

OUTCOME BASED EDUCATION (OBE)
CURRICULUM BASED SYLLABUS

2024



M.F.Sc. SEAFOOD SAFETY AND TRADE

SCHOOL OF INDUSTRIAL FISHERIES

COCHIN UNIVERSITY OF SCIENCE AND TECHNOLOGY

OUTCOME BASED EDUCATION (OBE), SYLLABUS FOR M.FSc. SEAFOOD SAFETY AND TRADE COURSE

Background

UGC has made it mandatory to follow the system of Choice Based Course (CBC) and Outcome Based Education (OBE), as our PG courses with fairly well updated contents have been under choice based credit and semester system. Although their overall standard is quite good, their structure, composition, procedures and credit administration are to be further fine tuned to incorporate the features of OBE. Courses are well designed instruction packages in specific knowledge fields, with preconceived results that go into the making of the outcome of the Academic Programme. They are scientifically structured with insights of continuity, sequence, and integration, appropriate for effective learning. Workshops are organized in different universities in the state in this direction for the Board of Studies for redesigning the courses at the UG/PG level.

A high priority task in the context of future education development agenda in India is fostering quality higher education. Further improvement of quality of higher education is considered critical for enabling effective participation of young people in knowledge production and participation in the knowledge economy, improving national competitiveness in a globalized world and for equipping young people with skills relevant for global and national standards and enhancing the opportunities or social mobility. Sustained initiatives are required for institutionalizing an outcome-oriented higher education system and enhancing employability of graduates through curriculum reform based on a learning outcomes-based curriculum framework, improving/upgrading academic resources and learning environment, raising the quality of teaching and research across all higher education institutions; technology use and integration to improve teaching-learning processes and reach a larger body of students through alternative learning modes such as open and distance learning modes and use of MOOCs (massive open online courses). Other priority areas of action for fostering quality higher education include translation of academic research into innovations for practical use in society and economy, promoting efficient and transparent governance and management of higher education system, enhancing the capacity of the higher education system to govern itself through coordinated regulatory reform and increasing both public and private sector investment in higher education, with special emphasis on targeted and effective equity-related initiatives (<https://www.ugc.ac.in/>.)

India's National MOOC platform 'SWAYAM' (Study Webs of Active-Learning for Young Aspiring Minds) was launched in July 2017. The objective of the programme is to make available the best teaching learning resources of an Institution to all, including the most disadvantaged. As per the UGC (Credit Framework for online learning courses through SWAYAM) Regulation 2016, Universities can identify courses where credits can be transferred on to the academic record of the students for courses done on SWAYAM. Up to 20% of the total credit in each semester can be based on online courses offered through SWAYAM Platform (www.swayam.gov.in). Courses delivered through SWAYAM are available free of cost to the learners, and students are advised to register for the final proctored exams, some of which come at a fee and attend in person at designated centres on specific dates, so as to get SWAYAM certificate. Universities/colleges approving credit transfer for these courses can use the marks/certificate obtained in these courses for the same.

With this prelude, the curriculum based syllabus MFSc Seafood Safety and Trade course is amended based on the Outcome Based Education.

School of Industrial Fisheries has been successfully conducting the Multi-disciplinary Masters Programme in Seafood Safety and Trade since 2012. Periodic revisions of the curriculum have been effected depending on the changing “Academic, Research and Industrial Requirements” both within the country and abroad. This Professional Post Graduate Degree Programme is one of the main sources of human resource for the seafood production, sales, marketing, quality assurance, food safety, total quality management institutions and upper level management positions in food industry in general and seafood industry in particular. The entrepreneurial skill acquired from this programme has given confidence to the post graduates to venture into their own business in different facets of fisheries. The employability of this programme has been attracting talented students from both within the state and outside states to join this programme.

Program Outcomes (PO) - MFSc Seafood Safety and Trade

PO1 - Apply the knowledge of food science, technology, food safety, food economics and business management disciplines to the solution of complex problems in the field of seafood safety and trade

PO2 - Identify, formulate, review research literature, and analyze complex problems reaching substantiated conclusions using the principles of food science, technology, food safety, food economics and business management disciplines

PO3 - Design solutions for complex problems in seafood safety and trade with appropriate considerations for the industrial, societal and environmental needs.

PO4 - Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5 - Create, select and apply appropriate techniques, resources, and modern tools pertaining to food science, technology, food safety, food economics and business management with an understanding of the limitations.

PO6 - Communicate effectively on complex activities with all the stakeholders and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO7 - Recognize different global value systems and understand the moral dimensions of decisions, and accept responsibility for them

PO8 - Understand the impact of challenges in food safety and food business in an industrial and societal context and demonstrate knowledge for sustainable development

PO9 - Demonstrate understanding of the societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to seafood safety and trade.

PO10 - Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

Program Specific Outcome (PSO) - MFSc Seafood Safety and Trade

PSO1 - Ability to apply concepts, tools and techniques in production, processing, safety, management and trade of seafood products to identify and solve problems in the setting of seafood safety and trade

PSO2 - Demonstrate knowledge on diverse aspects of industrial and entrepreneurial applications of fish processing technology, seafood safety, trade, economics and management of the seafood business.

PSO3 - Understanding the functioning of all core activities related to seafood processing, seafood safety and trade in the industrial settings.

PSO4 - Demonstrate professional and entrepreneurial skills to meet the current and future challenges in the corporate and public sectors

Faculty of Marine Sciences

School of Industrial Fisheries SCHEME & SYLLABUS OF EXAMINATION

2024 Admission

FIRST SEMESTER

Course Code	Title of the Paper	Credits	Core / Elective	Marks		
				Continuous evaluation	End Sem. Exam.	Total
24-386-0101	Commercially Important Aquatic Resources	3	C	50	50	100
24-386-0102	Managerial Economics	4	C	50	50	100
24-386-0103	Food Science and Food Chemistry	3	C	50	50	100
24-386-0104	Food Business Management	4	C	50	50	100
24-386-0105	Research Methodology and Quantitative Techniques for Seafood Safety and Trade	4	C	50	50	100
24-386-0106	Fundamentals of Food Microbiology	2	C	50	50	100
24-386-0107	Elective-1	2	E	50	50	100
24-386-0108	Elective-2	1	E	100	-	100
24-386-0109	Elective-3	1	E	100	-	100
Maximum Total Credit Offered in 1st Semester: 24 (20 credits for Core and 04 credits for Elective Courses)						

ELECTIVES

1.	Seafood Harvest Technologies	2	E
2.	Entrepreneurship Development in Seafood Business	2	E
3.	Food Science and Food Chemistry (Practical)	1	E
4.	Field visit: Fish markets/harbours/farms	1	E

SECOND SEMESTER

Course Code	Title of the Paper	Credit	Core/ Elective	Marks		
				Continuous assessment	End Sem. Exam.	Total
24-386-0201	Chilling and Freezing Technology	2	C	50	50	100
24-386-0202	Thermal, Non thermal processing and packaging Technology	3	C	50	50	100
24-386-0203	Food Safety and Quality Assurance	3	C	50	50	100
24-386-0204	Supply Chain Management and Logistics for Food Trade	4	C	50	50	100
24-386-0205	International Trade and Development	3	C	50	50	100
24-386-0206	Elective-1	3	E	50	50	100
24-386-0207	Elective-2	1	E	100	-	100
24-386-0208	Elective-3	1	E	100	-	100
24-386-0209	Elective-4	4	E	100	-	100
Maximum Total Credits offered in Second Semester: 24 Credits (15 Credits for Core and 09 Credits for Elective Courses)						

ELECTIVES

1.	Aquatic Food Production Systems and Practices	3	E
2.	Food Economics	3	E
3.	Seafood Processing Technology (Practical)	1	E
4.	Food Safety and Food Microbiology (Practical)	1	E
5.	Internship in Seafood Industry and Report Evaluation	4	E

THIRD SEMESTER

Course Code	Title of the Paper	Credit	Core/ El ective	Marks		
				Continu ous assessm ent	End Sem. Exam.	Total
24-386-0301	Value Addition in Food Products	4	C	50	50	100
24-386-0302	International Marketing	3	C	50	50	100
24-386-0303	Food Safety Management Systems	4	C	50	50	100
24-386-0304	Methods for seafood quality evaluation	2	C	50	50	100
24-386-0305	Marketing research for seafood business	3	C	50	50	100
24-386-0306	Sustainable aquaculture for safe food production	3	C	50	50	100
24-386-0307	Elective-1	3	E	50	50	100
24-386-0308	Elective-2	1	E	100	-	100
Maximum Total Credits offered in Third Semester: 23 Credits (19 Credits for Core and 04 Credits for Elective Courses)						

ELECTIVES

1.	International Business Environment and Finance Management	3	E
2.	Economics for Sustainable Food and Nutrition policy	3	E
3.	Value Added Products Technology (Practical)	1	E
4.	Analytical Methods in Aquaculture (Practical)	1	E

FOURTH SEMESTER

Course Code	Title of the Paper	Credit	Core/ Elective	Marks		
				Continuous assessment	End Sem. Exam.	Total
24-386-0401	Analytics for Decision Making in Seafood Business and Research	3	C	50	50	100
24-386-0402	Dissertation/ Project Report Evaluation	8	C	100	-	100
24-386-0403	Course Viva-voce	1	C	100	-	100
24-386-0404	Elective-1	4	E	100	-	100
24-386-0405	Elective-2	1	E	100	-	100
24-386-0406	MOOC	2	E	-	100	100
Maximum Total Credit Offered in 4th Semester: 19 (12 credits for Core and 07 credits for Electives)						

ELECTIVES

1.	Internship in Seafood Industry and Report Evaluation	4	E
2.	Startups and Business Incubation in Food Industry	1	E

TOTAL CREDITS OFFERED IN DIFFERENT SEMESTERS

	Maxi-mum Offered	Credits	Semester 1	Semester 2	Semester 3	Semester 4	Total Credits
		CORE	20	15	19	12	66
		ELECTIVE	04	09	04	07	24
		TOTAL	24	24	23	19	90

TOTAL CREDITS OF BOTH ELECTIVES AND CORE PAPERS FOR THE AWARD OF THE DEGREE WILL BE ADJUSTED ACCORDING TO THE PROVISIONS IN THE CHOICE AND CREDIT BASED SYSTEM ADOPTED BY THE UNIVERSITY FROM TIME TO TIME.

FOR THE AWARD OF MFS_c. DEGREE IN SEAFOOD SAFETY AND TRADE STUDENT SHALL ACQUIRE MINIMUM OF **90 CREDITS**.

SEMESTER- I

24-386-0101 COMMERCIALY IMPORTANT AQUATIC RESOURCES (3 Core)

Course Outcome (CO)- After completing the course, students will be able to

CO1- Identify major commercial and cultivable fish and shellfish.

CO2- Prepare dichotomous keys for fishes, crustaceans and molluscs

CO3- Apply the principles rules of taxonomy and procedures for naming species

CO4- Identify species by ascertaining various names used currently and in past

CO5- Identify species used for export market and aquaculture quickly

CO/PSO	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	1
CO2	2	1	-	-
CO3	2	1	1	1
CO4	2	2	1	2
CO5	3	3	2	2

Module 1: Principles of taxonomy

Alpha- beta – gamma taxonomy. Type concepts in fish taxonomy –Binomial nomenclature- International Code of Nomenclature: principles and rules. Dichotomous keys. Synonyms and antonyms. Morphology- Description of species based on type specimen. Osteological keys- Cephalic bones- vertebrae. Morphometry and meristics- truss morphometry. Methods of taxonomic data collection. Digital taxonomic information repositories – Fishbase, ITIS, WORMS, Catalogue of fishes, Sealifebase.

Module 2: Classification

Systematics. Phylogenetic studies: introduction and concepts of phylogeny. Cladistics in taxonomy, cladogram, characters used for phylogeny reconstruction– phylogenetic tree.

Module 3: Classification of commercially important fishes

Characters of taxonomic value in respect of major families and species. Preparation of dichotomous keys

Module 4. Classification of commercially important crustaceans

Shrimps, prawns, crabs, lobsters. Characters of taxonomic value in respect of major families and species. Preparation of dichotomous keys. Classification of commercially important molluscs- bivalves,gastropods, cephalopods. Characters of taxonomic value in respect of major families and species. Preparation of dichotomous keys. Marine algae of commercial importance

Module 5. Modern taxonomic tools

Electrophoretic studies, Karyotyping, PCR, RAPD, RFLP, Microsatellites, mini satellites. Molecular markers – nuclear and mitochondrial DNA and their application in taxonomy– DNA barcoding- meta barcoding- eDNA. Species misrepresentation.

Suggested Reading:

- Cooksey, K. 1997. Molecular Approaches to the study of the oceans. Chapman and Hall, London, 549p.
- FAO. 2000. DNA Based Molecular Diagnostic Techniques.
- Jayaram, K.C. (2002) Fundamentals of fish taxonomy. Narendra Publishing House, 174p
- Kocher TD & Carol AS. (Ed.). 1997. Molecular Systematics of Fishes. Academic Press.
- Le Gal Y & Halvorson HO. 1998. New Development in Marine Biotechnology. Plenum Press.
- Mayer, E. 1977. Principle of systematic zoology, Tata McGraw Hill Publishing Co. Ltd. New Delhi, 428p.
- Moyle, P.B and J.C. Joseph Jr. 2000. Fishes – An Introduction to Ichthyology. 4th Ed. Prentice Hall, 612p.
- Munro, I. 1982. Marine and freshwater fishes of Ceylon, 349p.
- Nair, P.R. 2008. Biotechnology and Genetics in Fisheries and Aquaculture. Dominant Publ,
- Nelson 1990. Fishes of the world 308p.
- Ponniiah AG & George J. 1998. Fish Chromosome Atlas. National Bureau of Fish Genetic Resources (NBFGR), Lucknow.
- Thomas D. Kocher and Carol A. Stepien (Ed.) 1997. Molecular systematics of Fishes. Academic press. New York, 314p
- Whitmore DH. 1990. Electrophoretic and Isoelectric Focusing Techniques in Fisheries Management. CRC Press.
- Hewitt, G.M., Johnston, A. and Young, J.P.W. (Eds.) 1991. Molecular Techniques in Taxonomy, Springer-Verlag: 410 pp.
- Mayr, E. and Ashlock, P.D. 1991. Principles of Systematic Zoology. McGraw-Hill, New York: 475 pp.
- Quicke, Donald L.J. 1993. Principles and Techniques of Contemporary Taxonomy, Blackie Academic & Professional, London: 331 pp.
- Schuh, R. T. and Brower, A. V. Z. 2009. Biological Systematics: Principles and Applications (2nd edn.). Cornell University Press: 311 pp.
- Venkataraman K & C. Sivaperuman. 2014. Marine Faunal Diversity in India: Taxonomy, Ecology and Conservation. Academic Press 546 pp.
- Winston, Judith E. 1999. Describing Species: Practical Taxonomic Procedure for Biologists, Columbia University Press, New York

24-386-0102- MANAGERIAL ECONOMICS (4 Core)

Course Outcome (CO)- After completing the course, students will be able to

CO1. Understand the foundations of managerial Economics.

CO2. Distinguish between law of demand and law of supply and determination of market equilibrium price.

CO3. Estimate elasticity of demand and supply to determine the optimal price-quantity combination to maximize revenues and profits.

CO4. Analyze production and costs in the short and long run.

CO5. Explain different pricing practices such as price discrimination, average cost pricing, limit pricing and peak load pricing.

CO6. Apply theoretical knowledge about Managerial Economics into practical situations.

CO/PSO	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3
CO2	3	2	2	2
CO3	3	3	3	3
CO4	3	2	3	2
CO5	3	3	3	3
CO6	3	2	2	2

Module 1. Introduction to Managerial Economics

Characteristics of Managerial Economics – Nature, Scope, and Methodology of Managerial Economics, Basic Economic Tools in Managerial Economics- Managerial Decision Making and Economic Theory, Goals of the firm: Measuring and Maximising Economic Profit, Economic Cost of Using Resources, Economic Profit versus Accounting Profit, Other Goals Forms of Business Organisation, Separation of Ownership and Control.

Module 2. Demand and Supply Analysis

Demand Functions - Law of Demand, Violations of the Law of Demand, Shifts in Demand; Elasticity of Demand: Demand- Determinants, Computation and relation to total revenue, Price Elasticity of demand, Factors affecting price elasticity of demand, Income Elasticity, Cross Elasticity. Law of supply, elasticity of supply, market equilibrium, changes in equilibrium.

Module 3. Production and Cost Analysis

Production Function, Short Run and Long Run, Law of Variable proportions, Laws of Returns to Scale, Economies of Scale, Expansion Path, Cost of Production, Fixed and Variable Costs, Relationship between Average and Marginal Cost, Long run cost curves, Relationship between LAC and SAC, Modern Theory of Cost.

Module 4. Managerial Decision Making under Alternative Market Structures

Characteristics of Market Forms, Profit Maximisation, Price and Output in Competitive Markets, Break Even Point, Shut Down Point. Price Discrimination under Monopoly, Profit Maximisation, Output and Pricing Decisions under Monopoly and monopolistic competition. Oligopoly, Interdependence of strategic decision making, Collusive and non-collusive oligopoly.

Module 5. Pricing Decisions

Pricing decisions under Risk and Uncertainty, Pricing of new products, Penetration pricing, Skimming pricing, Average Cost Pricing, Marginal cost pricing, Peak Load Pricing, Limit Pricing, Multiproduct Pricing, and Transfer Pricing.

Module 6. Externalities and Market Failure

The Principal - Agent Problem, Asymmetric Information, Moral Hazard and Adverse Selection, Understanding externalities and market failures, pricing under market failure.

