Choice Based Credit System

Scheme & Syllabus of

Master of Science in Food Technology

M.Sc. Food Technology

Batch 2024 onwards

By

Board of Study Food Science and Engineering

Department of Academics

I.K. Gujral Punjab Technical University

Vision:

To create competent professionals those, contribute towards the economic development of the nation by going in line with the policy of Government of India in the field of food processing food safety and security.

Mission:

- Development of human resources in the field of food science and technology to serve the cause of the nation
- Providing a strong theoretical and practical background across the food science discipline with an emphasis on developing sustainable resources to cater to food and nutrition-related challenges
- Development of human resources in the area of clinical nutrition and research to contribute effectively to making India healthy
- Create a favorable environment for innovation to translate theoretical knowledge into practical applications
- Inculcating professional ethical values, innovative research capabilities, and leadership abilities
- Holistic development of the youth through the process of self-evaluation and continuous improvement

Program Name:	Master of Science in Food Technology **Or** M.Sc. in Food Technology
Program Level	Postgraduate (PG) Program
Duration	2 years (4 Semesters)
Eligibility for Admission	Passing of Bachelor of Science / Applied Science in any subject/ B. Tech Food Technology / Biotechnology/ Sugar Technology/ Sugar and Alcohol Technology/ Fermentation Technology / Dairy Technology/ B.Voc. Food Science and Technology or any Allied Field/Agri-Food Technology/Food Processing/ Bachelor in Hotel Management and Catering Technology or any other examination recognized equivalent thereto with atleast 50% marks in aggregate
Year of Implementation	New Syllabus will be implemented from 2024 onwards.
Medium of Instruction	English

Program Education Objectives (PEOs):

POE1	**Technical Proficiency:** Students will demonstrate advanced knowledge and technical skills in food technology, encompassing food processing, preservation, and safety, enabling them to address complex challenges in the food industry.
POE2	**Research and Innovation:** Students will engage in cutting-edge research and innovation, contributing to the development of sustainable and efficient food technologies, while keeping abreast of emerging trends and scientific advancements.
POE3	**Professional Development**: Students will exhibit strong leadership, ethical practices, and effective communication skills, preparing them for successful careers in academia, industry, and regulatory bodies within the food sector.
POE4	**Global Competence:** Students will be equipped with a global perspective on food technology issues, understanding international standards, regulations, and market dynamics, allowing them to thrive in diverse and multicultural environments.
POE5	**Problem-Solving Excellence in Food Science and Technology:** Students will possess the capability to identify, formulate, and solve complex problems in food science and technology, ensuring innovative and effective solutions for industry challenges.

Program Outcomes (POs):

PO1	Students will demonstrate advanced knowledge and technical skills in food technology, focusing on food processing, preservation, and safety to tackle industry challenges.
PO2	Students will engage in cutting-edge research, developing sustainable and efficient food technologies, and staying updated with emerging scientific advancements.
PO3	Students will exhibit strong leadership, ethical practices, and effective communication, preparing for careers in academia, industry, and regulatory bodies.
PO4	Students will understand international food technology standards, regulations, and market dynamics, thriving in diverse and multicultural environments.
PO5	Students will have ability to identify, formulate, and solve food science and technology problems

Mapping of Program Outcomes with Program Education Objectives: -

POE / PO	POE1	POE2	POE3	POE4
PO1	**3**	**2**	**1**	**1**
PO2	**2**	**3**	**1**	**1**
PO3	**1**	**1**	**3**	**2**
PO4	**1**	**1**	**2**	**2**
PO5	**1**	**1**	**2**	**3**

Course Type Coding:

DSC	Discipline Core
DSE	Discipline Elective
QP-NOS	Qualification Pack - National Occupational Standards.
SEC-SB	Skill Enhancement Course- Skill Based
SEC-VB	Skill Enhancement Course- Value Based
AECC	Ability Enhancement Course
OE	Open Elective

Important Notes:

1. Theory courses will be of 04 hours and practical will be of 04 hours duration per week. For all lecture courses, one credit per lecture/week/semester will generally be adopted. One laboratory hour per week per semester will be assigned half credit.
2. No elective course will be run unless the number of students registered for the elective course is five or more.

Table of content

SEMESTER- I

Program Scheme & Syllabus

Semester I

Course Code	Course Title	Course Type	Load			Marks Distribution		Total	Credits
			L	T	P	Internal	External		
MSFT411-24	Principles of Food Science	DSC	4	0	0	40	60	100	4
MSFT412-24	Food Processing & Preservation	DSC	4	0	0	40	60	100	4
MSFT413-24	Food Analysis and Preservation (Lab)	DSC	0	0	4	30	20	50	2
MSFT414-24	Food Microbiology	DSC	4	0	0	40	60	100	4
MSFT415-24	Food Microbiology (Lab)	DSC	0	0	4	30	20	50	2
FIC/Q9005	Industrial Production Worker – Food Processing[#]	QP-NOS	4	0	0	40	60	100	4
SEC111-24	Digital Fluency	SEC-SB	4	0	0	40	60	100	4
SEC112-24	Digital Fluency (Lab)	SEC-SB	0	0	4	30	20	50	2
MSFT416-24	Industrial Visit and FoSTaC course	AECC	0	0	3	40[##]	--	40	3
	Total		**20**	**0**	**15**	330	360	690	29

[#] Students will learn the practical application of Industrial Production Worker – Food Processing skills in the food industry through industrial visits in first semester and summer training after their first year.

