		

	15	Evaluation of retort pouch		
	16	Identification of plastic films		
6.	**Semester**	**Course No.**	**Title**	**Credits**
	II	**CNC.122**	**Physical Education, First Aid & Yoga Practices**	**0+1=1**
	Practical	**PRACTICAL:**		
	1	Introduction to physical education: definition, objectives, scope, history, development and importance;		
	2	Physical culture; Meaning and importance of Physical Fitness and Wellness;		
	3	Physical fitness components - speed, strength, endurance, power, flexibility, agility, coordination and balance;		
	4	Warming up - General & Specific & its Physiological basis;		
	5	Test and measurement in physical education;		
	6	Training and Coaching - Meaning & Concept;		
	7	Methods of Training; aerobic and anaerobic exercises;		
	8	Calisthenics, weight training, circuit training, interval training,		
	9	Fartlek training; Effects of Exercise on Muscular, Respiratory, Circulatory & Digestive systems;		
	10	Balanced Diet and Nutrition: Effects of Diet on Performance; Physiological changes due to ageing and role of regular exercise on ageing process;		
	11	Personality, its dimensions and types; Role of sports in personality development; Motivation and Achievements in Sports; Learning and Theories of learning;		
	12	Adolescent Problems & its Management; Posture; Postural Deformities; Exercises for good posture.		
	13	Yoga; Introduction to - Asanas, Pranayam, Meditation and Yogic Kriyas; Role of yoga in sports;		
	14	Governance of sport in India; Important national sporting events; Awards in Sports; History,		
	15	Latest rules, measurements of playfield, specifications of equipments, skill, technique, style.		
	16	Coaching of major games(Cricket, football, table Tennis, Badminton, Volleyball, Basketball, Kabaddi and Kho-Kho) and Athletics		
7.	**Semester**	**Course No.**	**Title**	**Credits**
	VI	**FPT. 327**	**Fish By-Products and Waste Utilization**	**1+1=2**
	Lecture	**THEORY :**		
	1	Fish meal. Dry reduction and wet reduction methods – specification – packaging and storage.		

	2	Fish oil – body oil – extraction – purification – preservation – storage – application.		
	3	Fish oil – liver oil – extraction – purification – preservation – storage – application.		
	4	Shrimp wastes – chitin – chitosan production – uses.		
	5	Fish protein concentrate		
	6	Fish hydrolysate		
	7	Partially hydrolyzed and deodorized fish meat,		
	8	Functional fish protein concentrate and their incorporation to various products		
	9	Fish silage – acid silage – fermented silage – application.		
	10	Fishmaws & isinglass,		
	11	Fish glue,fish gelatin pearl essence		
	12	Shark leather, sharkfin rays		
	13	Beach-de-mer.		
	14	Biochemical and pharmaceutical products.		
	15-16	Utilization of seaweeds: agar agar, algin, carrageenan		
	Practical	**PRACTICAL:**		
	1	Preparation of fish meal.		
	2	Preparation of fish body oil.		
	3	Preparation of fish liveroil		
	4	Preparation of fish maws, isinglass		
	5	Preparation of fish silage & ensilage		
	6	Preparation of fish glue		
	7	Preparation of fish gelatin,		
	8	Preparation of pearl essence		
	9	Preparation of chitin, chitosan		
	10	Preparation of fish manure		
	11-13	Preparation of acid and fermented silage		
	14	Preparation of fish protein concentrate		
	15-16	Preparation of fish hydrolysate.		
8.	**Semester**	**Course No.**	**Title**	**Credits**
	VI	**FPT. 326**	**Fish Products and Value Addition**	**2+1=3**
	Lecture	**THEORY :**		
	1	Principle of fish preservation and processing		
	2-3	Processing of fish by traditional methods– salting, sun drying, smoking, marinading and fermentation.		
	4	Theory of salting, methods of salting–wet salting and dry salting		
	5	Drying and dehydration- theory,importance of water activity in relation to microbial growth.		
	6	Sun drying and artificial drying- solar dryer		