Suggested Reading

- Allen, W. B. 2009. Managerial Economics Theory, Applications, and Cases, 7th Edition. Norton.
- Baye, Michael. Managerial Economics and Business Strategy. 9th Edition. Boston: McGraw-Hill Irwin, (2017).
- Gupta, G.S. 2011. Managerial Economics. McGraw Hill Education (India) Private Limited. Geethika, Ghosh & Choudhury, Managerial Economics, 2/e, McGraw Hill.
- Damodaran Suma (2010) Managerial Economics, Oxford University Press
- Hirschey, M. 2009. Fundamentals of Managerial Economics, Cengage Learning.
- Jhingan, M.L. and Stephen, J.K. 2014. Managerial Economics. 2nd Edtn. Vrinda Publications P Ltd.
- James, A Pappas and Mark Hirschey, Fundamental of Managerial Economics, The Dryden Press.
- Koutsoyiannis, Modern Micro Economics, 2/e, Macmillan Press Ltd
- Keat, P. and Young, P.K. 2013. Managerial Economics, 7th Edtn. Prentice Hall.
- Kumar, A and Sharma, R. 1998. Managerial Economics. Atlantic Publishers and Distributors, New Delhi.
- Maheshwari K. L. and Varshney R.L. 2014. Managerial Economics, 22nd Revised Edition, Sultan Chand & Sons.
- D.M. Mithani, Managerial Economics, 5/e, Himalaya Publishing House, Mumbai.
- Salvatore, D. 2014. Managerial Economics in a Global Economy. Oxford University Press 8th edition.
- Samuelson, W.F. and Marks, S.G. 2011. Managerial Economics. 7th edition. John Wiley & Sons.
- Yogesh, Maheswari, Management Economics, PHI learning, New Delhi

24-386-0103 FOOD SCIENCE AND FOOD CHEMISTRY (3 Core)

Course Outcome (CO)- After completing the course, students will be able to

CO1. *Understand the nutritional components and their biological role in metabolism and growth*

CO2. *Calculate the daily requirements of nutritious food for wellbeing and health.*

CO3. *Demonstrate the factors responsible for the physical, chemical and microbiological quality of seafood*

CO4. *Understand the novel food components and nutraceuticals extracted from various plant and animal sources.*

CO5. *Explain the significance of biomolecules and its effect during processing and storage.*

CO/PSO	PSO1	PSO2	PSO3	PSO4
CO1	2	2	1	2
CO2	2	1	-	2
CO3	3	3	3	2
CO4	3	3	3	3
CO5	1	1	2	2

Module 1. Concept and definition of terms

Food, Nutrients, Nutrition, Malnutrition and Health: Scope of Nutrition Energy in Human Nutrition : Idea of Energy and its unit, Energy Balance, Assessment of Energy Requirements—deficiency and excess, Determination of Energy in food, B.M.R. and its regulation. Estimation of calories. Nutrigenomics, metabolomics, nutrition for space travelers, nutraceuticals, functional foods, genetically modified(GM) foods, fat substitutes.

Module 2. Classification of Food

Classification of Nutrients. Carbohydrates - Structure and properties. Amino acids- Classification, types, functions. Sources, Recommended Daily Intake values of food components.functions. Lipids - Definition, Classification & Properties. Fatty acids - composition, properties, types. Proteins - Definition, Classification, Structure & properties. Role & nutritional significance of PUFA, MUFA, SFA, Omega-3(n3) fatty acids.. Their Role in Human nutrition.Dietary Fibre - Classification, sources, composition & nutritional significance. Minerals & Trace Elements-deficiency & excess (Calcium, Sodium, Potassium Phosphorus, Iron, Fluoride, Zinc, Selenium, Iodine, Chromium). Vitamins - deficiency & excess. Water - Functions, daily requirements, Water balance. Probiotics, Prebiotics, Organic Food.Assessment of Protein quality (BV, PER, NPU). Factors affecting protein bio-availability including anti-nutritional factors.

Module. 3 Biochemical composition of fish

Major and Minor components, Proximate Composition of fish- Water, Protein, Lipid and Minerals and vitamins in Fish. Non-Protein Nitrogenous compounds in Fish. Significance as quality and spoilage parameters. Fish muscle structure- Molecular organization of muscle –protein components of muscle cell- actin, myosin & actomyosin. Changes during muscle contraction.

Module 4. Health Foods from marine organisms.

Medical applications of fish and shelf fish. Arachidonic cascade. Medical applications of Omega 3 fatty acids, Chitosan, Glucosamine, squalene, alkoxy glycerol, sea cucumber and Mussels. Their role in human nutrition. Biotoxins of marine origin,

Module 5. Post mortem changes in Fish

Post mortem changes in Fish, Rigor mortis, significance in fish quality. Spoilage mechanisms in fish. Flavour changes in fish, Auto-oxidation of fatty acids and Rancidity. Mechanism of auto-oxidation. Factors affecting auto-oxidation, Antioxidant synergists and pro-oxidants. Spoilage of seafood. Classification of spoilage- Enzymatic, chemical and microbiological. Factors affecting fish spoilage.

Suggested Reading

- Anon, 1985. FAO/WHO/UNO: Technical Report Series, 724. Energy and Protein Requirement, Geneva.
- Ghosh, S. 1976. The Feeding and Care of Infants and Young Children, VHAI. 6th Ed. Delhi.
- Gopalan, C., Rama shastri, B. V. and Balasubramanian, S. C 1989. Nutritive value of Indian Foods, Indian Council of Medical Research.
- Guthrie, A. H. 1979. Introductory Nutrition, 6th Ed. The C. V. Mosby Company.
- Mann and Truswell. 2007. Essentials of Human Nutrition, Oxford University press.
- Robinson, C. H. Lawler, M. R.; Chei Toweth, W. L. and Garwick, A. E. 1990. Normal and Therapeutic Nutrition. 17th Ed. Mac Millan Publishing Co.
- Simpson D. S, 1987. Food Biochemistry and Nutritional value, Longman Scientific and Technical.
- Srilakshmi, B. 2003. Dietetics, New Age International Publishers.
- Swaminathan, M. 1974. Essentials of Foods and Nutrition, Vols-1 and II. Ganesh and Co. Madras.
- WHO 1978. A growth chart for International use In Maternal and Children Health Care, Geneva.
- K. Gopakumar and G. Balagopal. Health Foods from Ocean Animals, NPI Publishing. 2019. C-21 Vaun Apartment New Delhi- 110085.

24-386-0104 FOOD BUSINESS MANAGEMENT (4 Core)

Course Outcome (CO)- After completing the course, students will be able to

CO1-Understand the management functions applicable in fish business management

CO2- Understand concepts of individual, interpersonal and organisational processes for managing organisations

CO3-Apply the tools and techniques of management and organisational processes in managerial decision making

CO4- Analyse the challenges and constraints for management functions in fish business

CO5-Evaluate the management strategies in different fish businesses

CO/PSO	PSO1	PSO2	PSO3	PSO4
CO1	3	-	-	-
CO2	3	-	-	1
CO3	3	2	2	2
CO4	3	3	3	3
CO5	3	3	3	3

Module 1: Introduction to food business

Food business management- Management process, Role of a manager in business- Management and administration, Individual processes- Perception, Concepts and theories, Perception and Decision Making, Learning and Learning Theories, Motivation- Motivation Theories, Personality Concepts- Theories of Personality – Personality testing and applications in organizations

Module 2: Functions of Management- Planning

Steps involved in Planning –Classification of Plans-Strategic Planning- SWOT analysis and Operational Planning Process of Managing by Objectives (MBO) – Strategies, Policies & Planning Premises

Module 3: Organising

Formal and informal organization – Organization Chart – Structure and Process – Departmentalization by different strategies –Line and Staff authority – Decentralization and Delegation of Authority – Staffing – Selection Process - Techniques – HRD –Managerial Effectiveness.

Module 4. Directing

Directing – Group Dynamics -Understanding Groups and Teams, Types of Teams- Team Performance- Process of Group Formation, Interpersonal processes-Leadership, Leadership styles and Leadership Theories, Interpersonal communication- - Interpersonal Communication-Conflict and conflict management, Stress and negotiation-Decision Making, Organisational Processes- Decision making, Job design and Job Enriching, Organisation Design, Organisation culture, Organisation change

Module 5. Controlling

Controlling as a management function, Performance Appraisal, System and process of Controlling – Requirements for effective control – Productivity – Reporting

Suggested Reading

Fred Luthans, (2010). *Organizational Behavior*. New York: McGraw-Hill Education,

Koontz, H. (2010). *Essentials of Management*. New Delhi: Tata McGraw-Hill Education. McGraw-Hill Education.

Jim Griesmer (2010) *Organisational Change: Themes and Issues*, Oxford

Robbins & Coulter (2013). *Management*. New Delhi: Prentice Hall.

Robbins, S.P. & Decenzo, D. A. (2014). *Fundamentals of Management: Essential Concepts and Applications*. New Delhi: Pearson Education.

Robbins S.P, Judge T.A. and Vohra N. (2013) *Organisational Behaviour*, Pearson

Charles W.L, Hill and Steven McShane (2017) *Principles of Management*

Schermerhorn, J.R *Management for Productivity*, 1984. (Wiley Series in Management)

Stoner, Freeman & Gilbert Jr. (2009). *Management*. New Delhi: Prentice Hall.

Wehrlich, H. & Koontz, H. (2010). *Management- A Global Perspective*: New Delhi: Tata

24-386-0105 RESEARCH METHODOLOGY AND QUANTITATIVE TECHNIQUES FOR SEAFOOD SAFETY AND TRADE (4 Core)

Course Outcome (CO)- After completing the course, students will be able to

CO 1. Understand the scientific method and its application to research in seafood safety and trade, enabling them to critically evaluate research studies and design their own.

CO 2. Understand the research design and various sampling techniques and to comprehend the role of research in advancing and sustaining seafood safety and trade practices.

CO 3. Apply their understanding of different data collection methods to demonstrate the ability to match research questions and objectives with suitable methodologies in seafood safety and trade contexts.

CO 4. Analyze the data using different analytical tools for meaningful decision making

CO 5. Apply different reporting and presentation styles to disseminate research findings.

CO/PSO	PSO1	PSO2	PSO3	PSO4
CO1	3	1	1	1
CO2	3	1	1	-
CO3	3	2	2	1
CO4	3	3	2	2
CO5	1	3	3	3

Module 1: Introduction to Research Methodology

Understanding the scientific method Importance of research in industrial fisheries. Types of research (basic, applied, quantitative, qualitative) Formulating research questions and objectives. Modern methods for reviewing the literature. Ethical considerations in research

Module 2: Research Design and Sampling Techniques

Principles of research design. Experimental vs. observational studies. Cross-sectional, longitudinal, and case-control studies. Sampling techniques in seafood safety and trade research. Sample size determination and power analysis. Bias and error in sampling

Module 3: Data Collection Methods

Primary vs. secondary data Techniques for collecting primary data in seafood safety and trade (surveys, interviews, observations). Instrument development and validation (questionnaires, scales). Remote sensing and GIS applications in seafood safety and trade research. Data logging and telemetry. Ethnographic methods in seafood safety and trade research.

Module 4: Data Analysis and Interpretation

Introduction to statistical analysis. Descriptive statistics (mean, median, mode, variability). Inferential statistics (parametric vs. non-parametric tests). Hypothesis testing and confidence intervals.

Module 5: Reporting and Presenting Research Findings

Structure of a research report (title, abstract, introduction, methods, results, discussion, conclusion, references). Writing styles and formatting guidelines. Effective data visualization techniques (Infographics. graphs, charts, tables). Oral presentation skills and public speaking tips. Peer review process and publication ethics. The role of scientific conferences and journals in disseminating research findings.

Suggested Reading

- Research Methodology: A Step-by-Step Guide for Beginners" by Ranjit Kumar, 4th edition, SAGE
- Research Design: Qualitative, Quantitative, and Mixed Methods Approaches, John W. Creswell (Author), J. David Creswell (Author), 6th edition, Sage.
- Statistical Methods for Research: A Step by Step Approach Using IBM SPSS. K Kalyanaraman, 1st Edition. ATLANTIC.
- Experimental and Quasi-Experimental Designs for Generalized Causal Inference" by Donald T. Campbell and Julian C. Stanley. Wadsworth Publishing
- Research Methodology in the Social, Behavioural and Life Sciences: Designs, Models and Methods, Gideon J Mellenbergh (Editor), Herman J Ader (Editor), 1st Edition. SAGE

Course Outcome (CO)- After completing the course, students will be able to

CO1- Describe the structure, sources of the major microorganisms in environment

CO2- Understand the role and significance of beneficial microorganisms

CO3- Demonstrate the factors responsible for the food spoilage

CO4- Analyze and formulate mechanisms of bacterial actions in food.

CO5- Apply various enumerative techniques for the isolation of food borne pathogens and bacteria.

CO6- Apply various techniques required to control the bacterial contamination in food and seafood.

CO/PSO	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	2
CO2	2	2	2	2
CO3	3	3	3	3
CO4	3	2	3	2
CO5	3	2	2	2
CO6	3	3	3	2

Module 1. Introduction to microbiology- History, Classification of microorganisms, Morphology and structures of microorganisms in foods. Sources of microorganisms in foods. Basic bacterial characteristics - Factors affecting growth- moisture content, pH, water activity, redox potential and oxygen

Module 2. The role of microorganisms in the food industry - Positive types/ beneficial use of microorganisms in foods-microorganisms used in food fermentation. Probiotics. , food fermentation, intestinal beneficial bacteria, and food bio preservatives of microbial origin, food ingredients and enzymes of microbial origin. Negative types microorganisms- food spoilage microorganisms, microbial food borne diseases

Module 3. Microbial growth in foods -Intrinsic parameters- nutrients and growth-carbohydrate in foods, proteins in foods, lipids in foods. Extrinsic factors- temperature and growth.

Module 4. Important bacterial pathogens in foods- gas producing bacteria, spore formers, aerobes, facultative aerobes, coliforms, faecal coliforms, enteric pathogens. Pathogenic viruses, food borne protozoan parasites, yeasts and molds. New pathogens and emerging food borne diseases.

Module 5. Microbial detection and indicator organisms- Quantitative methods for microbial enumeration in foods, qualitative methods to isolate microorganisms in foods, rapid methods, molecular typing methods, bioluminescence methods and biosensor for pathogen detection. Pathogen indicators- coliforms, enterobacteriaceae and bacteriophage.

Suggested Readings

- Ahmed, E. and Carlstrom, C. 2003. Food Microbiology: A Laboratory Manual. John Wiley & Sons, 304p.
- Anon, 2011. Intl Commission on Microbiological Specifications for Foods. Microorganisms in Foods: Use of Data for Assessing Process Control and Product Acceptance (Intl Commission on Microbiological Specifications for Foods). Springer. 400p.
- Barbara, L. and Tony, C. 2004. Microbiological Safety and Quality of Food. Springer Science & Business Media, Science. 2024p.
- Bibek, R. and Bhunia, A., 2013. Fundamental Food Microbiology. CRC Press; 5th Edtn. 663p.
- Bligh, E.G. 1992 Seafood Science and Technology. Fishing News Books, England.
- Corry, J. E. L., Curtis, G.D.W. and Baird, R.M., 1996. Culture Media for Food Microbiology. Elsevier. 490p.
- Frank, Y. 2015. Food Safety=Behavior: 30 Proven Techniques to Enhance Employee Compliance (Food Microbiology and Food Safety), Springer. 115p.
- Harrigan, W. F. 1998. Laboratory Methods in Food Microbiology. Gulf Professional Publishing, Medical. 532p.
- Harrigan, W. F. 1998. Laboratory Methods in Food Microbiology. Gulf Professional Publishing, Medical. 532p.
- Hayes P.R 1985, Food Microbiology and Hygiene. Elsevier Applied Science Publishers, London.
- Herson. A. C. and Hulland. E. D. 1964. Canned Foods, an Introduction to their Microbiology.
- James, M. and Martin, J. 2006. Modern Food Microbiology (Food Science Text Series). Springer; 7th ed. 790p.
- Latiful, B. and Dike, O. 2015. Foodborne Pathogens and Food Safety (Food Biology Series). CRC Press. 280p.
- Lynne, M. 2003. Food Microbiology Laboratory (Contemporary Food Science). CRC Press; 1 ed., 196p
- Martin R. and Maurice O. 2007. Food Microbiology. Royal Society of Chemistry; 3rd edition. 463p
- Martin R. and Maurice O. 2007. Food Microbiology. Royal Society of Chemistry; 3rd edition. 463p
- Richard, H. 2013. Food Microbiology and Hygiene. Springer Science & Business Media; Technology and Engineering. 516p.
- Richard, H. 2013. Food Microbiology and Hygiene. Springer Science & Business Media; Technology & Engineering. 516p.
- Thomas, J., Karl, R. and Kalmia, E. 2012. Food Microbiology: An Introduction. ASM Press; 3rd Edtn.
- Tibor, D. and Farkas, J. 2012. Microbiology of Thermally Preserved Foods: Canning and Novel Physical Methods. DE Stech Publ. 334p

ELECTIVES

1. SEAFOOD HARVEST TECHNOLOGIES (2 credit)

Course Outcome (CO)- After completing the course, students will be able to

CO1. Identify fishing crafts along different maritime states of the country and state technical details of fishing boats

CO2. Describe deck lay out of fishing vessels according to the type of fishing methods

CO3. Explain different types of fishing gears and methods of operation in capture fisheries sector

CO4. Compare different types of fish harvesting practices in aquaculture farms and ponds

CO5. Apply food safety and quality systems in fish harvest technologies

CO/PSO	PSO1	PSO2	PSO3	PSO4
CO1	3	-	3	.
CO2	3	2	-	1
CO3	1	2	3	1
CO4	1	2	3	1
CO5	3	2	2	3

Module 1 Traditional capture methods

Motorised, mechanized and industrial fishing; Classification of fishing vessel types-. Different types of fishing boats used in India.

Module 2 Deck Layout & Equipment

General arrangement and deck lay out of Trawler, Purse seiner, Gillnetter, Longliner and Combination Vessel. Onboard chilling systems, Fish Hold – types, design and structure. Classification and description of fishing gears and methods- Trawl nets, Gill nets, Purse Seines, Long line, Troll lines, Hand line, Pole and line, Traps. FAO classification of fishing gears

Module 3 Seafood harvesting systems

Methods of commercial fishing operations: Trawl fishing – Different types of trawling operations. Gill netting – Principle, Types of Gill net operations. Surrounding nets – Operation of Purse seine – single boat purse seining, double boat purse seining. Line fishing methods; Pole and line operation, Oceanic Long line operation (monofilament & multifilament), Trolling; Oceanic Squid Jigging, Trap fishing methods

Module 4 Harvesting methods of aquaculture species

Harvesting drainable ponds, Seining undrainable ponds, Other methods - Cast net, dipnet, gillnet, traps, barriers; Selective harvesting. Harvesting cage and raceway farms. Traditional methods of shrimp farm harvesting: Sluice net, gillnet, cast net, seine net, drag net, aerial traps, stupefying, warming of water etc

Module 5 Process control requirements on board the vessel

Storage Control requirements on board the vessel; HACCP in capture fisheries; Requirements for HACCP approval for fishing/factory vessels. Effect of catching methods on quality of fish.