	7	Packaging and storage of salted and dried fish.		
	8	Different types of spoilage in salt cured fish.		
	9	Quality standard for salted and dryfish		
	10	Fish preservation by smoking-chemical composition of wood smoke and their role in preservation.		
	11	Methods of smoking and equipments used for smoking.		
	12	Carcinogenic compound in wood and methods to remove them		
	13-15	Hurdle technology in fish preservation and processing		
	16	Fish and prawn pickles,		
	17	Fish sauce and Fish paste,		
	18	Traditional Indian fermented products		
	19	Fermented fish products of Southeast Asia		
	20-21	Principles and methods of preparation of various fish paste products like fish sausage, fish ham, surimi, fish cake, kamaboko etc.		
	22-23	Fish muscle structure, myofibriller protein and their role in elasticity formation.		
	24-25	Extruded products – theory of extrusion, equipments used, advantages of extruded products, methods of preparation of extruded products.		
	26	Value addition.		
	27	Diversified fish products:battered and braided products-		
	28-29	Fishfinger, fishcutlet,fish wafer,and fish souppowder etc		
	30-31	Imitation products.		
	32	HACCP in safe products production.		
	Practical	**PRACTICAL:**		
	1	Preparation of salted fish by different methods		
	2-3	Preparation of dried fish		
	4	Preparation of smoked fish		
	5	Quality assessment of salted,dried and smoked fish		
	6-7	Preparation of prawn & fish pickles.		
	8	Preparation of fermented fish sauce and marinaded products.		
	9-11	Preparation of surimi and surimi based products.		
	12-14	Preparation of diversified and value added fish products.		
	15-16	Quality assessment of market sample of dried and fermented fish products.		
9.	**Semester**	**Course No.**	**Title**	**Credits**
	VI	**FPT. 328**	**Microbiology of Fish and Fishery Products**	**2+1=3**
	Lecture	**THEORY :**		
	1	Introduction and history of microorganisms in foods.		
	2	Role and significance of microorganisms in nature and in foods.		

	3-5	Sources and types of microorganisms in fish and fishery products.		
	6-7	Factors (intrinsic and extrinsic) affecting the growth and survival of microorganisms in food.		
	8-12	Enumeration of microorganisms in food by conventional techniques.		
	13-16	Enumeration of microorganisms in food by rapid technique.		
	17-19	Microbial principles of fish preservation and processing by application of low temperature, high temperature, drying, irradiation and chemicals.		
	20-21	Microbiology and spoilage of fresh, semi processed and processed fish and fishery products.		
	22-23	Indicators of microbiological quality of fish and fishery products.		
	24-28	Food borne pathogens involved in infective and intoxication type of food poisoning – *Vibrio cholerae, Vibrio parahaemolyticus, E. coli, Salmonella, Listeria monocytogenes, Clostridium botulinum, C. perfringens, Campylobacter and Staphylococcus aureus* – their occurrence, growth, survival, pathogenicity and prevention.		
	29	Other biological hazards associated with fish and fishery products-		
	30-32	Marine toxins-shellfish toxins, scombroid toxins, ciguatera toxins and puffer fish toxins; mycotoxins, parasites and viruses.		
	Practical	**PRACTICAL:**		
	1	Sampling and processing of samples for microbiological investigation		
	2_4	Enumeration of microorganisms associated with finfish, shellfish, water and ice.		
	5	Testing of water for potability		
	6_10	Isolation and identification of pathogenic bacteria associated with fish and fishery products - *Vibrio cholerae, Vibrio parahaemolyticus,, E coli, Salmonella, Listeriamonocytogenes* and faecal streptococci.		
	11_12	Biochemical tests for characterization of bacteria.		
	13_15	Molecular methods for the detection of pathogenic microorganisms		
	16	Determination of MIC and MCC of chemical preservatives.		
10.	**Semester**	**Course No.**	**Title**	**Credits**
	VIII	**FPT. 429**	**Quality assurance of Fish and Fishery Products**	**2+1=3**
	Lecture	**THEORY :**		
	1	Quality dimensions of seafood – sensory, intrinsic, quantitative and affective parameters.		
	2	Pre-harvest and post harvest factors affecting quality.		
	3	Assessment of quality changes in fresh and iced fish.		
	4	Quality changes during processing.		

	5-8	Application of HACCP concept in surveillance and quality assurance programmes for raw, frozen, canned, cured, irradiated, cooked and chilled, modified atmosphere packaged and freeze dried products
	9-10	Risk assessment, principles of plant hygiene and sanitation, pest control, personnel hygiene, planning and layout, equipment construction and design.
	11-12	Food laws and standards, national and international legislation, mandatory and non mandatory standards.
	13-14	Role of export inspection council & export inspection agency and MPEDA in fish and fishery products.
	14-16	Executive instructions on fish and fishery products, Legislation for export quality assurance in India
	17-18	Certification system for fish & fishery products.
	19-20	Legal basis for monitoring products related EU requirements. Scheme for approval and monitoring of establishments/factory vessels/ freezer vessels processing/storing fish & fishery products for export. Complaint handling procedure on fish and fishery products.
	21-22	Complaint handling procedure on fish and fishery products. Interpretation of test reports and limits on chemical residues.
	23	GOI notifications on fish and fishery products.
	24	General requirements for export of fish and fishery products to the EU.
	25-27	International regulatory framework for fish safety and quality. Prerequisites to HACCP, Labelling for product traceability and Labelling requirements- National and international, legislation on labelling, components of traceability code-nutrition facts and nutrition labelling, specific requirements of nutrition labelling, food meant for specific age group and convalescing people.
	28	EU legislation on traceability of fish and fish products, Assessment of food safety programmes.
	29	The HACCP for seafood industries and protection of food from adulterants.
	30	Standards for sea foods.FSSA, FDA, ISO
	31	Use of additives in seafood processing as quality enhancers. Seafood safety, authenticity, traceability
	32	Waste management in seafood processing.
	Practical	**PRACTICAL:**
	1-3	Assessment of quality of fresh fish by sensory, biochemical, and instrumental methods.
	4	Chlorination and Hardness estimations.
	5-8	Quality analysis of canned, frozen, cured and pickled fish products.

	9	Quality tests for tin and corrugated containers.
	10	Assessment of plant, equipment sanitation and personnel hygiene
	11-12	Detection of filth and extraneous matter in traditional processed products.

Fish Processing Technology				
Courses offered (VI Dean)				
Sr. No.	**Semester**	**Course No.**	**Title**	**Credits**
1.	**II**	**SEC.124**	**Fish Handling, Preservation and Value Addition**	**0+2=2**
	Practical	**Practical**		
	1-2	**To study the organoleptic characteristics of seawater and freshwater fish and shellfish.**		
		Importance of sensory evaluation (visual, aroma and odor, taste, appearance/ texture).		
		Structure of the Nine-Point Hedonic Scale.		
		Organoleptic characteristics of both seawater and freshwater fish and shellfish.		
	3-5	**Knowledge of Basic Processing Techniques/ Understanding Basic Processing Techniques**		
		Cleaning and Gutting: Learn how to properly clean and gut fish to maintain hygiene and quality.		
		Scaling, Skinning and peeling: Practice removing scales and skin of finishes and peeling and deveining of shrimps or prawns		
		Filleting: Learn how to effectively fillet various species and reduce waste.		
	6-9	**Fish Preservation Methods**		
		Freezing: Understand most favorable freezing temperatures and methods to maintain freshness of fish and shellfish.		
		Curing (Salting, Smoking): Learn how to cure fish with salt or smoke to extend shelf life while enhancing flavor.		
		Ø Drying and dehydration: Explore sun-drying, air-drying techniques for different/local avaible fish species.		
	10-11	**Preparation of mince meat**		
		Traditional method		
		Using meat mincer/bone separator		
		Surimi-based mincing (washing)		
	12-14	**Value added fish products**: Techniques to create value-added fish products		
		Fish mince and mince-based products: Fish fingers, fish cutlets, fish burger, fish sausages, fish chakali, shev etc		
		Restaurant oriented fish products: Fish momos, fish pizza, fish briyani, fish tikka, fish wraps/rolls, and fish Samosa etc.		
	15-16	**Quality Control and Safety Standards**		
		Introduction to food Safety in Fish Processing: Implementation of good manufacturing practices (GMP) and hygiene standards.		