Suggested readings:

- Bate, Smite, E.C. and Blendal, J.R. (1956) Changes in muscle after death. *Protein Medical Bulletin* 12 : 2305
- Connell J.J. (1975) Control fish quality, Fishing News Book Ltd. England.
- Brandt von, A. (1972). *Fish Catching Methods of the World*, Fishing News (Books)Ltd., Surrey, 240p.
- Hansen, P. (1983) Bulk handling and chilling of large catches of small fish Part-3, Trawl catches, *Infotish Marketing Digest*, 83 (2): 34-33
- Erst, R.C. Jr. (1984) Applications of refrigerated and chilled seawater systems to South East U.S. Fisheries – a project overview and progress Report. Boston, International Institutes of Refrigeration Commission, Ce, DI, D2 and D3.
- Putro, S. (1986) Better on board handling of oil sardines in the Bat strait using chilled sea water. *Info fish Marketing Digest* 86(1): 33-35.
- Chapelle, H. I. (1994). *Boatbuilding: A Complete Handbook of Wooden Boat Construction*, W.W. Norton, ISBN 0393035549, 624p.
- Coackley, N. (1991). *Fishing Boat Construction: 2 Building a Fiberglass Fishing Boat*, Issue 321 of FAO fisheries technical paper, FAO, ISBN 9251031169, 84p.
- FAO, (1975). *FAO catalogue of small-scale fishing gear*, Fishing News (Books) Ltd. Surrey, England, 191p.
- Fyson, J. (1985). *Design of Small Fishing Vessels*, Fishing News Books Ltd. Farnham, Surrey, England, 320p
- Ponnambalam, A. (2003). *Fishing Craft Technology*. CIFNET. Cochin, 158p.
- Meenakumari, B., Boopendranath, M.R., Pravin, P., Thomas, S.N. and Edwin, L. (2009) *Handbook of Fishing Technology*, Central Institute of Fisheries Technology, Cochin, 372 p
- Pravin, P, Meenakumari B and Boopendranath M.R (2008). Harvest technologies for tuna and tuna like fishes in Indian seas and by catch issues. In *Harvest and post harvest technology for tuna* (Joseph, J., Boopendranath, M.R., Sankar, T.V., Jeeva, J.C., and Kumar, R., Eds.), Society of Fisheries Technologists (India), Cochin-1-9: 79-103
- Richard O. N. Riley, Jeremy M. M. Turner (1995) *Fishing Boat Construction: 3 Building a ferro-cement fishing boat*, Volume 354 of FAO fisheries technical paper, FAO, ISBN 9251037647, 149p.
- Sainsbury, J. C. (1996). *Commercial Fishing Methods- An Introduction to Vessels and Gears*. Third Edition, Fishing News Books, Osney Mead, Oxford OX2 OEL, England: 359 p.
- Edwin L., Pravin, P., Madhu, V. R., Thomas, S. N., Ramesan, M. P., Baiju, M. V., Ravi, R., Das, D. P. H., 2014 Boopendranath M. R. and Meenakumari, B., (2014) *Mechanised Marine Fishing Systems: India*, Central Institute of Fisheries Technology, Cochin p225

Shibu.A.V. (2017) Fishing Gear Materials Accessories and Design- Revised Second Edition (Publisher- Director, CIFNET, Govt. of India, Kochi -16, ISBN Number - 81-87245-16-6). p249

Leela Edwin, Sally Thomas N, P Ramesan , P Mohammed Ashraf, M V Baiju, Manju Lakshmi N, and Madhu R (2019) Responsible Fishing: Recent advances in resource and energy conservation, Publ by Dr. Ravisankar C N, Director, ICAR Central Institute of Fisheries Technology, November 2019, 432p.

2. ENTREPRENEURSHIP DEVELOPMENT IN SEAFOOD BUSINESS (2 credit)

Course Outcome (CO) - After completing the course, students will be able to

- CO1. *Understand the entrepreneurial concepts and principles relevant to the seafood business sector, including identifying opportunities, assessing risks, and creating value through innovative business ventures.*
- CO2. *Apply techniques to create appealing business plans*
- CO3. *Analyse various funding opportunities and to select one which is most suitable for the venture*
- CO4. *Understand about social entrepreneurship and the importance of social entrepreneurship in addressing social and environmental challenges.*
- CO5. *Understand the legal and regulatory framework governing seafood business businesses*

CO/PSO	PSO1	PSO2	PSO3	PSO4
CO1	3	3	1	3
CO2	3	3	2	3
CO3	2	2	2	2
CO4	1	1	1	3
CO5	3	3	2	2

Module 1: Introduction to Entrepreneurship in Seafood Business

Overview of entrepreneurship in the seafood business. Importance and role of entrepreneurship in seafood business development. Historical perspective and evolution of entrepreneurial activities in seafood business. Entrepreneurial opportunities and challenges in the seafood business. Government policies and initiatives supporting entrepreneurship in seafood business

Module 2: Business Planning and Management in Seafood Business

Concept and components of a business plan in seafood business entrepreneurship. Market analysis and identification of market opportunities in seafood business. Financial planning and management for seafood business. Operations management and supply chain considerations in seafood business. Risk assessment and mitigation strategies for seafood business.

Module 3: Funding Opportunities for Entrepreneurs

Overview of the funding landscape in India. Importance of funding for entrepreneurial ventures. Types of funding sources: equity, debt, grants, and subsidies. Introduction to government schemes and initiatives supporting entrepreneurship. Overview of bank loans and debt financing options for entrepreneurs. Types of bank loans available for start-ups and SMEs. Eligibility criteria and documentation requirements for obtaining bank loans. Alternative forms of debt financing: peer-to-peer lending, invoice financing, and microfinance

Module 4: Social Entrepreneurship

Definition and characteristics of social entrepreneurship. Importance of social entrepreneurship in addressing social and environmental challenges. Distinction between traditional entrepreneurship and social entrepreneurship. Case studies of successful social entrepreneurial ventures in seafood business and environmental conservation. Models of social enterprises focusing on sustainable seafood business management, marine conservation, and ecosystem restoration. Examples of social entrepreneurship initiatives promoting community-based seafood business management and marine protected areas

Module 5: Legal Compliance in Entrepreneurship

Overview of the legal and regulatory framework governing seafood business businesses. Importance of legal compliance for starting and operating a seafood business-based venture. Key regulatory bodies and agencies responsible for overseeing seafood business laws and regulations. Procedures for registering a seafood business-based business entity (e.g., sole proprietorship, partnership, private limited company). Obtaining necessary permits, licenses, and approvals from regulatory authorities (e.g., seafood business department, pollution control board). Compliance with tax laws, GST registration, and other statutory requirements for business operations

Suggested Reading

India Startup Ecosystem: The Complete Roadmap" by Startup India - This comprehensive guide offers an overview of the startup ecosystem in India, including funding options, support networks, and government initiatives aimed at fostering entrepreneurship.

Stay Hungry Stay Foolish" by Rashmi Bansal - This book profiles the journeys of 25 entrepreneurs in India, offering inspiring stories and insights into the challenges and opportunities of entrepreneurship in the country.

Made in India: The Story of India's 'Unicorn' Startups" by Akshay Sharma - This book profiles some of India's most successful startups, offering insights into their business models, strategies, and the factors contributing to their success.

The Business of Sustainable Seafood" by Jennifer L. Jacquet - This book explores the intersection of business, sustainability, and seafood, discussing challenges and opportunities for entrepreneurs in promoting sustainable practices within the industry.

The New Fish Wave: How to Ignite the Seafood Industry by Thor Sigfusson. The New Fish Wave describes how the Iceland Ocean Cluster has inspired more innovation and entrepreneurship

in the global seafood industry: doing more with less to create value from fish byproducts and to build sustainable global seafood business.

3. FOOD SCIENCE AND FOOD CHEMISTRY (Practical) (1 credit)

Course Outcome-After completing the course, students will be able to

CO1. Understand the basic principles of food science and food chemistry

CO2. Understand the working of laboratory equipments and instruments

CO3. Apply the knowledge of food analysis in qualitative and quantitative measurements

CO4. Evaluate the proximate composition of of foods particularly the seafood

CO/PSO	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	2
CO2	2	3	1	2
CO3	3	3	1	3
CO4	3	3	2	3

Module 1: Basic laboratory safety and hygiene protocols

Overview of food analysis methods: qualitative and quantitative. Principles of sample preparation and extraction.

Module 2. Introduction to laboratory instruments and instrumental analysis techniques Basic Principles of Colorimetry, Spectrophotometry and Chromatography.

Module 3: Proximate Analysis of Food- Determination of moisture content by oven drying method.

Extraction and quantification of fat content by Soxhlet extraction methods. Protein determination by Kjeldahl method and colourimetry methods. Determination of ash content by dry ashing method. Calculation of carbohydrate content. Proximate analysis of fish and shell fish- moisture, ash, fat and protein.

Module 4: Basic experiments in Biochemistry

Estimation of Glucose, Glycogen, free amino acids and soluble proteins in fish samples .

Module 5. Determination of fat constants

Saponification Value, Iodine Value and Acid Value. Estimation of FFA value, Peroxide Value and TBA Value as indices of rancidity.

Suggested Reading

- AOAC 2012. Official Methods of Analysis of AOAC international
 Eskin M.N. A. 1990. Biochemistry of foods. Academic Press Inc., New York.
 Fennemma. O.L. Principles of Food Sciences Part 1 Marcel Decker, INC, New York
 Owen, R. F. 1996. Food chemistry. Marcel Dekker, Inc., New York.
 Robert, G. A. 1989. Marine, Biogenic Lipids Fats and oils Vol. II CRC Press Inc., Boca Raton, Florida.
 Roy, E. M., Geroge, J. F. and Donn, R. W. 1982. Chemistry and Biochemistry of marine food products. AVI publishing company, Westport, Connecticut.
 Smith, W.H., 1973. Principles of Biochemistry, 5th edition, McGraw Hill, Kogkusha Ltd., Sydney
 Wilson K. and J. Walker, Principles and Techniques of Practical Biochemistry. Cambridge University Press, Medical. 784p

4. FIELD VISIT: FISH MARKEST/ HARBOURS/FARMS (1 credit)

Course Outcome (CO)- After completing the course, students will be able to

- CO1- Understand and evaluate how far the infrastructure facilities available in fishing harbours meet the food safety requirements*
CO2- Evaluate facilities available onboard different types of fishing vessels
CO3- Analyse different types of fish harvesting practices in terms of food safety requirements.
CO4- Compare different types of fish harvesting systems in terms of catch quality.
CO5- Apply advanced knowledge in food safety for improving the fish handling procedures during harvesting operations.

CO/PSO	PSO1	PSO2	PSO3	PSO4
CO1	3	1	2	2
CO2	1	2	3	1
CO3	3	2	2	3
CO4	3	2	1	3
CO5	3	1	1	3

Module 1

Visit to Fishing harbour and assess the infrastructure facilities

Module 2

Visit various types of fishing vessels to understand deck layout, fish hold and preservation facilities. Visit to the fishing harbors and fish landing centers to study fish handling methods.

Module 3

Voyage onboard fishing vessels to understand the catch process, hygienic fish handling, onboard fish preservation techniques, chilling technologies etc and preparation of reports;

Module 4

Visit to Cold storage, fresh/chilled/frozen fish outlets and markets

Module 5

Visit aquaculture farms/ponds, cages and pen sites. Observe harvesting practices of aquaculture species.

Suggested Reading

FAO, (1975).FAO catalog of small-scale fishing gear, Fishing News (Books) Ltd. Surrey, England, 191p.

Fyson, J. (1985). Design of Small Fishing Vessels, Fishing News Books Ltd. Farnham, Surrey, England, 320p

Meenakumari, B., Boopendranath, M.R., Pravin, P., Thomas, S.N. and Edwin, L. (2009) Handbook of Fishing Technology, Central Institute of Fisheries Technology, Cochin, 372 p

Pravin, P, Meenakumari B and Boopendranath M.R (2008). Harvest technologies for tuna and tuna like fishes in Indian seas and by catch issues. In Harvest and post harvest technology for tuna (Joseph, J., Boopendranath, M.R., Sankar, T.V., Jeeva, J.C., and Kumar, R., Eds.), Society of Fisheries Technologists (India), Cochin-1-9: 79-103

Richard O. N. Riley, Jeremy M. M. Turner (1995) Fishing Boat Construction: 3 Building a ferrocement fishing boat, Volume 354 of FAO fisheries technical paper, FAO, ISBN 9251037647, 149p.

Sainsbury, J. C. (1996). Commercial Fishing Methods- An Introduction to Vessels and Gears. Third Edition, Fishing News Books, Osney Mead, Oxford OX2 OEL, England: 359 p.

Edwin L., Pravin, P., Madhu, V. R., Thomas, S. N., Ramesan, M. P., Baiju, M. V., Ravi, R., Das, D. P. H., 2014 Boopendranath M. R. and Meenakumari, B., (2014)Mechanised Marine Fishing Systems: India, Central Institute of Fisheries Technology, Cochin p225

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SECOND SEMESTER

24-386-0201 CHILLING AND FREEZING TECHNOLOGY (2 Core)

Course Outcome (CO)- After completing the course, students will be able to

CO1-Understand the importance of seafood preservation

CO2-Understand the principles of chilling and freezing technology

CO3-Understand the mechanism of refrigeration and working of coolers/freezers

CO4-Understand the day today and unit operations of seafood freezing industry

CO5-Apply the principles in preserving fresh and processed foods for domestic/export markets.

	PSO1	PSO2	PSO3	PSO4
CO1	2	3	2	1
CO2	3	2	2	1
CO3	2	2	2	1
CO4	3	3	3	2
CO5	3	3	3	1

Module 1 : Spoilage in fish

Physical, chemical, microbiological, Need to prevent fish spoilage, methods to retard or prevent spoilage. Chilled storage of fish. Types of chilling, Heat load calculation, different types of ice, manufacture of ice, physical, chemical, microbiological and sensory changes during chill storage, melanosis and its prevention, iced storage shelf life, cold shock.

Module 2: Onboard handling of fish

Onboard chilling methods, handling of fish in landing centres, harbours etc. 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.

Module 3: Freezing of fish and shellfish

Structure of water and ice, influence of solutes on the structure of water and ice, phase equilibria and freezing curves of pure water and binary solutions, freezing curves for fish, determination of freezing points from time, temperature plots, calculation of freezing time; crystallization, nucleation- homogeneous and heterogeneous nucleation; super cooling, crystal growth, eutectic point, location of ice crystals in tissue, changes during freezing.

Module 4: Technological aspects of freezing

methods of freezing (plate freezing, IQF, etc), selection of a freezing method, product processing and packaging, packing of fresh and frozen fish for consumers, modified atmosphere packaging, controlled packaging. Module V Frozen storage- physical changes, freezer burn and recrystallisation, different types of recrystallisation. Chemical changes in lipids, proteins and nucleotides, freeze denaturation and theories on denaturation, changes in pH, bacterial changes, sensory changes, texture, taste, odour, effect of post-mortem condition on sensory qualities. Prevention of quality loss during frozen storage, treatments prior to freezing, antioxidants, cryoprotectants and other additives, theories of cryoprotection, glazing- importance and methods.

Module 5: Principle of freezing and refrigeration and freezing

Refrigerants, classification of refrigerants, refrigeration cycle. Cold storage management- arrangements within a cold storage, handling and stacking systems. Time temperature tolerance, temperature and duration of storage on quality and shelf life.

Suggested Readings

- Wheaton F.W and Lawson T.B (1985) Processing of Aquatic Food Products, John Wiley & Sons , New York.
- Huss H.H (1994), Assurance of Seafood Quality, FAO Fisheries Technical paper – 334, FAO.
- Joan K. Loken (1995), The HACCP Food Safety Manual, John Wiley and Sons.
- Connel J.J (1980), Control of Fish quality. Fishing News Books Ltd., England.
- Quality Assurance in Seafood Processing, (2000) Society of Fisheries Technologists, (India) Cochin.
- Hall G.M (1997), Fish Processing Technology, Blackie Academic & Professional New York.
- Davies. R (1982) Developments in Food Microbiology, Applied Set. London.
- Alasavar .C Taylor. T. (2002), Seafood -quality, Technology and Nutraceutical applications, Springer-VerlagBerlin.
- Da-wen Sun (2012), Handbook of frozen food processing and packaging, contemporary food engineering series, Taylor & Francis group.London.
- Herbert Stone & Joel L. Sidel (1985) Sensory evaluation practices- Food Science & Technology: A series of Monographs, Florida.
- Venugopal V.(2006) Sea food processing-Adding value through quick freezing, retortable packaging and Cook-chilling. CRC-Taylor & Francis group.

Course Outcome (CO) - After completing the course, students will be able to

CO1. Understand the principles and importance of seafood processing, including the role of processing in food safety and preservation.

CO2. Apply appropriate thermal processing techniques for seafood, considering factors such as heat transfer, equipment, and safety.

CO3. Evaluate and apply nonthermal processing techniques for seafood, including high-pressure processing, pulsed electric fields, and irradiation.

CO4. Explain the fundamentals of seafood packaging, including different packaging materials and their properties.

CO5. Apply advanced seafood packaging technologies, such as modified atmosphere packaging and vacuum packaging, to extend the shelf life and maintain the quality of seafood products.

CO6. Analyze and propose solutions for packaging challenges in the seafood industry, considering sustainability, safety, and consumer preferences.

CO/PSO	PSO1	PSO2	PSO3	PSO4
CO1	3	1	2	1
CO2	3	2	3	3
CO3	3	2	3	2
CO4	2	3	1	2
CO5	2	2	3	2
CO6	3	3	2	3

Module 1: Introduction to food Processing

Overview of the seafood processing industry, Importance of seafood processing for food safety and quality, Introduction to thermal and nonthermal processing technologies.

Module 2: Thermal Processing of food

History and evolution of canning process, Principles of thermal processing, Mechanism of heat transfer, heat resistance of bacteria and spores, decimal reduction time, thermal death time, "Z" and "F" values, heat penetration, cold point, can size, shape, contents etc. definition of canning, absolute sterility, commercial sterility, pasteurization Vs sterilization. Canning process, steps involved, process flow, additives, HTST processing and aseptic canning, Canning machinery and equipment , Canning process of fish/shellfish , Value added canned products , Spoilage of canned food. Examination of cans and seams. Canning plant location: Practical considerations, canning plant facilities, lay out design. Retort Pouch Processing. Process machineries. Shelf life evaluation. Lamination process. Freeze Drying, AFD Principles and Applications.