		Fundamentals of Hazard Analysis and Critical Control Points (HACCP)		
		Microbiological and Chemical Testing: Techniques/methods to examine contaminants, pathogens, and spoilage in fishery products.		
2.	**Semester**	**Course No.**	**Title**	**Credits**
	III	**FPT.211**	**Fundamentals of Biochemistry and Food Chemistry**	**2+1=3**
	1	A brief introduction to developments in biochemistry and its transformation to molecular biology.		
	2	Cell structure, water and major molecules of life.		
	3	Composition of food and nutritional value.		
	4	Moisture in foods.		
	5-6	Biological oxidation, electron transport chain, P/0 ratio; oxidative phosphorylation. Carbohydrates: Structure, classification and functions of carbohydrate.		
	7	Isomerism and mutarotation.		
	8	Metabolism of carbohydrates: Glycolysis, gluconeogenesis, glycogenolysis, glycogenesis, TCA cycle, central role of TCA cycle in metabolism.		
	9	Naturally occurring polysaccharides in foods. Seaweed polysaccharides – sources and uses. Browning reactions – enzymatic and non-enzymatic.		
	10	Lipids: Classification, structure, functions and properties of lipids. Essential fatty acids and phospholipids.		
	11	Metabolism of lipids, oxidation of fatty acids, lipoproteins; VLDL and HDL and their importance. Lipid autooxidation.		
	12	Significance of Omega-3 and Omega-6 fatty acids.		
	13	Proteins: Classification, structure, function and properties of proteins.		
	14	Essential and nonessential amino acids.		
	15	Biuret reaction and xanthoproteic reaction of protein detection.		
	16	Metabolism, deamination, decarboxylation, metabolic fate of amino acids, nitrogen balance.		
	17	Deamination reactions and nitrogen excretion with special reference to fish.		
	18	Fish muscle proteins, chemical changes in muscle during contraction.		
	19-20	Proteins in foods, role in hydration- native and denatured proteins, gel formation, functional properties of proteins, changes during heat treatment and processing.		
	21	Texturized proteins. Enzymes: Nomenclature; classification; specificity; mechanism of enzyme action; kinetics and regulation of enzyme activity.		
	22	Steroid and peptide hormones: Chemistry and function.		
	23	Vitamins and Minerals: Classification and functions. Structure and functions of fat and water-soluble vitamins.		

	24	Minerals: Classification and functions minerals. Nucleic acids: Structure and function. Importance of genetic code.		
	25	Chemistry of taste, flavour and odour components in foods, flavour intensifiers, synthetic flavouring substances. The taste of fish and shellfish.		
	26-28	Food additives - types and their chemical nature, emulsifiers and antimicrobial additives, sequestrants, flavour potentiators surface active agents; non-nutritive sweeteners, colour additives in food.		
	29	Assessment of quality of food by instrumental and chemical methods.		
	30	Nutritive value of foods. Energy value and energy requirements and their estimation.		
	31	Water, electrolytic and acid-base balance. Nutritive value of proteins PER, BV digestibility coefficient, NPU values, pepsin digestibility.		
	32	Role of fibre in human nutrition.		
	Practical	**Practical**		
	1	Preparation of normal solution of acid and base, buffers and reagents.		
	2	Estimation of moisture in fish sample		
	3	Estimation of crude protein in fish sample		
	4	Estimation of fat in fish sample		
	5	Estimation of ash (including acid soluble) in fish sample.		
	6	Estimation of carbohydrates in foods.		
	7	Determination of energy value of fish.		
	8	Estimation of glucose and salt content in foods.		
	9	Colorimetric method of estimation of proteins and carbohydrates.		
	10-13	Estimation of freshness quality indices such as TVBN, TMA, alpha-amino nitrogen, PV, FFA, TBA value of fish.		
	14	Estimation of fibre in foods.		
	15	Determination of specific gravity of oil.		
	16	Determination of saponification value, iodine value and free fatty acid value.		
3.	**Semester**	**Course No.**	**Title**	**Credits**
	IV	**FPT.222**	**Post-Harvest Handling and Preservation**	**1+1=2**
	Lecture	**Theory**		
	1	Structure of fish myosystems, Postmortem changes - Structural and chemical.		
	2	Fish as raw material for processing: Body structure, physical properties, shape, specific weight, bulk weight, angle of slip, weight composition.		

	3	Factors affecting quality of fresh fish: intrinsic and extrinsic factors.		
	4	Handling of fish onboard fishing vessels, Unit operations.		
	5	Unloading fish, Fish pumps.		
	6	Post-harvest Fishery losses, Methods to reduce losses.		
	7	Handling of fish in landing centers, defects and modifications needed.		
	8	Chill storage of fish: Heat load calculation, storage methods.		
	9-10	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.		
	11	Different types of ice and their advantages.		
	12	Melanosis and its prevention, discolouration in aquatic products, non-enzymatic browning.		
	13	Depuration of bivalves.		
	14	Transportation: Live fish/shell fish, Transportation of raw fish to local markets and processing centres, Improvements needed in transportation, Refrigerated transport systems.		
	15	Classification of transport vehicles.		
	16	Cold chain.		
	Practical	**Practical**		
	1-7	Chill storage studies: Chemical, physical and sensory analysis, determination of shelf life.		
	8-16	Handling of fish, bivalves, prawns, molluscs, Depuration, treatment with chemicals, evaluation of freshness of fish.		
4.	**Semester**	**Course No.**	**Title**	**Credits**
	IV	**FPT.223**	**Fish Products, By-products, Value Addition and Waste Management**	**2+1=3**
	Lecture	**Theory**		
	1	Principle of fish preservation and processing.		
	2	Processing of fish by traditional methods– salting, sun drying, smoking, marinading and fermentation.		
	3	Theory of salting, methods of salting– wet salting and dry salting.		
	4	Drying and dehydration- theory, importance of water activity in relation to microbial growth. Sun drying and artificial drying- solar dryer.		
	5	Packaging and storage of salted and dried fish.		
	6	Different types of spoilage in salt-cured fish.		

	7	Quality standard for salted and dry fish.
	8	Fish preservation by smoking-chemical composition of wood smoke and their role in preservation.
	9	Methods of smoking and equipment used for smoking.
	10	Carcinogenic compound in wood and methods to remove them.
	11	Hurdle technology in fish preservation and processing.
	12-13	Marinated and fermented fish products–role of acids in marinades, Fish and prawn pickles, fish sauce and Fish paste, traditional Indian fermented products.
	14	Principles and methods of preparation of various fish paste products like fish sausage, fish ham, surimi, fish cake, kamaboko etc.
	15	Fish muscle structure, myofibrillar protein and their role in elasticity formation.
	16	Extruded products: theory of extrusion, equipment used, advantages of extruded products, methods of preparation of extruded products.
	17	Value addition.
	18	Diversified fish products: battered and braided products-fish finger, fish cutlet, fish wafer, and fish soup powder etc
	19	Imitation products.
	20	HACCP in safe product production.
	21	Fish meal: dry reduction and wet reduction methods, specification, packaging and storage.
	22	Fish oil: body oil, liver oil extraction, purification, preservation, storage, and application.
	23	Shrimp wastes: chitin, chitosan production, uses.
	24	Fish protein concentrate.
	25	Fish hydrolysate, partially hydrolyzed and deodorized fish meat,
	26	Functional fish protein concentrate and their incorporation to various products.
	27	Fish silage, acid silage, fermented silage and their application.
	28-30	Fish maws, shark leather, fish glue, fish gelatin, isinglass, pearl essence, shark fin rays, beach-de-mer.
	31	Biochemical and pharmaceutical products.
	32	Utilization of seaweeds: agar agar, algin, carrageenan.
	Practical	**Practical**
	1	Preparation of salted fish, dried fish and smoked fish by different methods.
	2	Quality assessment of salted, dried and smoked fish.