Module 3: Nonthermal Processing of food

Introduction to Nonthermal Processing, Importance of nonthermal processing for preserving seafood quality and safety, Comparison of nonthermal and thermal processing methods, Principles and applications of High-Pressure Processing (HPP), Pulsed Electric Fields

(PEF), Irradiation, Other Nonthermal Processing Techniques: Ultrasound, Ozone treatment, Pulsed light, etc.

Module 4: Introduction to Food Packaging

Packaging: Package requirements, package functions. Package Materials: classification packages, Importance of packaging in seafood processing, Kraft paper, Aluminium foil, corrugated fibre board and various flexible plastic films, Laminations and Co-extrusions, properties of various packaging materials, etc. Physical and mechanical properties of packaging materials, etc

Module 5: Advanced Seafood Packaging Technologies

Retort pouch packaging, Vacuum Packaging, Polymeric Packaging Materials and their safe use in food contact application. Packaging requirements of fresh fish, frozen fish, Canned Fish, Dehydrated Fish and nonthermal processed products, etc. Insulated boxes. Accelerated shelf testing. Emerging trends in biodegradable plastic materials for seafood packaging. Biodegradable films, Bio plastics, materials advantages and disadvantages. Intelligent Packaging, Edible coating and innovations for enhanced shelf life of seafood.

Suggested Readings:

- Balasubramanian, S., & Marshall, D. L. (2014). Nonthermal processing technologies for food. John Wiley & Sons.
- Bhat, R., & Alias, A. K. (2018). Nonthermal Processing Technologies for Food. John Wiley & Sons.
- Chevalier, D., Le Bail, A., Ghidossi, R., & Oulahal, N. (2017). Non-thermal technologies for seafood processing: The perspective of emerging technologies. In Innovations in traditional foods (pp. 169-191). Springer, Cham.
- Da-wen Sun (2012), Handbook of frozen food processing and packaging, contemporary food engineering series, Taylor & Francis group.London.
- Esteve, M. J., & Frígola, A. (2018). Non-thermal processing of foods and emerging technologies. CRC Press.
- Herbert Stone & Joel L. Sidel (1985) Sensory evaluation practices- Food Science & Technology: A series of Monographs, Florida.
- Herson.A.C. &Hulland. E. D. (1964) Canned Foods, An Introduction to their Microbiology.
- Roldán, M., & Regenstein, J. M. (2010). Nonthermal processing technologies for food. IFT Press series, John Wiley & Sons.
- Venugopal V.(2006) Sea food processing-Adding value through quick freezing, retortable packaging and Cook-chilling. CRC-Taylor & Francis group.
- Barbosa-Cánovas, G. V., & Juliano, P. (2005). Nonthermal Preservation of Foods*. CRC Press.
- Ortega-Rivas, E., & Welti-Chanes, J. (2011). Nonthermal Processing Technologies for Food*. Wiley-Blackwell.
- Tang, J., & Sun, X. (2002). Nonthermal Processing Technologies for Food*. Iowa State Press.
- Balasubramanian, S., & Lalitha, K. V. (2019). Non-Thermal Processing of Foods*. CRC Press.
- Ramaswamy, H. S., & Marcotte, M. (Eds.). (2007). Nonthermal Processing Technologies for Food. Institute of Food Technologists.

24-386-0203 FOOD SAFETY AND QUALITY ASSURANCE (3 Core)

Course Outcome (CO) - After completing the course, students will be able to

- CO1. Understand the national and international food safety regulations
 CO2. Describe the role and significance of food additives, preservatives
 CO3. Apply the HACCP in food processing establishment
 CO4. Analyze the food safety issues in seafood supply chain
 CO5. Understand the emerging technologies for ensuring seafood safety.
 CO6. Apply the procedures for factory auditing and seafood traceability

CO/PSO	PSO1	PSO2	PSO3	PSO4
CO1	2	2	1	1
CO2	2	1	1	1
CO3	3	3	3	3
CO4	3	3	3	3
CO5	3	3	2	2
CO6	3	2	2	1

Module 1: Water quality in seafood processing

Drinking water quality, Water quality factors. Water treatment agents, Types of disinfection – methods.. Storage and transport- delivery equipment design, Railcars, Air shipping, warehousing.

Module 2: Factory sanitation and hygiene.

National and International requirements, SSOP, Establishment and maintenance of sanitation, Personal hygiene- Personal training. Quality Assurance and Certification: Total quality management; Good Manufacturing practices, Good Laboratory Practices, Quality Management systems QSS. Quality circles, SQC., ISO System. HACCP, Principles, Implementation. Plan Documentation, types of records.Auditing, Surveillance; Audit, Mock audit, third party quality certifying audit, Auditors and Lead auditors. Certification, certification procedures, certifying bodies, Accrediting bodies, International bodies.

Module 3: Hazards in seafoods

Physical, chemical and microbiological poisoning by chemicals-Heavy metals, pesticides, non-metals-occurrence in food and toxic effects.Biological toxins occurring in sea food: Shell fish poisoning, ciguatera poisoning, puffer fish poisoning etc.Biogenic amines, heavy metals and industrial pollutants, Antibiotic residue-antibiotic resistance, risk analysis and risk assessment

Module 4: Processing and safety of New Generation Foods

Cook – chilling, processing, Minimally processed foods, Sous-vide technology. Modified atmospheric packaging, Aseptic packaging, Ultra high temperature, Pasteurized foods. Non-thermal techniques, High pressure processing. Biotechnological applications in packaging of value-added products. Emerging trends in fish packaging and shelf life enhancement.

Toxicology and safety evaluation of food additives. Food colour natural and artificial. Pigments- their importance and utilization as food colour. Taste and flavor inducer, potentiators. Food preservatives and their chemical action. Mode of action salt, chelating agents stabilizers, polyhydric alcohol, antioxidants, non-nutritional sweetness and antimicrobial agents.

Module 5: National and International laws and regulations

Regulatory agencies-International standards-ISO 9000 series of quality systems-Traceability in seafood production chain- Methods, good traceability practice, principle and methods for the validation of traceability. Processing plant, Food flow considerations, Cross contamination. Food safety standards for employees, Pest control, Waste management. Preparation of HACCP manual, Seafood factory auditing. Traceability of fish species and recall. Catch from sustainable stock certification.

Suggested Reading

- Alaswar. C & Taylor T.(2002), Seafoods – Quality, Technology and Nutraceutical applications, Springer- Verlag Berlin.
- Andrew Bolton (1997) Quality Management Systems for the Food industry; A guide to ISO 9001/2. Published by Blackie Academic & Professionals, UK.
- Gopalakrishna Iyer, T.S, Kandoran, M.K, Mary Thomas & Mathew, P.T (2002) Quality Assurance in Seafood processing, CIFT, Cochin & Society of Fisheries Technologists, (India).
- Wheaton F.W. and Lawson T.B (1985) Processing of Aquatic Food Products, John Wiley & Sons .New York
- Huss .H.H (1994), Assurance of Seafood Quality, FAO Fisheries Technical paper – 33, FAO.
- Joan K. Loken (1995), The HACCP Food Safety Manual, John Wiley and Sons
- Connel . J.J (1980), Control of Fish quality. Fishing News Books Ltd., England.
- Quality Assurance in Seafood Processing, (2000) Society of Fisheries Technologists, (India) Cochin.
- Davies. R (1982) Developments in Food Microbiology, Applied Setl. London C.
- Alasavar & T. Taylor (2002), Seafoods-quality, Technology and Nutraceutical applications, Springer-Verlag Berlin .
- Surendran, P.K.. et.al (2003) Seafood Safety pp.662 Society of Fisheries Technologists (India) Cochin
- Surendran. P.K. et.al.(2006) Laboratory Manual on Microbiological Examination of Sea food, Central Institute of Fisheries Technology, Cochin.
- Sara Mortimore and Carrol Wallace (1997) – HACCP - A Practical approach- Chapman and Hall, London.
- Standard methods for the examination of water. Waste water (1985) 16th Edition APHA, AWWA.

24-386-0204 SUPPLY CHAIN MANAGEMENT AND LOGISTICS FOR FOOD TRADE (4 Core)

Course Outcome (CO) - After completing the course, students will be able to

CO1- Understand the general concepts of supply chain management

CO2- Apply the processes involved in supply chain management of food trade

CO3- Analyze the flows and drivers in the supply chain management in food trade

CO4-Evaluate the effectiveness of e business in supply chain

CO5- Create frameworks on supply chain for domestic and international trade

CO/PSO	PSO1	PSO2	PSO3	PSO4
CO1	3	-	-	1
CO2	3	2	2	1
CO3	3	1	1	3
CO4	3	2	1	2
CO5	3	3	2	2

Module 1- Introduction to Supply chain management

Definition of supply chain, Scope, functions and importance – Supply chain flows, decision phases in supply chain, Supply chain drivers, Process view, cycle view and push and pull view.

Module 2: Supply chain management process

Demand management, sourcing, material requirement planning (MRP), production planning and scheduling, inventory management- warehouse management- distribution management, customer relationship management (CRM).

Food Logistics – Movement of Food, Packaging in Logistics , Temperature Controlled Supply Chains

Sourcing and supplies management, procuring and outsourcing, third party logistics and fourth party logistics, outsourcing benefits, vender evaluation,

Supplier Relationship Management Supply Chain Performance-Achieving Strategic Fit and Scope – Competitive and Supply Chain Strategies, Expanding Strategic Scope.

Module 3- Demand Forecasting in a Supply Chain

Role of Forecasting, forecasting Methods, Basic Approach to Demand Forecasting- Time series forecasting methods,

Module -4 Production planning and inventory management

Production planning- Resource requirement planning – Material requirement planning, capacity requirement planning, ERP (Enterprise resource planning), inventory management, cycle inventory, safety inventory, Collaborative Planning, Forecasting and Replenishment (CPFR)

Module 5- Role of E-Business in coordinating Supply Chain

Coordination and integration in Supply Chain, E-Business and the Supply Chain, Role of IT, Impact of Internet and E-Business, IT enabled SCM - BI- Lean SCM-SCM information systems, ERP, SCM models, Optimization- SCOR- SCM software.

Suggested Readings:

Sunil Chopra and Peter Meindl (2007). Supply Chain Management: Strategy, Planning and Operation. Fourth edition published by Prentice-Hall, Inc.

Wisner, Keong Leong and Keah-Choon Tan, (2005). Principles of Supply Chain Management A Balanced Approach, Thomson Press.

Madeleine Pullman and Zhaohui Wu (2021) Food Supply Chain Management: Building a Sustainable Future, Publisher: Routledge; 2nd edition (29 March 2021), ISBN-13 : 978-0367351199, 342p

Samir Dani (2015) Food Supply Chain Management & Logistics (From Farm to Fork) Published by KoganPage, New Delhi. ISBN-10 : 9780749473648, 280p

Jane F Eastham, Liz Sharples & Stephen D Ball (2001) Food Supply Chain Management Published by Butterworth Heinemann, New Delhi. Ebook ISBN 9780080506678 , 360p

Donald J Bowersox, Dand J Closs, M Bixby Coluper, (2008). Supply Chain Logistics Management, TMH, Second Edition.

John J. Coyle, C. John Langley, Brian J. Gibson, Robert A Novack, A Logistics Approach to supply Chain Management

24-386-0205 INTERNATIONAL TRADE AND DEVELOPMENT (3 Core)

Course Outcome (CO) - After completing the course, students will be able to

- CO1. Understand the role of international trade on economic development, trade policies and multilateral trade agreements.*
- CO2. Distinguish between absolute and comparative advantage models.*

- CO3. Examine the neo-classical theories of international trade.
 CO4. Explain the nature and significance of Intra-industry trade.
 CO5. Evaluate the relevance of Singer-Prebisch hypothesis and trade policy implications.

CO/PSO	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	3
CO2	3	3	2	3
CO3	2	2	2	2
CO4	2	2	3	3
CO5	2	3	2	2

Module 1-

A Brief Historical Introduction to the Theory and Practice of International Trade
 Evolution of trade - International trade transfers - Mercantilism.

Module 2 -

Core Trade Models and Empirical Tests

The Classical Theory of Trade: Absolute and Comparative Cost Advantage models. Neo-classical Theories: Heckscher-Ohlin and Related Models, Marxist and Dependency Theories of Trade: Motives, Dynamics, and Consequences for the International Division of Labor and Income Distribution

Module 3-

The “New” Trade Theories

Increasing Returns, Intra-Industry Trade, Geography, and the Gravity Model. Problems of trade in primary commodities: Singer –Prebisch hypothesis: income terms of trade :double factors terms of trade and the (international)Lewis model.

Module 4 -

Multilateral Trade Agreements, Trade, Development, and Growth, Trade and the Environment: Trade Policies for developing countries. The Globalization of Trade, Finance, and Resistance: Linkages between International Labor and Capital Mobility, Multinational Corporations, Investor Rights, Labor Standards, and the Nature of Recent Multilateral Agreements. WTO and related issues.

Module 5

Trade Policy and International Agreements, Overview of international trade agreements relevant to seafood trade (e.g., WTO agreements, regional trade agreements), Economic implications of tariffs, quotas, and non-tariff barriers on seafood trade, Analysis of trade disputes and their impact on seafood markets, Strategies for navigating trade agreements to maximize market access and competitiveness. Discussion on the harmonization of food safety standards and the challenges of achieving regulatory coherence in global seafood trade

Suggested Readings

- Arghiri, Emmanuel, (1972) Unequal Exchange: A Study of the Imperialism of Free Trade, New York: Monthly Review Press.
- Bhagwati, J.N., Arvind Panagariya, and T. N. Srinivasan, (1998) Lectures on International Trade. Cambridge: MIT Press. (Second edition) [BPS]
- Dominick Salvatore (2011) International Economics: Trade and Finance, John Wiley International Student Edition, 10th edition, 2011.
- ´Caves, R., J. Frankel, and R. Jones, 2007. World Trade and Payments. Boston: Pearson, Addison, Wesley. (Tenth edition).
- Dixit, A.K. and V. Norman, 1993. Theory of International Trade. Cambridge: Cambridge University Press.
- International Labour Organization (ILO). Human Rights: A Common Responsibility. International Labour Conference, 75th Session, 1988. Geneva: ILO, 1988.
- Jagdish N. Bhagwati, ed. International Trade: Selected Readings, 2nd edition (Cambridge, MA: MIT Press, 1987
- Krugman, Paul R., Maurice O Bhagwati, J. P. Krishna, and A. Panagariya (1999). Trading Blocks: Alternative Approaches to Analyzing Preferential Trade Agreements (MIT Press)
- Krugman, P., Obstfeld, M. and M. Melitz, 2012. International Economics: Theory and Policy, Boston: Addison-Wesley.
- Markusen, J. R., Melvin, James R Kaempfer, William H and Maskus, Keith E (1995): International Trade: Theory and Evidence, International Trade (Cambridge, MA, MIT press).
- Paul R. Krugman (1990) Rethinking International Trade, Cambridge, MA: MIT Press.
- Robert C. Feenstra, (2004) Advanced International Trade: Theory and Evidence, Princeton University Press, ISBN 0-691-11410-2
- Stern, Robert, Labor Standards and International Trade, Discussion Paper # 40, School of Public Policy, University of Michigan, 1998.
- Williams, John, (1929), "The Theory of International Trade Reconsidered," Economic Journal, 39 (154), pp. 195-209.
- Viner, Jacob. 1953. International Trade and Economic Development. Oxford: Clarendon Press.
- Williamson, John and Milner, Chris (1991). The World Economy Hemel Hempstead, Herts: Harvester Wheatsheaf.

ELECTIVES

1. AQUATIC FOOD PRODUCTION SYSTEMS AND PRACTICES (3 credit)

Course Outcome (CO) - After completing the course, students will be able to

CO1- Understand the status of world and Indian aquaculture

CO2- Understand major countries involved in world aquaculture practices

CO3- Design finfish and shellfish hatcheries and developing sustainable farming practices

CO4- Understand the design and construction of farms and their management

CO5- Design, construction and maintenance of aquarium and aquascaping

CO/PSO	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	1
CO2	3	2	2	2
CO3	2	1	1	1
CO4	2	2	1	2
CO5	2	1	-	1

Module 1: Global trends in aquaculture production and consumption

Major countries and species involved in aquaculture. Employment in the aquaculture sector. Present status of aquaculture and growth of aquaculture production in India. Present status of finfish and shellfish seed production in India. Challenges and prospects of aquaculture in India.

Module 2: Different types of hatchery systems

Hatchery design and management: Criteria for site selection of hatchery and nursery, culture and use of different live feed in shellfish hatcheries; Hatchery technology for different cultivable and ornamental species: Brood stock management - Induced breeding– new generation inducing agents.

Module 3: Aquaculture engineering

Aquaculture engineering -Technical components of farm designing, site selection and evaluation, construction of bunds, dykes etc.; Hydrodynamics; rates of discharge and types of flows, design, components and construction of tanks, ponds and cages. Aquatic environment- abiotic and biotic factors – physical- chemical and biological characteristics

Module 4: Aquaculture systems:

Extensive, semi-intensive and intensive culture of fish, Pen and cage culture in lentic and lotic water bodies, polyculture, composite fish culture, integrated farming. Paddy-cum fish culture, Pokkali shrimp farming, Pond culture, raceways, Cage and pen culture.

Aquarium keeping: Design and construction of tanks; Aquarium fabrication, setting and maintenance; Aquascaping.