	3	Preparation of prawn and fish pickles.		
	4	Preparation of fermented fish sauce and marinade products.		
	5-6	Preparation of surimi and surimi-based products.		
	7-9	Preparation of diversified and value-added fish products.		
	10	Quality assessment of market sample of dried and fermented fish products.		
	11-14	Preparation of fish meal, fish body oil, fish liver oil, fish maws, isinglass, fish silage, ensilage, fish glue, fish gelatin, fattice, pearl essence, chitin, chitosan and fish manure.		
	15	Preparation of acid and fermented silage.		
	16	Preparation of fish protein concentrate and fish hydrolysate.		
5.	**Semester**	**Course No.**	**Title**	**Credits**
	V	**FPT.314**	**Fish Freezing Technology**	**1+1=2**
	Lecture	**Theory**		
	1	Introduction to freezing technology; characteristics of fish and shellfish.		
	2	Changes in fish after death, spoilage of fish, spoilage and pathogenic microorganism.		
	3	Handling of fresh fish; sanitation in processing plants.		
	4	Principles of low temperature preservations.		
	5	Chilling of fish: methods and equipment for chilling; icing: quality of ice, ice making; refrigerated or chilled sea water, chilling rate;		
	6	Spoilage of fish during chilled storage;		
	7	Use of antibiotics and chemicals.		
	8	Freezing of fish: fundamental aspects; heat units; freezing point depression, eutectic point; freezing rate;		
	9	methods of freezing, freeze drying,		
	10	Physico–chemical changes that occur during freezing,		
	11	Mechanism of ice crystal formation; preparation of fish and shellfish for freezing.		
	12	Changes that occur during frozen storage: microbiological, physical and chemical changes, protein denaturation, fat oxidation, dehydration, drip;		
	13	Protective treatments: polyphosphate, glazing, antioxidants, packaging;		
	14	Thawing of frozen fish and shellfish: methods of thawing.		
	15	Transportation of frozen fish and shellfish, cold chain, quality control,		

	16	HACCP in freezing industry.		
	Practical	**Practical**		
	1	Sanitation and plant housekeeping.		
	2	Chilling and freezing equipment, instruments.		
	3	Packages and product styles.		
	4	Methods of icing fish;		
	5	Calculation of Cooling rate.		
	6	Preservation by chilled sea water;		
	7	Drawing of freezing curve		
	8	Drawing of thawing curves.		
	9-12	Freezing of different varieties of fish and shellfish;		
	13	Estimation of drip.		
	14	Determination of quality changes during frozen storage.		
	15	Inspection of frozen fishery products.		
	16	Visits to ice plants, cold storages, and freezing plants.		
6.	**Semester**	**Course No.**	**Title**	**Credits**
	V	**FPT.315**	**Fish Canning Technology and Packaging**	**1+1=2**
	Lecture	**Theory**		
	1	Fish Canning Technology: Introduction to canning and its historical developments. Advantages of canning in relation to other preservation methods. Raw materials, their characteristics and suitability for canning.		
	2	Classification of foods based on pH, commercial sterility, absolute sterility, pasteurization and sterilization.		
	3	Canning process: Process flow steps involved HTST and aseptic canning. General steps in canning procedure and importance, preparation of raw material, packing, pre-cooking, exhausting, seaming, retorting, cooling labelling and storage.		
	4	Principles of thermal processing. Heat resistance of microorganisms, heat penetration studies, mechanism of heat transfer. Cold spot and its importance, convection and conduction type of packs. Process calculation by general/ graphical methods. Estimation of Fo value of the process (D-value, Z-Value TDT, F-value, lethal rate). Commercial sterilization, 12-D concept.		

	5	Canning of commercially important fin fishes, shellfishes and cephalopods. Spoilage of canned foods, types, causes and preventive measures.
	6	Quality standards, plant layout, hygiene and sanitation and waste disposal.
	7	Packaging: Introduction to packaging, Importance of packaging in fish processing, functions, objectives and requirements.
	8	Packaging materials, basic and laminates, principles of their manufacture and their identification. Properties of packaging materials and their use; Protective packaging with special reference to food.
	9	Printing for packaging and print identification. Closures of packaging, heat seals bottle closure.
	10	Principles of packaging: fresh produce handling and transportation.
	11	Packaging for retail sale and storage. Packaging equipment and machinery. Package design, evaluation and testing.
	12	Flexible packaging materials, rigid containers, thermoform containers, glass containers, corrugated fiber boards, duplex cartons, edible packaging materials.
	13	Laminations and co-extrusions. Retort pouch packaging - advantages and disadvantages. Biodegradable films, vacuum packaging, active packaging, Modified Atmosphere Packaging (MAP).
	14	Polymeric Packaging. Packaging requirements of fresh fish, frozen fish, canned fish.
	15	Transport worthiness of packaging materials, accelerated shelf testing.
	16	Safety and legislation aspects of packaging. Labelling and bar coding
	Practical	**Practical**
	1	Types of cans, canning equipment and layout of cannery.
	2-3	Canning of different varieties of fish and shellfish.
	4	Cutout test of canned products.
	5	Examination of can double seam.
	6	Heat resistance of bacteria.
	7	Heat penetration in canned food, thermal process calculation by general method.
	8	Study of spoilage condition in canned products.