Module 5: Innovative farming systems and aquarium keeping

Integrated Multi Trophic Aquaculture (IMTA); Recirculatory Aquaculture System (RAS); Biofloc based aquaculture system; Periphyton based aquaculture; Bioturbation technique; Aquaponics; Organic aquaculture; cage and enclosure systems in aquaculture; Flow-through raceways; Partitioned Aquaculture Systems; Best aquaculture practices (BAP)

Suggested Readings:

Bardach, J. E. 1997. Sustainable Aquaculture. John Willey & Sons. 251p

- De Silva, S.S and. Anderson T.A 1995. Fish Nutrition in Aquaculture.Chapman & Hall Aquaculture Series. 320p
- Diwan, A.D., Joseph, S and Ayyappan S. 2008. Physiology of Reproduction, Breeding and Culture of Tiger Shrimp. Narendra Publ. House. 292p.
- Elena M. 2003. Nutrition, Physiology and Metabolism in Crustaceans.Science Publishers. 160p.
- Hagiwara, A., Snell, T.W., Lubzens, E. and Tamaru C.S. 1997. Live Food inAquaculture. Proceedings of the Live Food and Marine Larviculture Symposium.Kluwer. 328p.
- Halver, J. and Hardy R.W.2002. Fish Nutrition. Academic Press. 726p
- Halver, J.E and Tiews, K.T. 1979. Finfish Nutrition and Fish feed Technology. Vols.I, II Heenemann, Berlin. 75-85pp
- Hertrampf, J.W and Pascual F.P. 2000. Handbook on Ingredients for Aquaculture Feeds.Kluwer. 573p
- Holmer, M, Black, K., Duarte, Marba C.M N. and Karakassis, I. (Eds.). 2008. Aquaculture in the Ecosystem. Daya Publ. House. 326p.
- ICAR. 2006. Handbook of Fisheries and Aquaculture. ICAR. 850p
- Leung, P., Lee, C.S. and O'Bryen J.P. (Eds.). 2007. Species and System Selection for Sustainable Aquaculture. Blackwell Publ. 528p
- Midlen and Redding T.A.1998. Environmental Management for Aquaculture.Chapman& Hall. 224p
- MPEDA., 1993. Handbook on Aqua Farming - Live Feed. Micro Algal Culture. MPEDA Publication.61p
- Pillay T.V.R. 1972. Coastal aquaculture in the Indo – Pacific region, Fishing News. FAO of UnitedNations, Rome, Pp 566p
- Pillay, T.V.R and Kutty M.N. 2005. Aquaculture: Principles and Practices. 2nd Ed. Blackwell.P-640p
- Pillay, T.V.R. and Kutty M.N. 2005.Aquaculture- Principles and Practices. Blackwell. 624p
- Rajagopalsamy, C.B.T. and Ramadhas, V.2002. Nutrient Dynamics in Freshwater Fish Culture System.Daya Publ. 140p
- Rath, R.K. 2000. Freshwater Aquaculture.Scientific Publ. 597p
- Reddy, P.V.G.K. 2005.Genetic Resources of Indian Major Carps. FAO Publ.
- Santhanam, R. 1990. Coastal aquaculture in India.CBS Publications. 174p
- Selvamani, B.R and Mahadevan, R. 2008. Aquaculture, Trends and Issues.Campus Books International. 284p.
- Sharma, L.L., Sharma, S.K., Saini, V.P. and Sharma B.K. 2008. Management of Freshwater Ecosystems. Agrotech Publ. Academy.
- Avnimelech, Y, 2015. Biofloc technology- a practical guide.World Aquaculture Society. 258p
- Harvey, B., Soto, D., Carolsfeld, J. and D.M.Bartley, 2017. Planning for aquaculture diversification.The importance of climate change and other drivers. FAO Rome, 156p
- Samocha, T.M, 2019. Sustainable biofloc systems for marine shrimp. Academic Press, Elseiver.

2. FOOD ECONOMICS (3 Elective)

Course Outcome (CO) - After completing the course, students will be able to

- CO1. Evaluate the statistical profile of Indian economy and the role of population and requisite for food security.*
- CO2. Examine the significance of food economics and the transformation of food systems using economic principles.*
- CO3. Discuss the main components of food system approaches of food production, marketing and consumption and relevance for sustainable food system.*

CO4. Analyse the effectiveness of the national and international food system, food self-sufficiency, resilience and the market effects of compliance with food safety standards.

CO5. Evaluate the case studies of market dynamics and future trends in the national and international food market and the strategies for sustainable food production and consumption

CO/PSO	PSO1	PSO2	PSO3	PSO4
CO1	2	3	3	3
CO2	3	3	3	2
CO3	3	3	3	2
CO4	2	3	3	3
CO5	3	3	2	3

Module 1 Introduction to Food Economics

Statistical profile of Indian economy, Sector wise Contribution. Agricultural Revolution, Demographic transition, Theories of Population, Role of population and Economic Growth, Food Security, Food loss and waste, Artificial Intelligence in Food Economics.

Module 2 Dynamics of development and Transformation of Food Systems

Early human food systems and subsistence agriculture, Semi-subsistence food systems and commercial, market-oriented food systems, Central Problems in an Economy, Production Possibility Frontiers, Food supply and demand, Least cost nutrition diets, Gastronomy and economic development. .

Module 3 Components of Food Systems

Production or Farming Systems- Classification of farming systems, economic and diseconomies of scale; optimum scale of production, simple bio-economic model of production, Sustainable agricultural production.

Transportation, Marketing and Distribution: The Post-Harvest System, Sustainable Food Systems, Infrastructure, storage and information. Market power.

Consumption and Nutrition, Keynes's Theory of Consumption, Determinants of household food consumption, Changing food consumption patterns, Estimates of current and future demand for food. Coordination of the Components food system.

Module 4 National and World Food Systems

Dimensions of Food System Performance, food self-sufficiency, resilience of food systems , Market effects of compliance with national and international food safety standards ,economic value of food safety certifications and labels.

Module 5 Market Trends and Future Outlook

Analysis of emerging trends in the global food market. Economic implications of climate change on food production and trade, Forecasting future demand and supply dynamics in the food industry, Strategies for adapting to market changes and maximizing economic opportunities in the food sector. Analysis of trade disputes and their impact on food markets, Strategies for navigating trade agreements to maximize market access and competitiveness. Cost-benefit analysis of implementing food safety standards, evaluating

the economic implications of different regulatory approaches for sustainable food production and consumption.

Suggested Readings

- Chakaravathi RM. 1986. Under Development and Choices in Agriculture. Heritage Publ., New Delhi.
- Dewett K K. 2002. Modern Economic Theory. S. Chand & Co.
- M.L. Jhingan Economics of Development and Planning
- Dutta and Sundaram Indian economy
- H .L.Ahuja Indian Economy
- Todaro, Michael P. and Stephen C. Smith, Economic Development, Pearson.
- Westernization of Asian Diets and the Transformation of Food Systems: Implications for Research and Policy,” by Prabhu Pingali. (2006).
- Bai, Y., Alemu, R., Block, S.A., Headey, D. and Masters, W.A., 2020. Cost and affordability of nutritious diets at retail prices: Evidence from 177 countries. Food Policy, p.101983. <https://doi.org/10.1016/j.foodpol.2020.101983>
- A., N.Z. Rosenblum, and R.G. Alemu, 2018. "Agricultural transformation, nutrition transition and food policy in Africa: Preston curves reveal new stylised facts." Journal of Development Studies 54(5): 788-802. <https://doi.org/10.1080/00220388.2018.1430768>
- Bell, W., Lividini, K. and Masters, W.A., 2021. Global dietary convergence from 1970 to 2010 altered inequality in agriculture, nutrition, and health. Nature Food 2(3), pp.156-165. <https://doi.org/10.1038/s43016-021-00241-9>
- Nguyen H. Sustainable Food Systems Concept and Framework. Food and Agriculture Organization of the United Nations. 2018. (<http://www.fao.org/3/ca2079en/CA2079EN.pdf>)

3. SEAFOOD PROCESSING TECHNOLOGY (Practical) (1 credit)

Course Outcome (CO) - After completing the course, students will be able to

- CO1. Demonstrate proficiency in conducting sensory evaluation of raw and frozen fin fish and shellfishes.*
- CO2. Apply preprocessing techniques such as filleting and processing of prawns, squid, and cuttlefish, including yield calculations.*
- CO3. Analyze chill storage studies, including chemical, physical, and sensory analyses, to determine shelf life of seafood products.*
- CO4. Evaluate frozen/chilled fish using biochemical, microbiological, and sensory methods.*

CO5. Demonstrate competence in canning techniques, including operation of overpressure autoclaves and examination of canned fishery products.

CO/PSO	PSO1	PSO2	PSO3	PSO4
CO1	2	2	3	3
CO2	3	3	2	1
CO3	2	2	3	2
CO4	2	3	2	2
CO5	1	3	2	1

Module 1 Sensory Evaluation Techniques

Demonstrate proficiency in conducting sensory evaluation of raw and frozen fin fish and shellfishes.

Interpret sensory analysis results to assess the quality of seafood products.

Module 2: Seafood Preprocessing

Perform filleting techniques for fish and processing methods for prawns, squid, and cuttlefish, while accurately calculating yield.

Evaluate the quality of processed seafood products and identify areas for improvement.

Module 3: Chill Storage Studies

Conduct chemical, physical, and sensory analyses of chilled seafood, and determine the shelf life of chilled seafood products.

Make informed decisions regarding the storage and quality maintenance of chilled seafood.

Module 4: Evaluation of Frozen/Chilled Fish

Use biochemical, microbiological, and sensory methods to evaluate frozen and chilled fish, ensuring compliance with quality and safety standards.

Implement corrective measures to maintain the quality of frozen and chilled seafood.

Module 5: Evaluation of Canned Products

Conduct thorough examinations of canned fishery products to assess quality and safety.

Identify and address potential issues related to can seams and sterility of canned products.

Monitor and control double seam parameters, heat penetration curve, Fo Value, Z value, and process time for optimal canning outcomes.

Suggested Readings:

Balachandran, K.K. 2003. Fish Canning Principles and Practices. CIFT, Cochin.

Gopakumar K. 2002. Text Book of Fish Processing Technology. ICAR, New Delhi .

Hall G. M. 1992. Fish Processing Technology 1992. Blackie Academic and

Larousse, J and Brown, B. E. 1997. Food Canning Technology. Willey VCH New York.

Regenssein, J. M. and Regenssein, C. E., 1991. Introduction to fish technology.

Sen D. P. 2005. Advances in Fish Processing Technology. Allied Publishers Pvt. Ltd.

Alasalvar, C., & Bhat, R. (Eds.). (2020). Seafood Processing: Technology, Quality and Safety. Wiley-Blackwell.

Badii, F., & Howell, N. (2012). Seafood Processing: Technology, Quality and Safety. Wiley-Blackwell.

Shahidi, F., & Simpson, B. K. (2013). Seafood Processing: Technology, Quality and Safety. Wiley-Blackwell.

Sriket, P., Benjakul, S., & Visessanguan, W. (Eds.). (2014). Seafood Processing: Technology, Quality and Safety. Springer.

Sun, D. W. (2016). *Seafood Processing: Technology, Quality and Safety*. Springer.

4. FOOD SAFETY AND FOOD MICROBIOLOGY (Practical) (1 credit)

Course Outcome (CO) - After completing the course, students will be able to

CO1- Understand the principles of food safety and food microbiology

CO2- Demonstrate the ability to undertake basic and advanced food safety analysis

CO3- Apply the techniques for qualitative and quantitative food analysis

CO4- Apply the principles of HACCP in food industry

CO5- Apply the principles of food microbiology in food testing laboratories.

CO/PSO	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	2
CO2	3	3	2	2
CO3	3	3	2	2
CO4	3	3	3	2
CO5	3	3	3	3

Module 1: Introduction to Food Microbiology Laboratory

Laboratory safety guidelines and procedures. Introduction to microbiological media and reagents, Proper aseptic techniques and handling of microbial cultures, Calibration and use of laboratory equipment. Quality characteristics of water, ice and fish.

Module 2: Microbial Enumeration Techniques

Total plate count method for quantification of viable microorganisms in food samples, Pour plate and spread plate techniques for microbial enumeration, Calculation of microbial counts and determination of colony-forming units (CFU/g or CFU/mL), Interpretation of microbial growth on agar plates.

Module 3: Detection of Foodborne Pathogens

Bacterial Isolation-Isolation and identification of common bacterial foodborne pathogens: *Escherichia coli*, *Salmonella*, and *Staphylococcus aureus* etc. Enrichment and selective media for isolation of specific pathogens, Confirmation of bacterial isolates using biochemical tests and serological methods.

Module 4: Analysis of Food Spoilage Microorganisms

Isolation and enumeration of food spoilage microorganisms: yeasts, molds, and lactic acid bacteria. Selective media and conditions for the isolation of spoilage organisms.

Identification of common spoilage microorganisms using morphological and biochemical tests.

Module 5: HACCP

Preparation of HACCP manual. Determination of CCPs of fresh and processed food products. Hygiene and sanitation requirements and assessments. Analysis of food additives, chemical contaminants, physical hazards etc.

Suggested Readings

- Gopalakrishna Iyer, T.S, Kandoran, M.K, Mary Thomas & Mathew, P.T (2002) Quality Assurance in Seafood processing, CIFT, Cochin & Society of Fisheries Technologists, (India).
- Wheaton F.W. and Lawson T.B (1985) Processing of Aquatic Food Products, John Wiley & Sons .New York
- Huss .H.H (1994), Assurance of Seafood Quality, FAO Fisheries Technical paper – 33, FAO.
- Joan K. Loken (1995), The HACCP Food Safety Manual, John Wiley and Sons
- Connell . J.J (1980), Control of Fish quality. Fishing News Books Ltd., England.
- Quality Assurance in Seafood Processing, (2000) Society of Fisheries Technologists, (India) Cochin.
- Davies. R (1982) Developments in Food Microbiology, Applied Setl. London C. Alasavar & T. Taylor (2002), Seafoods-quality, Technology and Nutraceutical applications, Springer-Verlag Berlin .
- Surendran, P.K.. et.al (2003) Seafood Safety pp.662 Society of Fisheries Technologists (India) Cochin
- Surendran. P.K. et.al. (2006) Laboratory Manual on Microbiological Examination of Sea food, Central Institute of Fisheries Technology, Cochin.

5. INTERNSHIP IN SEAFOOD INDUSTRY AND REPORT EVALUATION (4 credit)

Course Outcome (CO) - After completing the course, students will be able to

- CO1. Apply principles of seafood supply chain management in real-world settings.*
- CO2. Evaluate and ensure seafood quality using sensory, microbiological, and biochemical analysis techniques.*
- CO3. Develop and implement Good Manufacturing Practices (GMP) and Hazard Analysis and Critical Control Points (HACCP) principles in seafood processing.*
- CO4. Demonstrate knowledge of waste management and effluent treatment methods specific to seafood processing units.*
- CO5. Acquire technical skills in seafood processing and marketing relevant to the industry.*

CO/PSO	PSO1	PSO2	PSO3	PSO4
CO1	2	3	3	3
CO2	3	3	3	2
CO3	3	3	3	2
CO4	2	3	3	3
CO5	3	3	2	3

Students are expected to have hands-on-experience on various aspects of supply chain in the production and marketing of seafood.

Students should undergo training in quality assurance and management including training in organoleptic quality, microbiology and bio-chemical analysis with respect to national and international standards.

Students should have thorough understanding on the GMP / HACCP and other quality management systems including preparation of HACCP manual and Export Documentation procedures.

Students should also learn waste management/ treatment practices and various systems of effluent treatment methods used in seafood processing units.

**

THIRD SEMESTER

24-386-0301 VALUE ADDITION IN FOOD PRODUCTS (4 Core)

Course Outcome (CO) - After completing the course, students will be able to

- CO1. Understand the concept and significance of seafood value addition, including its role in increasing product diversity and market competitiveness.*
- CO2. Apply appropriate techniques for handling and preprocessing seafood to maintain quality and safety.*
- CO3. Demonstrate proficiency in the production of cured fish products, minced fish, surimi-based products, battered, and breaded seafood products.*
- CO4. Understand the principles and applications of extrusion technology in seafood processing.*
- CO5. Apply food safety and quality assurance principles throughout the seafood value addition process.*

CO/PSO	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	1
CO2	3	3	2	3
CO3	2	3	1	3
CO4	1	2	1	1
CO5	3	3	2	3

Module 1: Introduction to Value Addition

Overview of food value addition: definition, importance, and scope, Market trends and consumer preferences in value-added seafood products, Principles of value addition: enhancing quality, extending shelf life, adding convenience, Factors influencing value addition in food, Current status and constraints of value addition in seafood, Future Trends in Value Addition, etc.

Module 2: Raw Material Handling and Preprocessing of Seafood

Organoleptic Evaluation Criteria, Organoleptic Evaluation of Raw Materials, Raw Material Receiving Quality, Calculation of Shrimp Count, Demonstration of Grading, Live Fish Quality Check, Condition of Carriage, De-icing and Washing, Sorting of Raw Materials, Re-icing, etc., Cleaning and Washing Techniques, Cutting and Filleting, Equipment and Machinery Used in Preprocessing- Overview of commonly used equipment (e.g., knives, scales, filleting machines), Maintenance and cleaning of equipment for safe use, storage of pre-processed seafood, waste management, etc.

Module 3: Minced Fish and Surimi Based Products

Importance of mince in seafood processing, Methods for preparing mince from different seafood species, Equipment and machinery for mince preparation, Quality considerations in mince production, freezing, and frozen storage of fish mince. Value-Added Products from Mince- fish balls, fish cakes, fish sausages, etc.

Surimi: basic concepts, process elements, washing process, strainer, dehydrator, cryoprotectants, freezing, and storage of surimi, Gel formation, gel structure, types of gels, and evaluation methods, Surimi-based products: kamaboko type products, fish burger, cutlet, texturised products, moulded products, formulated products, etc.

Module 4: Battered and Breaded Food Products

Introduction to Battered and Breaded food - Present and potential market for battered and breaded seafood, Principles and techniques for batter and breading in seafood, Ingredients for Battering Systems- Selection and properties of batter ingredients, Functionality of ingredients in batter systems, Flavorings and Seasonings in Battering and Breading Systems: Types and sources of flavorings and seasonings, Techniques for applying batters and breadings to fish, shrimp, and squid, Equipment for Battered and Breaded Seafood, Factors affecting adhesion and coating uniformity, Common issues and solutions in batter and breading processes, Production methods for specific battered and breaded seafood products.

Module 5: Extrusion Technology

Introduction to Extrusion Technology, Principles of Extrusion technology, Types of Extruders: Single screw extruders, Twin screw extruders, extruded seafood Products, Factors Affecting Extrusion: Moisture content in raw materials, Temperature and pressure profiles in the extruder, Effect of screw speed and residence time on product quality. Challenges and opportunities in extruded product development, Future trends in extrusion technology.