	9	Familiarization with various packaging materials and container for fish products.		
	10-16	Determination of grammage of paper and board, bursting strength, burst factor, punctures resistance, water proofness, stiffness of the board, ring stiffness of paper and board, flat crush, tensile strength and elongation at break of plastic films, density of plastic films, breaking length, impact strength of plastic films, tearing strength of paper and plastic films, water vapour transmission rate, oxygen transmission rate, heat seal strength, suitability of plastic films for food contact applications, evaluation of retort pouch, identification of plastic films.		
7.	**Semester**	**Course No.**	**Title**	**Credits**
	VI	**FPT.326**	**Microbiology of Fish and Fisheries Products**	**1+1=2**
	Lecture	**Theory**		
	1	Introduction and history of microorganisms in foods.		
	2	Role and significance of microorganisms in nature and in foods.		
	3	Sources and types of microorganisms in fish and fishery products.		
	4	Factors (intrinsic and extrinsic) affecting the growth and survival of microorganisms in food.		
	4-5	Enumeration of microorganisms in food by conventional and rapid techniques.		
	6-7	Microbial principles of fish preservation and processing by application of low temperature, high temperature, drying, irradiation and chemicals.		
	8	Microbiology and spoilage of fresh, semi-processed, and processed fish and fishery products.		
	9	Indicators of microbiological quality of fish and fishery products.		
	10-14	Food-borne pathogens involved in infective and intoxication type of food poisoning – Vibrio cholerae, Vibrio parahaemolyticus, E. coli, Salmonella, Listeria monocytogenes, Clostridium botulinum, C. perfringens, Campylobacter and Staphylococcus aureus – their occurrence, growth, survival, pathogenicity and prevention.		
	15	Other biological hazards associated with fish and fishery products		
	16	Marine toxins shellfish toxins, scombroid toxins, ciguatera toxins and puffer fish toxins; mycotoxins, parasites and viruses.		
	Practical	**Practical**		
	1	Sampling and processing of samples for microbiological investigation.		
	2-3	Enumeration of microorganisms associated with finfish, shellfish, water and ice.		
	4	Testing of water for potability.		
	5-11	Isolation and identification of pathogenic bacteria associated with fish and fishery products - Vibrio cholerae, Vibrio parahaemolyticus, E. coli, Salmonella, Listeria monocytogenes and faecal streptococci.		

	12-13	Biochemical tests for characterization of bacteria.		
	14-15	Molecular methods for the detection of pathogenic microorganisms.		
	16	Determination of MIC and MCC of chemical preservatives.		
8.	**Semester**	**Course No.**	**Title**	**Credits**
	VII	**FPT.417**	**Quality Assurance of Fish and Fishery Products**	**2+1=3**
	Lecture	**Theory**		
	1	Quality dimensions of seafood – sensory, intrinsic, quantitative and affective parameters.		
	2	Preharvest and post-harvest factors affecting quality.		
	3	Assessment of quality changes in fresh and iced fish.		
	4	Quality changes during processing.		
	5-7	Importance of quality, definitions and terminologies. Application of HACCP concept in surveillance and quality assurance program for raw, frozen, canned, cured, irradiated, cooked and chilled, modified atmosphere packaged and freeze-dried products.		
	8	Risk assessment, principles of plant hygiene and sanitation, pest control, personnel hygiene, planning and layout, equipment construction and design.		
	9	Food laws and standards, national and international legislation, mandatory and non-mandatory standards.		
	10	Role of export inspection council and export inspection agency and MPEDA in fish and fishery products.		
	11	Executive instructions on fish and fishery products, Legislation for export quality assurance in India.		
	12	Certification system for fish and fishery products.		
	13	Legal basis for monitoring products related EU requirements.		
	14	Scheme for approval and monitoring of establishments/factory vessels/ freezer vessels processing/storing fish and fishery products for export.		
	15	Complaint handling procedure on fish and fishery products.		
	16	Interpretation of test reports and limits on chemical residues.		
	17	GOI notifications on fish and fishery products.		
	18	General requirements for export of fish and fishery products to the EU.		
	19	International regulatory framework for fish safety and quality.		
	20	Prerequisites to HACCP.		
	21-25	Labelling for product traceability and Labelling requirements - National and international, legislation on labelling, components of traceability codenutrition		