Suggested Readings:

- Balachandran, K. K. 2001. Post-harvest technology of fish and fish products. Daya Publishing House, New Delhi.
- Bligh, E. G. 1992. Seafood science and technology, Fishing News Books. Borgstrom, G. 1961. Fish as food Vol. I- IV Academic Press, New York.
- Gopakumar, K. 2002. Text book of Fish Processing Technology. Indian Council of Agricultural Research, New Delhi.
- Govindan, T. K. 1985. Fish processing technology. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
- Johnson, A. H. and Peterson M. S. 1974. Encyclopedia of Food Technology, Vol.1st and 2ndEdtn. Amerind Publishing Company, Pvt. Ltd, New Delhi.
- Proceedings on Summer Institute on Non-Traditional diversified fish products & by-products, CIFT, Cochin.
- Roller, T. and Christian. 1995. Water activity and food, Academic Press, London Seow, C.C. 1986. Food Preservation by moisture control, Elsevier Applied Science, New York.
- Wheaton, F.W. and Lawson, T. B. 1985. Processing of Aquatic Food Products. Wiley Publ. New York.
- Tiwari, B. K., Norton, T., & Holden, N. M. (Eds.). (2012). Advances in Food and Beverage Labelling: Information and Regulations. Woodhead Publishing.
- Rai, D. R., & Kaur, S. (Eds.). (2019). Value Addition of Horticultural Crops: Recent Trends and Future Directions. Springer.
- Nollet, L. M. L., & Toldrá, F. (Eds.). (2016). Handbook of Analysis of Edible Animal By-Products. CRC Press.
- Charis, M. (Ed.). (2016). Functional Food and Human Health. IntechOpen.
- Barbosa-Cánovas, G. V., & Juliano, P. (2005). Nonthermal Preservation of Foods. CRC Press.

24-386-0302 INTERNATIONAL MARKETING (3 Core)

Course Outcome (CO) - After completing the course, students will be able to

CO1- Understand international marketing concepts

CO2- Apply the international marketing strategies in food export

CO3-Analyse the challenges in food export to international markets

CO4-Evaluate the trends and position of India in international trade

CO5- Develop new marketing strategies for international marketing of food

CO/PSO	PSO1	PSO2	PSO3	PSO4
CO1	3	1	1	1
CO2	3	1	1	-
CO3	3	2	2	1
CO4	3	3	2	2
CO5	3	3	3	3

Module 1. Introduction International Marketing

Nature and significance - Transition from domestic and transnational marketing, International market orientation – ERPG framework- International Marketing Environment, Geographical, demographic, economic, socio-cultural, political and legal environment, International marketing information system

Module 2-Global Market Selection and marketing strategies

International market entry strategies -International market segmentation, Selection of foreign markets, International positioning. Global Product strategies- Standardization vs. Product adaptation, New product Development, Managing global distribution channels, Pricing for global markets, Global promotion strategies-Digital Marketing

Module 3- Indian seafood trade

The trends in International seafood trade-Major global markets for seafood, importers and exporters- India's share in international seafood trade- Indian seafood trade-Implications, issues and policy imperatives-Foreign trade policy- Exim policy, General provisions regarding imports and exports, Promotional Measures- Export Promotion Capital Goods (EPCG) Scheme. Seafood trade policies in India – Foreign trade policy supports for marine products exports, - ITC Code for marine products, Special focus initiatives in marine products trade, Sustainable Green Marketing.

Module 4- Access issues in International Markets

Complexities and regulations in International marketing- WTO, Free Trade Agreement (FTA), Sanitary and Phyto Sanitary (SPS) Measures and Technical Barriers to Trade (TBT), Tariff barriers- Antidumping Duty, Countervailing Duty (CVD), Rejections.

Non-tariff barriers (NTB) -Import bans, quotas, Complex/discriminatory Rules of Origin, Quality conditions imposed by the importing country on the exporting countries, SPS, Unreasonable packaging, labelling, product standards-eco labelling, catch certification

Module 5-Export Documentation and formalities for export Export Documents

- Contract/Order, INCO Terms, Invoices, Transport Documents- Bills of Lading, Airways Bill, Statutory Requirement: Excise, Customs and Port Formalities for Export Shipment, Foreign Exchange Rules, Document and Exchange Control. Statutory requirements; Excise, Customs and Port formalities for export shipment, Foreign exchange rules.

Method of payment in international trade; Documentary credit (Letter of credit) UCPDC 500. Negotiation of Export Bills and collection of sales proceeds, Pre-post shipment credits, bank guarantees.

Standardized Documentation through electronic mode, Introduction to ICEGATE, Bill of entry through ICEGATE system, Introduction to H S code of commodity classification. Duty drawback, Central Excise Rebate and Bond System, Income tax concessions and other tax incentives.

Procedural and Documentary formalities as per Import Policy of India for Duty Exemption Scheme EPCG, SEZ/100%EOU/EHTP/STP. Deemed Exports Status Holders (EH/TH/STH/SSTH)

Suggested Readings:

Czinkota, M.R. (2012). *International Marketing*, 10thEdn. Cengage Learning. Boston

Keegan, W.J.(1995). *Global Marketing Management*. Prentice Hall New Delhi.

Cherunilam, F. 2010. *International Marketing*, Himalaya Publishing House Ltd.12th edition.

Francis Cherunilam (2012). *International Trade and Export Management*, Himalaya Publishing House.

Sirachy, R. And V.Terpstra. (2006). *International Marketing*. Prentice Hall. New Delhi

Export Import Policy: Ministry of Commerce. Government of India

Cateora, Philip :*International Marketing* (Richard D Irwin)

Majaro, Simon: *International Marketing* (GeorgeAtten& Unwin)

24-386-0303 FOOD SAFETY MANAGEMENT SYSTEMS (4 Core)

Course Outcome (CO) - After completing the course, students will be able to

CO1- Understand the concepts and scope of food safety management system

CO2- Understand the different Food Safety Management Systems

CO3-Apply FSMS concepts in different food systems

CO4- Analyse the risks and challenges in implementing FSMS

CO5-Evaluate the documentations in food safety management systems

CO/PSO	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	2
CO2	3	1	2	2
CO3	3	2	2	2
CO4	3	1	1	2
CO5	3	2	2	2

Module 1 Introduction to Food Safety Management System

Concepts and Principles, Scope of Food Safety Management for organizations in the food chain, Food Safety Management Systems (FSMS), Codex Alimentarius, Hazard Analysis and Critical Control Points (HACCP), Quality Management Systems (QMS), International organization for standardization (ISO), ISO 9000 , ISO 22000, FSSC 22000, BRC Food, IFS Food, Dutch HACCP ,BRCGS, International commission on microbiological specifications for Food (ICMSF), Global food safety initiative (GFSI) and other proprietary standards- Standards and Clauses.

Food Safety and standards act of India 2006, Role of Bureau of Indian Standards (BIS), - Food safety laws and regulations, Regulatory agencies and their roles, Compliance and enforcement mechanisms, European union (EU) and United states Food and Drug Administration (USFDA) Food Safety Standards Authority of India (FSSAI)

Module 2 -Clauses in Food Safety Management Systems

Scope, Terms and Definitions, Food Safety Management System, Management Responsibility, Resource Management, Planning and Realization of Safe Products, Validation, Verification and Improvement of the FSMS

Module 3 - Management responsibility in FSMS

Implementation of Food safety management system - Trained team, hazard plan, prerequisite programs, comprehensive monitoring system, traceability system, and proper documentation. Business objectives of organisation, Management Commitment and evidence, define the scope. Products or product categories, processes and production sites, Establishing Food safety policy-system management, FSMS planning, preparing resources needed for ensuring food safety, Role definition , Food safety team leader, implementation and continual improvement of the food safety system.

Module -4 Prerequisite programs (PRPs)

Construction and lay-out of buildings and associated utilities, Lay-out of premises, including workspace and employee facilities, Supplies of air, water, energy and other utilities, Supporting services, including waste and sewage disposal, The suitability of equipment and its accessibility for cleaning, maintenance and preventive maintenance, Management of purchased materials, supplies (e.g. water, steam, ice etc.), disposals (e.g. waste and sewage) and handling of product (e.g. storage and transportation), Measures for prevention of cross contamination, Cleaning and sanitization, Pest control, Personnel hygiene

Module- Performance evaluation and documentation for audit

Human, financial and infrastructure resources to implement and maintain FSMS- Competence of personnel involved in FSMS- Awareness and training. Communication: Establishing effective internal and external communication processes related to food safety. Structured framework for organizations to establish, implement, maintain, and continually improve their food safety management systems, control of non conformity

Documentation for Internal and External Audit- Document FSMS, Management reviews; monitoring performance and metrics

Suggested Readings

Food Safety Management: A Practical Guide for the Food Industry" by Yasmine Motarjemi and Huub Lelieveld

Food Safety Management Systems: A Practical Approach" by Sara E. Mortimore and Carol Wallace

Food Safety Management Systems: Applications, Best Practices, and Compliance" edited by Debabrata Biswas:

Codex Alimentarius: Food Hygiene Basic Texts" by Codex Alimentarius Commission
Hazard Analysis and Critical Control Points (HACCP): Systematic Approach to Food Safety" by Gerald J. McDonnell and Sarah Louise Lees

Food Safety Handbook" by Richard Lawley, Laurie Curtis, and Judy Davis

HACCP/TACCP - Threat and vulnerability assessments - food fraud and food defence a practical guide by Campden BRI

ISO 22000:2018 Standard

FSSC22000 V 6 Standard.

Websites

<http://dgft.gov.in/>

<http://www.mpeda.com/>

<http://www.eicindia.gov.in/>

www.fssai.gov.in

24-386-0304 METHODS FOR SEAFOOD QUALITY EVALUATION (2 Core)

Course Outcome (CO) - After completing the course, students will be able to

- CO1. Understand the mechanism and factors influencing the fish spoilage*
- CO2. Demonstrate the factors responsible for the physical, chemical and microbiological quality of seafood*
- CO3. Apply sensory methods for fish quality assessment*
- CO4. Apply the biochemical methods for fish quality during fresh, chilled, frozen conditions.*
- CO5. Apply various instrumental techniques for seafood quality evaluation at laboratories and in seafood processing units.*

CO/PSO	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	1
CO2	3	3	3	1
CO3	3	3	2	2
CO4	2	3	2	1
CO5	2	2	1	1

Module 1:

Spoilage in fish- Physical, chemical, microbiological, Need to prevent fish spoilage, methods to retard or prevent spoilage. Post mortem changes in fish muscle glycolysis, rigor mortis. Changes in flavor, texture, protein, lipid etc. Melanosis and its prevention, Discoloration in aquatic products. Auto-oxidation- mechanism, role of antioxidants, synergistic and pro-oxidants, factors responsible for lipid oxidation in fish muscle. Storage methods and factors influencing the storage of fresh, chilled, frozen and canned products.

Module2:

Sensory evaluation: sensory characteristics, Sensory evaluation of fresh fish and fish products- basic aspects, different methods of evaluation, taste panel selection and constitution, statistical analysis. Sensory changes- texture, taste, odour, effect of post-mortem condition on sensory qualities, water holding capacity, time temperature tolerance, temperature and duration of storage on quality and shelf-life. Quality Index Method (QIM).

Module 3:

Chemical analysis of seafood. Determination of pH in fish muscle, factors influencing the changes in pH. Drip loss, calculation of drip loss. Quality analysis of pasteurized and canned products. Biochemical analysis of seafood: Lipid-protein interaction and their impact on quality. Methods of addressing lipid oxidation in fish and fishery products, methods of assessing oxidative and hydrolytic rancidity. Changes of nitrogen, volatile compounds, Ammonia, Trimethyl amino oxide, amino acids, peptides etc.

Module 4:

Instrumental techniques for seafood quality evaluation: Texture of fish muscle, significance of texture in seafood quality, texture profile analysis, factors influencing the texture of muscle foods., freshness tester, Torry meter, fat detector for seafood quality testing, advanced instruments for flavor testing, mechanism of flavor changes in seafood. Significance of colour of seafood, colour measurement. Rheology: Flow behavior of fluid system, Newtonian fluids, non-Newtonian fluids, deformation behaviour of solid food material, elastic behaviour, plastic behaviour, visco-elastic behaviour, strength of food material, applications. Measurement of properties of surimi Products, IQF products, AFD products, fish balls and paste.

Module 5:

Microbiological analysis: Factors influencing the microbial quality of seafood. Essential requirements for a microbiological laboratory. Quality characteristics of water, ice and fish. Sterilization, sample preparation for microbiological quality analysis, Spoilage bacteria and pathogenic bacteria. Methods of enumeration of bacteria. Media, colony characteristics, confirmatory tests. Limits of microorganisms in seafood for export. Molecular confirmation of bacterial strains. Advanced technologies for rapid detection of microorganisms in seafood for export. Microbiological quality evaluation of dried foods.

Suggested Reading

- Wheaton F.W and Lawson T.B (1985) Processing of Aquatic Food Products, John Wiley & Sons , New York.
- Huss H.H (1994), Assurance of Seafood Quality, FAO Fisheries Technical paper – 334, FAO.
- Joan K. Loken (1995), The HACCP Food Safety Manual, John Wiley and Sons.
- Connel J.J (1980), Control of Fish quality. Fishing News Books Ltd., England.
- Quality Assurance in Seafood Processing, (2000) Society of Fisheries Technologists, (India) Cochin.
- Hall G.M (1997), Fish Processing Technology, Blackie Academic & Professional New York.
- Davies. R (1982) Developments in Food Microbiology, Applied Set. London.
- Alasavar .C Taylor. T. (2002), Seafood -quality, Technology and Nutraceutical applications, Springer-VerlagBerlin.
- Herson.A.C. &Hulland. E. D. (1964) Canned Foods, An Introduction to their Microbiology.
- Da-wen Sun (2012), Handbook of frozen food processing and packaging, contemporary food engineering series, Taylor & Francis group.London.
- Herbert Stone & Joel L. Sidel (1985) Sensory evaluation practices- Food Science & Technology: A series of Monographs, Florida.
- Venugopal V.(2006) Sea food processing-Adding value through quick freezing, retortable packaging and Cook-chilling. CRC-Taylor & Francis group.

24-386-0305 MARKETING RESEARCH FOR SEAFOOD BUSINESS (3 Core)

Course Outcome (CO) - After completing the course, students will be able to

CO1. Understand the nature and scope of Marketing Research

CO2. Analyse and find out the apt research designs to be used in conducting marketing

CO3. Apply various qualitative research methods in solving marketing research problems in seafood business

CO4. Apply various Survey and Observation methods in solving marketing research problems in seafood business.

CO5. Apply various measurement and scaling technics to create appropriate data collection instruments.

CO/PSO	PSO1	PSO2	PSO3	PSO4
CO1	1	2	1	1
CO2	3	3	3	3
CO3	3	3	2	2
CO4	3	3	1	3
CO5	3	3	2	2

Module 1 Nature and scope of marketing research:

Overview of marketing research, Definition of Marketing Research, Classification of Marketing Research, Marketing Research Process, The Role of Marketing Research in Marketing Decision Making, Marketing Research and Competitive Intelligence, The Role of Marketing Research in MIS and DSS, International Marketing Research, Ethics in Marketing Research

Module 2 Research Design for Marketing Research:

Importance of Defining a Problem, The Process of Defining the Problem and Developing an Approach, Tasks involved in Problem Definition, Discussions with Decision Makers, Interviews with Industry Experts, Secondary Data Analysis, Qualitative Research. Research Design, Exploratory Research Design, Secondary and Syndicated Data, Exploratory Research Design, Descriptive Research Design, Causal Research Design: Experimentation.

Module 3 Conducting Qualitative Marketing Research:

Primary Data: Qualitative Versus Quantitative Research, Rationale for Using Qualitative Research Procedures, A Classification of Qualitative Research Procedures. Focus Group (FG) Interviews, Characteristics, Planning and Conducting Focus Groups, Telesessions and Other Variations , Advantages and Disadvantages of Focus Groups , Applications of Focus Groups, Online Focus Group Interviews, Advantages and Disadvantages of Online FGs, Depth Interviews, Characteristics, Techniques, Advantages and Disadvantages of Depth

Interviews , Applications of Depth Interviews, Projective Techniques, Association Techniques, Completion Techniques, Sentence Completion, Story Completion, Construction Techniques, Picture Response, Cartoon Tests, Expressive Techniques, Role Playing, Applications of Projective Techniques. Analysis of Qualitative Data

Module 4- Survey and Observation:

Overview, Survey Methods, Survey Methods Classified by Mode of Administration, Telephone Methods, Traditional Telephone Interviews, Computer-Assisted Telephone Interviewing (CATI), Personal Methods, Personal In-home Interviews, Mall-Intercept Personal Interviews, Computer-Assisted Personal Interviewing, Mail Methods, A Comparative Evaluation of Survey Methods, A Comparative Evaluation of Observational Methods, Observation Method, Structured Vs. Unstructured Observation, Disguised Vs. Undisguised Observation, Natural Vs. Contrived Observation, Ethnographic Research & Other Methods

Module 5: Measurement and Scaling :

Overview, Measurement and Scaling, Scales Characteristics, Primary Scales of Measurement, Nominal Scale, Ordinal Scale, Interval Scale, Ratio Scale, Comparative Scaling Techniques, Paired Comparison, Rank Order Scaling, Constant Sum Scaling, Q-Sort and Other Procedures. Noncomparative Scaling Techniques, Continuous Rating Scale, Itemized Rating Scale, Likert Scale, Semantic Differential Scale, Stapel Scale. Noncomparative Itemized Rating Scale Decisions, Number of Scale Categories, Balanced Vs. Unbalanced Scales, Odd or Even Number of Categories, Forced Vs. Non-forced Scales, Nature and Degree of Verbal Description, Physical Form or Configuration

Suggested Reading

Naresh K, Malhotra and Sathyabhusan Dash, (2019). Marketing Research, An applied orientation, Pearson Education Inc, 7th Edition.

Cooper Schindler, (2005). Marketing Research, Concepts and Cases, ,Tata McGraw-Hill.

David A Akar,V Kumar George S. Day, John Willy and Son (2012). Marketing Research, Inc. 6thEdition.

Donald R. Cooper (2013). Business research Methods, 12th Edition.

Gillbert.A, Churchill Jr.Dryden Press, (1999) Marketing Research Methodological Foundation.

Paul Green, Donald Tull, Gerald Albaum,(1988). Research for Marketing Decision.

24-386-0306 SUSTAINABLE AQUACULTURE FOR SAFE FOOD PRODUCTION (3 Core)

Course Outcome (CO) - After completing the course, students will be able to

CO1- Understand practices of major aquaculture practices.

CO2- Apply technologies for pre-stocking, stocking and post stocking management of Aqua-farms.

CO3- Design and construction of farms and cages depending on the species used and suitability of location.

*CO4- Apply advanced knowledge in production of safe seafood for export promotion
Contribute to aquaculture production enhancement.*

CO5- Design finfish and shellfish hatcheries and develop sustainable farming protocols.

CO/PSO	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	2
CO2	2	2	1	1
CO3	3	3	1	2
CO4	3	3	2	2
CO5	2	2	1	2

Module 1: Pre stocking and post stocking management preparation of ponds

Monitoring food availability – Primary and secondary production – aquatic food chain and ecological energetics – aquatic microbes- role of microbes in regeneration of nutrients. Assessing plankton production -supplementary feeding – water quality management–assessment of growth and standing crop.

Module 2: Nutritional requirements of fish and shellfish.

Feed formulations – farm made feeds - formulated feeds – square method –feed types- Feed properties evaluation-. Feed additives, binders and nutraceuticals ; Microbound-microencapsulated feeds- Storage properties of formulated feed- toxins in feed.

Use of chemicals in aquaculture – disinfectants, antibiotics, bioremediators, vaccines, immunostimulants, heavy metals, pesticides, biotoxins.

Module 3: Hatchery Technology

Finfishes- Indian major and minor carps, cichlids, Exotic carps, Catfishes, Tilapia, Masheer, Trout, etc. Marine fish seed production: Seabass, milkfish, mullets, sea breams, pompano, grouper, lutjanids, yellowtail, eel, cobia. Seed production of commercially important prawns, shrimps, crabs, lobsters, mussels, edible oysters, pearl oyster, scallops, clams; Diseases and their management in hatcheries.

Module 4: Farming of finfishes and shellfishes

Finfish aquaculture- carps, catfishes, seabass, milkfish, mullets, pearlspot, sea breams, rabbit fish, grouper, yellowtail, eel, cobia, salmon, flatfish .Fish diseases and control

Crustacean aquaculture- Shrimp farming: systems of farming, pond preparation, stocking, feed and water quality management, disease prevention and treatment; harvesting and handling; Mud crab fattening, production of soft shell crabs. Infectious bacterial and viral diseases: General characteristics, Epizootiology, Diagnosis, Prevention and treatment. Molluscan aquaculture: Present status and scope in India, culture of mussels, oysters, pearl oysters, scallops, clams, cockles, abalones, sea cucumber. Arming methods - Raft and rack culture off-bottom and on-bottom culture.

Module 5: Algae/Seaweed culture

Major seaweed species of commercial importance; methods of culture; farming of agar, algin, carrageenan yielding species; algal culture for food..

Suggested Readings:

- Azim, M.E., Verdegem, M.C.J., Van Dam, A.A., Beveridge, M.C.M. (eds.), 2005. Periphyton: Ecology, Exploitation and Management. CABI Publishing, UK, pp.325.
- Botkin, Daniel B. and Keller, Edward A, 2007. Environmental Science: Earth as a Living Planet. 6th ed. John Wiley & Sons, USA.
- Brisler, D.J. 2014. Organic aquaculture: the emergence of a new sustainable industry. Wiley-Blackwell; illustrated edition, ISBN-10: 0813826292, ISBN-13: 978-0813826295. P.224.
- Chen, Y., Avnimelech, Y. 1986. The role of organic matter in modern agriculture. Springer. ISBN-10: 902473360X, ISBN-13: 978-9024733606, 25; pp.324.
- Cutler, S.L, 1999. Environment Risks and Hazard. Prentice Hall of India, Delhi.
- Dash, S. K, 2007. Climate Change-An Indian Perspective. Centre for Environment Education and Cambridge University Press Pvt. Ltd., New Delhi.
- Eyhorn, F. 2007. Organic Farming for Sustainable Livelihoods in Developing Countries? The Case of Cotton in India, p.223.
- FAO, 2000. Code of conduct of responsible fisheries. ISBN 92-5-103834-5. Rome. p.41.
- Glasson, J. Therivel, R. and Chadwick, 2006. Introduction to Environmental Impact Assessment. Routledge, London.
- Groom, Martha J., Meffe, Gary K. and Carroll, C. Ronald, 2005. Principles of Conservation Biology.3rd ed. Sinaeur Associates, Inc., USA.
- Hardy, John T, 2003. Climate Change: Causes, Effects, Solutions. Wiley & Sons, USA.
- Harris, F, 2004. Global Environmental Issues. Wiley& Sons, Inc., USA.
- Hunter, Malcolm L., Jr., and Gibbs, James P, 2006. Fundamentals of Conservation Biology. 3rd ed. Wiley-Blackwell.
- Hutchinson, L. 2006. Ecological Aquaculture: A sustainable solution. Permanent Publications. ISBN-10: 1856230325, ISBN-13: 978-1856230322. p.160.
- Jeffries, M, 1997. Biodiversity and Conservation. 2nd ed. Routledge, UK.
- Jones, D. 2003. Organic Agriculture: Sustainability, Markets and Policies. CABI publishing. P.406.
- Kurup, B.M, 1995. Seed production and culture of *Labeodussumieri* (Val.) - An endangered indigenous carp of Kerala In: Technological Advancements in Fisheries (Eds. Hameed, M.S. and B.M. Kurup). 5-7th December, 1995, Cochin. pp: 37-46.
- Kurup, B.M., S. Sureshkumar and S. Prince, 1998. Preliminary observations on the larval rearing of *Macrobrachium rosenbergii* (de Man) using a two phase clear water system. In: Technological Advancements in Fisheries (Hameed M.S. and B.M. Kurup, (Eds.) Publ. No. 1 School of Industrial Fisheries, Cochin University of Science and Technology. pp: 1-7.

- Kurup, B.M., C.M. Nair and Binu Kuriakose, 1993. Preliminary observations on induced breeding of *Labeo dussumieri* (Val.) using carp pituitary extract and other hormones. Journal of Aquaculture Tropics 8: 255- 262.
- Kurup, B.M. and K. Ravindran, 2006. Sustain Fish. Proc. International Symp. on improved sustainability of fisheries 863 pp. SIF, CUSAT, India
- Kurup B.M. and M.R. Boopendranath, 2009. Ornamental Fish Breeding, Farming and Trade.139 pp. Dept. of Fisheries, Govt. of Kerala
- Laird, L., Kennedy, C., 1999. Risk management in aquaculture (Fisheries and aquaculture). John Wiley & Sons Inc. ISBN-10: 0471966290 ISBN-13: 978-0471966296. p.160.
- Lawson, T.B. 2011. Fundamentals of Aquacultural engineering. Springer. ISBN-10: 1461275784, ISBN-13: 978-1461275787, p.364.
- Mathias, J. A., Chares, A. T. Baotong, H. 1997. Integrated fish farming. CRC Press. ISBN 9781566702607. p.432.
- NIIR Board of Consultants and Engineers. 2003. Handbook of fisheries and aquaculture technology. Asia Pacific Business Press Inc. ISBN: 8178330792. p. 750.
- Petts, J. Handbook of Environmental Impact Assessment- Volume 1 and 2. Blackwell Publishers, UK 2005.
- Pillay, T.V.R. 2005. Aquaculture: Principle and practices. Wiley-Blackwell. ISBN: 978-1-4051-0532-3, p.640.
- Ramakrishnan, P.S. 2001. Ecology and sustainable development. National Book Trust, India. ISBN 8123736223, 9788123736228. p.198.
- Scarfe, D.A., Lee, C., O'Bryan, P. J. 2005. Aquaculture Biosecurity: Prevention, Control, and Eradication of Aquatic Animal Disease. Wiley-Blackwell. ISBN: 978-0-8138-0539-9p.182.
- Sharma, P.D, 1997. Ecology and Environment, Rastogi Publications, New Delhi.
- Stickney, R.R., McVey, J.P. 2002. Responsible marine aquaculture. CABI Publishing; First edition. ISBN-10: 0851996043 , ISBN-13: 978-0851996042 . p.416.
- Townsend, Colin R, 2007. Ecological Applications: Toward a Sustainable World. Wiley-Blackwell.
- Webster, C. D., Jana, B. B. 2003. Sustainable aquaculture: Global Perspectives. CRC Press; Ist edition. ISBN-10: 1560221046, ISBN-13: 978-1560221043. P. 365

ELECTIVES

1. INTERNATIONAL BUSINESS ENVIRONMENT AND FINANCE MANAGEMENT (3 credit)

Course Outcome (CO) - After completing the course, students will be able to

CO1. Understand then framework for analyzing international business environment

CO2. Understand Multinational Corporations and their involvement in International Business.

CO3. Apply the strategies formulated by MNCs for international business expansion.

CO4 Understand the structure of the International financial environment.

CO5 Understand foreign exchange management and analyse the exposure.

CO/PSO	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	2
CO2	3	2	1	2
CO3	1	2	3	3
CO4	2	1	2	3
CO5	2	2	2	3

Module 1- International Business Environment and Theoretical Foundations of International Business An overview, nature importance and scope Concept and relevance of International Business environment. Micro and Macro environment - Domestic, Foreign and Global environment- Analysis of Components of Foreign environment: Geographic, Economic and Financial, Demographic, Socio-cultural, Political, Legal, Ecological Environments, Theories of international trade, Current Trend and Issues in International Trade.

Module 2-Foreign Investment, Multinational Corporations and Regional Economic Integration

Types, motives, and effect, present structure of foreign direct investment with special reference to India. MNCs Nature, role, type and Operations, Global Competitiveness. Forms of integration, Regional economics, Grouping in practice - EU, NAFTA, ASEAN, SAARC and SAPTA. Major International economic co-operation.

Module 3-Strategic Analysis and Outsourcing.

Acquisition and Merger, Management of Joint ventures with special reference to India. Business Process Outsourcing, Nature and scope, meaning and importance- implications on India.

Module 4- International Financial Environment

Business Cycle, Overview of Financial system, Money and Capital market in India International Financial Management, International Monetary System- International

Financial Institutions and Development Banks- The Foreign Exchange Markets, Derivatives – Foreign Currency Options and Foreign Currency Futures- Balance of Trade, Balance of Payments, Structure-Disequilibrium in balance of payments.

Module 5- Managing Foreign Exchange Exposure

Management of Foreign Exchange Risk- Financial Management of Multinational Firm, Cost of Capital and Capital Structure of the Multinational Firm- Multinational Capital Budgeting- – Multinational Cash Management, International Banking- Euro Currency Market- Euro and its Implications for Indian Banking.

Suggested Readings:

Arora D. S.(2000). International Business: Issues Opportunities Techniques Case, Commonwealth Publishers,.

Ashghian,P & Ebrahimi,B (1900). International Business Economics, Environment and Management and Strategies, Grand Rapids,MI: Harper Collins.

Aswathappa, K., Business Environment for Strategic Management, Mumbai: Himalaya Publishing House

Beamish,Paul. Rpsenzweig, Philip M, Morrison, Allen J, Inkpen, Andrew.C., (2000).International Management: Text and Cases,4th Edition.McGraw-Hill College, Blacklick, Ohio, U.S.A.

Bhalla V K and S Shiva Rama,(2010). International Business, Environments and Management.Anmol Publications Pvt. Ltd. Pages 1069

Black and Sundaram, International Business Environment, New Delhi: Prentice Hall of India

Bosodersten,Geoffrey Reed,(1994). International Economics,St. Martins Press Business and Economics 714 Page.

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Donald A Ball, (2006). International Business: The Challenge of Global Competition,Cram101 Incorporated, Business & Economics.

Dutta, B. (2010). International Business Management: Text and Cases, New Delhi: Notes Excel Books.

Francis, C., International Business: Text and Cases, 3rd, Edition, Prentice-Hall of India Private Limited

John D Daniels and Lee H Radebaugh, (1999). International Business Environment and Operation Addison, Wesley, Business & Economics.

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John S Hodgson,Mark G, Herander (1983). International Economic Relations, Prentice Hall.

Mittal, V, Business Environment: Text and Cases, 2nd Edition, New Delhi: Excel Books

Peter H Lindert,(1982). International Economics, Published by Richard D Irwin.Inc. ILLinois.

Sheikh, S., Business Environment, New Delhi: Pearson Education

Vasudeva, P. K. (2010), International Trade: Text and Cases, New Delhi: Excel Books

Suggested reading

(International Finance Management)

Adhikary, M.,(2009).Global Business Management, New Delhi: Macmillan.

A.K. Seth, (2010).International Financial Management, Galgotia Publishing Co., Delhi.

Aswathappa, K.,(2014). Business Environment for Strategic Management, Mumbai: Himalaya Publishing House

Apte PG .(2008). International Financial Management, Tata McGrew Hill Education Pvt. Ltd.India.

- Arora D.S. (2000). International Business, Issues, Opportunities, Technique and cases Common Wealth Publication
- Bemish, Paul and Marrison Alleh,(2000). International Management Text and Cases, (4th Edition, 2000).
- Bhalla V.K (2000) . International Monetary Corporation, Anmol ,New Delhi.
Cherunilam, Francis, Business Environment, Mumbai: Himalaya Publishing House
- Gosh, Biswanath,(2003). Economic Environment of Business, New Delhi: South Asia Book
- Hill, C. W. L. International Business Competing in the Global Marketplace, 4th Edition, Tata McGraw-Hill Publishing Company Limited
- John Holland, (1993).“International Financial Management”, Basil Blackwell, London.
- Levi M(1900). International Financial Management and International Economy,McGrew Hill,Sigapore.
- Leslie Hamilton and Philip Webster (2015). The International Business Environment,)Oxford,Third edition
- Madure J (2012).International Financial Management, Cenage Learning,Publishers,11th ED,USA.
- Prakash G. Apte (2008).International Financial Management, Fifth Edition, Tata McGraw-Hill Education Pvt. Ltd.
- Ramu, S. S.(2005). International Business Environment & Management, New Delhi: Anmol Publication Pvt. Ltd.
- Redrignez, . Rita E.E. Carter, “International Finance Management”, Prentice Hall of India, Singapore.
- Shapiro, A.C.(2019), Multinational Financial Management, 11th Edition,Prentice hall of India.
- Sodersten BO (1980).International Economics; Macmillan London
- V.K. Bhalla & S. Shiva Ramu (2002). International Business Environment & Management, Anmol Publication Pvt.Ltd, New Delhi

2. ECONOMICS FOR SUSTAINABLE FOOD AND NUTRITION POLICY (3 credit)

Course Outcome (CO) - After completing the course, students will be able to

CO1. To explain, predict and evaluate food and nutrition policy using economic principles.

CO2. Explain and predict consumption, production and trade in agriculture and food markets, including regulation, taxation and enforcement of property rights in agriculture and food markets.

CO3. Discuss the global and national sustainable food and nutrition policy frameworks.

CO4. Analysis of National Nutrition Policy and Strategies of India.

CO5 Evaluate Role of economic factors in shaping food safety regulations, food and Nutrition policies.

CO/PSO	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	3
CO2	3	3	2	3
CO3	2	3	3	3
CO4	2	2	3	2
CO5	3	3	2	3

Module 1- Introduction to Food Policy and Governance

Overview of policy frameworks and Regulatory structures, Macroeconomics, National Income and Aggregates, Measures of economic welfare, poverty, unemployment, inflation and business cycle. Macroeconomic interface of Fiscal Policy and Monetary policy, food policy and nutrition policy, Government regulation, taxes and subsidies in food markets. Case studies of successful strategies around the world such as taxing foods with a high carbon footprint, subsidizing sustainable sea farming, reforming health systems to nutrition based care.

Module 2 - Behavioural economics

Food consumption behaviour, budget constraints, producer and consumer surplus, purchasing power, Farm production, food trade and market prices, Market equilibrium and social welfare in the food system, market conditions needed for perfect competition in food supply, behaviour of individuals and firms in monopolies and other market structures , welfare consequences of externalities, environmental damage. Market failure and collective action.

Module 3 Sustainable Food and Nutrition Policy

Overview of sustainable food management principles and approaches, SDG goals, Sustainable food system concepts and frameworks, three pillars of sustainability. Economic - profits, tax revenues, food supply, Social- cultural traditions, Nutrition and health workers rights and safety, animal health institutions. Environmental – Carbon footprint, water footprint, water health, soil health. Food loss and waste, bio-diversity, toxicity, inclusive growth, green growth and eco social progress. The food system and development paradigm.

Module 4 National Nutrition Policy and Strategies of India

Nutrition and food assistance programs, Nutritional Policies and Programs, Rural vs. Urban Disparities in Nutritional Access, promotion of Nutrient-Rich Indigenous Foods, Nutrition Education and Behaviour Change, Urbanisation and Changing Dietary Patterns, Public-Private Partnerships in Nutrition Programs. Analysis of National Nutrition Policy and Strategies of India, International organisations ensuring food security, Case studies illustrating the effectiveness of national food safety policies in ensuring food safety and trade compliance

Module 5- Emerging Issues and Future Directions in Food Policy

Exploration of challenges and opportunities in food safety and trade policy, Analysis of policy responses to emerging food safety risks, Discussion on innovative policy tools and governance mechanisms for enhancing food safety, sustainability, and trade, Discussion on the economic, environmental, and social implications of food management policies and their impact on food trade dynamics. Forecasting future trends in food policy and their implications for the food industry.