		facts and nutrition labelling, specific requirements of nutrition labelling, food meant for specific age group and convalescing people.		
	26	EU legislation on traceability of fish and fish products.		
	27-28	Assessment of food safety program, The HACCP for seafood industries and protection of food from adulterants.		
	29	Standards for sea foods. FSSAI, FDA, ISO.		
	30	Use of additives in seafood processing as quality enhancers.		
	31	Seafood safety, authenticity, traceability.		
	32	Waste management in seafood processing.		
	Practical	**Practical**		
	1-3	Assessment of quality of fresh fish by sensory, biochemical, and instrumental methods.		
	4	Chlorination and Hardness estimations.		
	5-8	Quality analysis of canned, frozen, cured and pickled fish products.		
	9	Quality tests for tin and corrugated containers.		
	10	Assessment of plant,		
	11-16	Equipment sanitation and personnel hygiene.		
9.	**Semester**	**Course No.**	**Title**	**Credits**
	VII	**FPT.418**	**Principles and Techniques of Seafood Analysis**	**1+1=2**
	Lecture	**Theory**		
	1-3	Separation of molecules: General principles of separation of micro and macro-molecules, Selection of appropriate tools for analysis of fish samples, Outlines of common techniques involved in biochemical analysis.		
	4-5	Filtration and centrifugation techniques: Different types of filtrations, Types of filters and means of using them;		
	6-7	Types of centrifugations (preparative and analytical), concept of Svedberg unit, Selecting appropriate rotor, Relative centrifugal force.		
	8-10	Viscoelastic properties, Rheology, Tribology, TPA; IR and FTIR spectrophotometry, Spectro-fluorimetry, ICP, Atomic absorption mass spectrometry, Tandem MS/MS.		
	11	Microscopy: Fluorescence microscopy, SEM, TEM, XRD.		
	12	Electrophoresis: General principles, types (native, denatured PAGE, 2D).		
	13-16	Chromatographic techniques; General principle, Types of chromatography: adsorption, partition, ion-exchange, molecular sieve, affinity, liquid and gas chromatography (GC), thin layer chromatography, HPLC, GCMS, LCMSMS.		

	Practical	**Practical**		
	1-3	Characterization of proteins based on solubility: sarcoplasmic, myofibrillar, and stroma; Estimation of proteins - Biuret techniques, Lowry techniques,		
	4-6	Dye binding technique and electrophoretic techniques.		
	7-8	Amino acid analysis by HPLC.		
	9-11	Fatty acid analysis by GC MS, Minerals and heavy metals by Atomic Absorption spectroscopy.		
	12	Texture analysis by TPA.		
	13	HPLC- determination of histamine.		
	14-16	Demonstration of GC-MS-MS.		
10.	**Semester**	**Course No.**	**Title**	**Credits**
	VII	**FPT.419**	**Trade Regulations, Certification and Documentation in Export of Fish and Fishery Products**	**1+1=2**
	Lecture	**Theory**		
	1-2	Trade policy and Legislation on labelling and other standards: Foreign Trade Policy of Fish and Fishery Products in Indian context and world context,		
	3-4	Labelling requirements of Fish and Fishery products stipulated by National and International Organizations.		
	5	Regulations: Export documentation- certificates of origin.		
	6-7	Other certificates for Shipment of specific goods, Export licenses; Import regulations, SPS-TBT agreement.		
	8-9	Export Certification systems: Consignment-wise, in process Quality,		
	9-10	Self-Certification, Food safety management system, Pre-shipment inspection,		
	10-11	Voluntary food certification scheme, Certificate for export (CFE), Health certificate.		
	12	Other certification,		
	13-14	Traceability issues for farm reared and wild aquatic products;		
	15-16	Dealing with returned consignments; foreign trade regulations in India.		