Suggested Readings

- Malthus, Thomas Robert. *An Essay on the Principle of Population*. 1872.
- Krugman P, Wells R. *Microeconomics*. 2012.
- Ahuja HL. 2007. *Macroeconomics: Theory and Policy*. S.Chand & Co.
- Collier Macmillan Dornbusch. 2006. *Macroeconomics* McGraw Hill Publication.
- Deepashree VA. 2012. *Macroeconomics* (5th Ed). New Delhi: Ane Books Pvt. Ltd.
- Eugene A Diulio. 2006. *Macroeconomics*. 4 Ed. Schaums' Outlines.
- Gardner Ackely. 1987. *Macro-Economic: Theory and Policy*. Macmillan Publishing Co., Inc., New York.
- Thomas F Dernburg. *Macro-economic-Concepts, Theories and Policies*, McGraw Hill Book, Company, London.
- Walsh EC. 2010. *Monetary: Theory and Policy* (3rd Ed.). New Delhi: PHI Learning Private Limited.
- Bolos LA, Lagerkvist CJ, Nayga RM. *Consumer Choice and Food Waste: Can Nudging Help? Choices*. 2019
- Gouel C, Guimbard H. *Nutrition Transition and the Structure of Global Food Demand*. *American Journal of Agricultural Economics*. 2019; 101(2): 383-403. (<https://doi.org/10.1093/ajae/aay030>) (20 pages)
- Nguyen H. *Sustainable Food Systems Concept and Framework*. Food and Agriculture Organization of the United Nations. 2018. (<http://www.fao.org/3/ca2079en/CA2079EN.pdf>)
- Willett W, Rockstrom J, Loken B, et al. *Food in the Anthropocene: the EAT-Lancet Commission on healthy diets from sustainable food systems*. *Lancet*. 2019; 393: 447- 492.
- Borras, A. M., & Mohamed, F. A. (2020). *Health Inequities and the Shifting Paradigms of Food Security, Food Insecurity, and Food Sovereignty*. *International Journal of Health Services*, 0020731420913184.
- Dasgupta, R., Ahuja, S., & Yunnam, V. (2014). *Can nutrition rehabilitation centres address severe malnutrition in India?* *Indian paediatrics*, 51(2), 95-99.
- De Onis, M., Blossner, M., & World Health Organization. (1997). *WHO global database on child growth and malnutrition* (No. WHO/NUT/97.4). World Health Organization

Dev, M.S. (2012). Agriculture-nutrition linkages and policies in India. Indira Gandhi Institute of Development Research, Mumbai. Retrieved from <http://ebrary.ifpri.org/cdm/ref/collection/p15738coll2/id/126931>

Fan, S.(2019, Nov 19). Some lessons from a Lessons in Food Policy. International Food Policy Research Institute. Retrieved from <http://www.ifpri.org/blog/some-lessons-life->

Food policy paradigm - 17 - Historical aspects of the green revolution and food consumption behaviour - 18 - Food insecurity during British Imperialism– 19 5 - Food insecurity in the era of globalization and Food Sovereignty- 20

3. VALUE ADDED PRODUCTS TECHNOLOGY (Practical) (1 credit)

Course Outcome (CO) - After completing the course, students will be able to

- CO1. Demonstrate proficiency in preparing dressed seafood and a variety of value-added products.
- CO2. Apply mincing techniques to produce surimi and create fish-based products like fish fingers and fish sausage.
- CO3. Create paste-based products such as fish balls and fish paste.
- CO4. Create marinated seafood products and understand their role in flavor enhancement and shelf life extension.
- CO5. Apply preparation techniques of battered and breaded seafood products, including fish, squid, and shrimp, while ensuring quality and meeting consumer expectations.

CO/PSO	PSO1	PSO2	PSO3	PSO4
CO1	2	3	2	3
CO2	2	3	1	2
CO3	3	3	2	3
CO4	3	2	1	3
CO5	3	3	2	3

Module 1

Introduction to Seafood Product Development. - Overview of value-added seafood products, Importance of product development in the seafood industry

Module 2:

Preparation of Dressed Seafood: Techniques for dressing and presenting seafood products, - Practice in preparing dressed seafood items

Module 3:

Value-Added Seafood Products: - Preparation of fish mince and its applications; - Preparation of fish and prawn cutlets, balls, fish fingers, etc. - Preparation of breaded fish and seafood pickles. Battered and Breaded Products - Preparation of battered and breaded fish-based products, - Preparation of squid (breaded squid rings, squid cut rings) - shrimp (butterfly sushi shrimp, cooked PDTO, cooked and peeled shrimp, skewers). Quality

Determination of Battered and Breaded Products - Methods for assessing the quality of battered and breaded seafood products - Factors affecting the quality of these products.

Module 4:

Mince-Based Fish Products: - Production of surimi and its uses, - Preparation of fish fingers and fish sausage

Module 5:

Marinated Products, - Techniques for marinating seafood products.

Suggested readings:

Alasalvar C, Miyashita K, Shahidi F, Wanasundara U. Handbook of Seafood Quality, Safety, and Health Applications. John Wiley & Sons; 2010.

Bremner HA, editor. Safety and quality issues in fish processing. Woodhead Publishing; 2002.

CIFT, 1981. Proceedings on Summer Institute on Non-Traditional diversified fish

Gopakumar, K. 1993. Fish packaging technology. Concept Publishing Company,

Gopakumar, K. 2002. Text book of Fish Processing Technology. Indian Council

Hartmut, R. and Jorg, O. 2009. Fishery products: quality, safety and authenticity. New Delhi.

Shahidi F, (2014) editor. Seafood Processing: Technology, Quality and Safety. John Wiley & Sons.

Wheaton, F. W. and Lawson, T. B. 1985. Processing of Aquatic Food Products.

Rai, D. R., & Kaur, S. (Eds.). (2019). Value Addition of Horticultural Crops: Recent Trends and Future Directions. Springer.

Nollet, L. M. L., & Toldrá, F. (Eds.). (2016). Handbook of Analysis of Edible Animal By-Products. CRC Press.

Charis, M. (Ed.). (2016). Functional Food and Human Health. IntechOpen.

Barbosa-Cánovas, G. V., & Juliano, P. (2005). Nonthermal Preservation of Foods. CRC Press.

4. ANALYTICAL METHODS IN AQUACULTURE (Practical) (1 Elective)

Course Outcome (CO) - After completing the course, students will be able to

CO1- Develop identification skills for the finfishes and shellfishes used in aquaculture,

CO2- Acquire expertise to analyze various physico-chemical and biological parameters of water and soil

CO3- Understand different types of diseases in aquaculture systems and their diagnostic methods

CO4- Skill to formulate feed and analyze different properties of feeds used in aquaculture

CO5- Master the skill of making different types of aquaculture systems

CO/PSO	PSO1	PSO2	PSO3	PSO4
CO1	2	2	1	2
CO2	-	-	-	1
CO3	3	2	1	2
CO4	2	2	1	2
CO5	2	2	1	2

Module 1:

Identification of finfishes and shellfishes used in aquaculture

Module 2:

Equipment used in soil and water analysis; Soil sampling, determination of soil moisture and bulk density; Measurements of temperature, pH, conductivity, salinity, transparency, turbidity and solids; Analyses of dissolved oxygen, alkalinity and hardness, phosphorus, nitrogen; Estimation of primary productivity and chlorophyll; Application of fertilizers and pond liming; Design and operation of biological filters.

Module 3:

Formulation and preparation of a balanced fish feed; feeding trials; proximate analysis- moisture, crude protein, crude lipid, ash, Estimation of crude fibre. Different kinds of fertilizers, manures, and fertilizers used in aquaculture

Module 4:

Major diseases – etiology – symptoms- treatment

Module 5:

Setting up of model recirculatory system, aquaponic system, aquarium, aquascaping

Suggested readings

Adhikari S & Chatterjee DK. 2008. Management of Tropical Freshwater Ponds. Daya Publ.
APHA, AWWA, WPCF. 1998. Standard Methods for the Examination of Water and Wastewater, 20thEd. American Public Health Association, American Water Works Association, and Water Pollution Control Federation, Washington, D. C.
Boyd, C. E. and Tucker, C. S. 1992. Water Quality and Pond Soil Analysis for Aquaculture, Alabama Agricultural Experimental Station, Auburn University.
Boyd CE. 1979. Water Quality in Warm Water Fish Ponds. Auburn University.
CRC Handbook of Mariculture. 1993. Vol. I. Crustacean Aquaculture (2nd Edition). J.P. McVey (Ed.). CRC Press, Inc., Boca Raton, Florida, USA. 526p. p.61-93.
FAO. 2007. Manual for Operating a Small Scale Recirculation Freshwater Prawn Hatchery. 8-18pp.
Guillame J, Kaushik S, Bergot P & Metallier R. 2001. Nutrition and Feeding of Fish and Crustaceans. Springer Praxis Publication.
Hertrampf, J.W and Pascual F.P. 2000. Handbook on Ingredients for Aquaculture Feeds. Kluwer. 573p

- Halver J & Hardy RW. 2002. Fish Nutrition. Academic Press.
- Halver JE & Tiews KT. 1979. Finfish Nutrition and Fish Feed Technology. Vols. I, II Heenemann, Berlin.
- Hertrampf JW & Pascual FP. 2000. Handbook on Ingredients for Aquaculture Feeds. Kluwer.
- Houlihan D, Boujard T & Jobling M. 2001. Food Intake in Fish. Blackwell.
- ICAR. 2006. Handbook of Fisheries and Aquaculture. ICAR.
- Lavens P & Sorgeloos P. 1996. Manual on the Production and Use of Live Food for Aquaculture. FAO Fisheries Tech. Paper 361, FAO.
- Lovell RT. 1998. Nutrition and Feeding of Fishes. Chapman & Hall.
- New MB. 1987. Feed and Feeding of Fish and Shrimp. A Manual on the Preparation and Preservation of Compound Feeds for Shrimp and Fish in Aquaculture. FAO – ADCP/REP/87/26.
- Parsons TR, Maita Y & Lalli CM. 1984. A Manual of Chemical and Biological Methods for Seawater Analysis. Pergamon Press.
- Pillay, T.V.R and Kutty M.N. 2005. Aquaculture: Principles and Practices. 2nd Ed. Blackwell. P-640p
- Rajagopalsamy CBT & Ramadhas V. 2002. Nutrient Dynamics in Freshwater Fish Culture System. Daya Publ. Sharma LL,
- Sharma SK, Saini VP & Sharma BK. (Eds.). 2008. Management of Freshwater Ecosystems. Agrotech Publ. Academy

**

FOURTH SEMESTER

24-386-0401 ANALYTICS FOR DECISION MAKING IN SEAFOOD BUSINESS AND RESEARCH (3 Core)

Course Outcomes

CO1. Understand the basic concept of Data management

CO2. Apply various techniques for generating descriptive statistics and visualisation

CO3. Apply parametric and non-parametric tools for decision making

CO4. Apply advanced analytical tools for decision making

CO5. Apply multivariate tools for decision making

CO/PSO	PSO1	PSO2	PSO3	PSO4
CO1	3	1	1	2
CO2	3	1	-	1
CO3	3	1	-	1
CO4	3	1	-	1
CO5	3	1	-	1

Module 1: Introduction to Data Management

Introduction to various analytical software and its features. Importing data from different file formats. Data cleaning and preparation techniques. Data transformation and recoding procedures. Variable selection and filtering

Module 2: Descriptive Statistics and Data Visualization using software

Generating descriptive statistics. Generating frequency distributions and histograms. Creating bar charts, pie charts, and scatter plots. Customizing chart properties and formatting options. Using multiple templates for graphical representation. Interpretation of descriptive statistics and graphical summaries

Module 3: Inferential Statistics: Parametric Tests and Non Parametric Tests using software

Assumptions and limitations of parametric tests. Performing t-tests for comparing means of two groups. Conducting one-way and factorial ANOVA. Performing simple and multiple linear regression analysis. Interpretation of output and drawing conclusions from parametric analyses. Performing non-parametric tests (e.g., Mann-Whitney U test, Kruskal-Wallis test).

Module 4: Inferential Statistics: Advanced Techniques using software

Understanding correlation: definition and significance. Types of correlation coefficients (e.g., Pearson, Spearman). Running the correlation analysis. Interpreting correlation coefficients: strength and direction of relationships. Understanding regression analysis: concepts and applications. Types of regression models (e.g., simple, multiple). Assumptions of regression analysis. Data preparation. Checking linearity. Running the test and interpretation of the output.

Module 5: Multivariate Analysis using software

Data considerations for Factor Analysis. Applying factor analysis to derive factors. Data considerations for conducting conjoint analysis. Running the test and interpreting the results. Time series analysis techniques (e.g., forecasting, decomposition).

Suggested Reading

Business Analytics for Decision Making 1st Edition, Kindle Edition by Regi Mathew 2024, Pearson

Statistical Methods for Research: A Step-by-Step Approach Using IBM SPSS Paperback – 1 January 2021 by K. Kalyanaraman; Hareesh N. Ramanathan; P.N. Harikumar, 2021, Atlantic.

EXCEL 2024: The All In One Step-by-Step Guide From Beginner To Expert. Discover Easy Excel Tips & Tricks to Master the Essential Functions, Formulas & Shortcuts to Save Time & Simplify Your Job by Mike Wang. 2024, Amazon.

R Programming: R Basics for Beginners: 1 Paperback –2023 by Andy Vickler (Author). Ladoo Publishing LLC

DATA ANALYSIS USING SPSS: Text and Cases, For Researchers, Teachers and Students Paperback – 1 January 2022 by Dr. Lalit Prasad (Author), Dr. Priyanka Mishra (Author). Nirali Prakashan

24-386-0402 DISSERTATION/PROJECT REPORT EVALUATION (8 Core)

Course outcome:

- CO1: Demonstrate a comprehensive understanding of the current issues, challenges, and trends in seafood safety regulations, international trade policies, and market dynamics through their project report.*
- CO2: Explain the complex relationships between various stakeholders in the seafood industry, including government agencies, regulatory bodies, producers, distributors, and consumers, as evidenced in their project report.*
- CO3: Apply their knowledge and analytical skills to assess the effectiveness of existing seafood safety management systems and trade policies in ensuring the quality and safety of seafood products, as demonstrated in their project report findings and recommendations.*
- CO4: Critically analyze data, case studies, and relevant literature to identify patterns, trends, and gaps in seafood safety and trade practices, utilizing various analytical frameworks and methodologies in their project report.*
- CO5: Synthesize their research findings and propose innovative strategies, interventions, or policy recommendations aimed at enhancing seafood safety standards, facilitating international trade, and promoting sustainable practices in the seafood industry, as outlined in their project report.*

CO/PSO	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3
CO2	3	3	3	3
CO3	3	3	3	3
CO4	3	3	3	3
CO5	3	3	3	3

The project report for the fourth semester of the Master of Fisheries Science (MFSc) program in Seafood Safety and Trade represents the pinnacle of students' academic exploration and practical application within the field. Over the course of their program, students delve deep into the intricate web of seafood safety regulations, international trade dynamics, and

sustainable practices shaping the global seafood industry. In their final semester, they embark on a comprehensive research endeavor, selecting a specific aspect of seafood safety or trade for in-depth analysis. Through meticulous research methodologies, including literature reviews, data analysis, and case studies, students examine pressing issues such as foodborne pathogens, regulatory compliance, market access barriers, or environmental sustainability, with a keen eye toward proposing innovative solutions and policy recommendations.

The project report serves not only as a testament to students' academic rigor and critical thinking abilities but also as a blueprint for industry stakeholders, policymakers, and researchers grappling with the multifaceted challenges of seafood safety and trade. By synthesizing theoretical knowledge with practical insights gained through internships, fieldwork, and industry collaborations, students demonstrate their readiness to tackle real-world complexities and drive positive change within the seafood sector. Through their project reports, they contribute valuable perspectives and evidence-based strategies that advance the collective goal of ensuring safe, sustainable, and equitable seafood production, trade, and consumption on a global scale.

24-386-0403 COURSE VIVA-VOCE (1 Core)

The viva voce examination in the fourth semester of the Master of Fisheries Science (MFSc) program in Seafood Safety and Trade represents a crucial milestone in students' academic journey, providing a platform for them to demonstrate their comprehensive understanding, critical thinking skills, and ability to articulate complex ideas in the field. During the viva voce, students engage in a structured oral examination conducted by a panel of faculty members and industry experts, where they are questioned on various aspects of seafood safety regulations, international trade dynamics, market trends, and sustainability practices. Through probing inquiries and interactive dialogue, students are evaluated on their depth of knowledge, analytical acumen, and ability to integrate theoretical concepts with practical insights gleaned from coursework, research projects, and industry experiences.

The viva voce not only serves as a rigorous assessment tool but also as an opportunity for students to showcase their expertise and passion for advancing seafood safety and trade practices. By confidently defending their project findings, explaining their methodological approach, and engaging in scholarly discourse with the examination panel, students demonstrate their readiness to become thought leaders and change agents within the seafood industry. Moreover, the viva voce fosters professional development by honing students' communication skills, critical thinking abilities, and capacity to navigate complex interdisciplinary challenges, thereby equipping them with the competencies needed to excel in diverse career pathways within the global seafood sector.

ELECTIVES

1. INTERNSHIP IN SEAFOOD INDUSTRY AND REPORT EVALUATION (4 credit)

Course Outcome

CO1. Apply principles of seafood supply chain management in real-world settings.

CO2. Evaluate and ensure seafood quality using sensory, microbiological, and biochemical analysis techniques.

CO3. Develop and implement Good Manufacturing Practices (GMP) and Hazard Analysis and Critical Control Points (HACCP) principles in seafood processing.

CO4. Demonstrate knowledge of waste management and effluent treatment methods specific to seafood processing units.

CO5. Acquire technical skills in seafood processing and marketing relevant to the industry.

CO/PSO	PSO1	PSO2	PSO3	PSO4
CO1	2	3	3	3
CO2	3	3	3	2
CO3	3	3	3	2
CO4	2	3	3	3
CO5	3	3	2	3

Students are expected to have hands-on-experience on various aspects of supply chain in the production and marketing of seafood.

Students should undergo training in quality assurance and management including training in organoleptic quality, microbiology and bio-chemical analysis with respect to national and international standards.

Students should have thorough understanding on the GMP / HACCP and other quality management systems including preparation of HACCP manual and Export Documentation procedures.

Students should also learn waste management/ treatment practices and various systems of effluent treatment methods used in seafood processing units.

2. STARTUPS AND BUSINESS INCUBATION IN FOOD INDUSTRY

(1 Elective)

CO1: An understanding of the underlying principles and concepts behind startup ventures and business incubation in the seafood industry.

CO2: Evaluate the effectiveness and impact of startup and incubation programs in fostering entrepreneurship and economic development in the seafood sector

CO3: Develop creative solutions and proposals for enhancing startup support and business incubation initiatives in seafood sector

CO/PSO	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3
CO2	3	3	3	2
CO3	3	3	3	2

This exciting elective course on Startups/Business Incubation Initiatives in Fisheries is specifically designed for students who harbor a passion for entrepreneurship and aspire to make a splash in the dynamic world of fisheries.

In today's rapidly evolving business landscape, entrepreneurship presents a gateway to creativity, innovation, and impactful change. This elective offers a unique opportunity to channel the entrepreneurial spirit into the realm of fisheries, a sector ripe with potential for disruption and growth.

This course combines technical expertise with business acumen, providing the students with the necessary tools to thrive as fisheries entrepreneurs. Whether envisioning launching their own startup or exploring business incubation opportunities, this course is tailored to fuel students' entrepreneurial ambitions.

The experienced instructors from the school and the industry experts are committed to providing mentorship and support, ensuring that the students have access to the resources and guidance needed to transform ideas into successful ventures.

3. MASSIVE OPEN ONLINE COURSE (MOOC) (2 credit)

Students are expected to successfully complete one MOOC from UGC Swayam/NPTEL/Other online courses of repute conducted by national/international universities/institutes.