FoSTaC - Basic Manufacturing course must be completed from https://www.skillindiadigital.gov.in/home or any FSSAI recognized Training center

MSFT411-24: Principles of Food Science

Total marks: 100	**L**	**T**	**P**
	4	**0**	**0**

Course objective:

Introduce students to the fundamentals of food science, including its historical development and composition, structure, and nutritional value of foods derived from plants and animals.

Course outcome: At the end of the course, the students will be able to

CO1	Explain the basics of food science and technology, and the status of the food industry in India and globally.
CO2	Analyze the functions and changes of nutrients during food processing and storage.
CO3	Describe the properties of water and its impact on food quality and spoilage.
CO4	Evaluate the composition, nutritional value, and processing techniques of plant-based foods.
CO5	Assess the composition, nutritional value, and processing effects on animal-based foods and understand the concept of healthy foods.

Mapping of Course Outcomes with Program Outcomes: Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)

PO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	2	1	3	2
CO2	3	3	2	2	3
CO3	2	2	1	1	3
CO4	3	2	2	2	3
CO5	3	2	2	2	3

Details of the Course Content - Principles of Food Science (MSFT411-24)

Unit	Contents	Contact Hours
I	**Introduction to Food Science and Fundamentals** **1. Introduction to Food Science, Food Technology, and Food Engineering:** Overview of food science, its importance, and interdisciplinary nature; Distinctions and interrelationships between food science, food technology, and food engineering **2. Status of the Food Industry in India and Abroad:** Current trends and statistics of the food industry in India; Comparison with global food industry trends; Key challenges and opportunities in the food industry **3. Nutrients and Functions of Food:** Carbohydrates, Proteins, Lipids, Vitamins, Minerals**:** Types, functions, dietary sources, importance in the diet, and Changes in nutrient composition during food processing and storage **4. Physical Properties of Water and Ice:** Chemical nature and structure of the water molecule; Physical properties of water and ice; Absorption phenomena and types of water solutions; Colligative properties of water; Distinction between free and bound water; Water activity and its role in food spoilage; Freezing and ice structure: Impact on food preservation and quality	12
II	**Food Dispersions and Plant-Based Foods** **1. Food Dispersions:** Introduction to food dispersions; Structure and classification of different types of food dispersions (e.g., solutions, suspensions, emulsions, gels); Stability factors and mechanisms affecting food dispersions **2. Cereals and Millets:** Definition, types, composition, nutritional value, structure (Wheat and rice), factors affecting and changes in major cereals and millets during processing (cooking and germination) **3. Pulses:** Definition, types, composition, nutritional value, factors affecting and changes in major pulses during processing (Soaking, Germination, Decortication, Cooking, Fermentation); Identification and implications of antinutritional factors in pulses	11
III	**Composition and Nutritive Value of Plant-Based Foods** 1. **Nuts & Oilseeds:** Definition, types, composition, and nutritional value of nuts and oilseeds; Processing techniques for oilseeds such as soybeans and coconut; Production and applications of protein isolates and texturized vegetable protein (TVP) 2. **Fruits & Vegetables:** Definition, classification, composition, and nutritional value of fruits and vegetables; Vegetable cookery: Techniques and nutritional implications; Changes in fruits and vegetables during maturation, ripening, storage, and cooking;	11

	Concept and mechanisms of enzymatic browning in fruits and vegetables 3. **Spices & Herbs:** Definition, classification, composition, and nutritional value of spices and herbs; Culinary and preservative uses of spices and herbs; Overview of essential oils and oleoresins: Extraction, properties, and applications.	
IV	**Composition and Nutritive Value of Animal-Based Foods and Health Foods** 1. **Eggs:** Structure, composition and nutritional value of eggs; Grading and quality assessment of egg; Changes in eggs during cooking and storage 2. **Meat & Fish:** Structure, types, composition and nutritional value of meat and fish; Different processing methods and their effects on meat and fish quality and nutritional value 3. **Dairy Products:** Definition, types, composition, nutritional value of milk; Overview of different types of market milk and milk products; Changes during milk processing such as pasteurization and homogenization; Storage and its effects on milk and milk products 4. **Health Foods:** Functional foods and nutraceuticals; definition, classification and their role in health; Organic foods: Definition and advantages; Genetically modified (GM) foods: Concept and Implications.	14

Recommended Books and Resources

1. Potter, N. N., & Hotchkiss, J. H. (1998). Food science (5th ed.). Springer.
2. DeMan, J. M. (2014). Principles of food chemistry (4th ed.). Springer.
3. Manay, N. S., & Shadaksharaswamy, M. (2009). Food facts and principles. New Age International.
4. Srilakshmi, B. (2016). Food science (4th ed.). New Age International.
5. Frazier, W. C., & Westhoff, D. C. (2008). Food microbiology (5th ed.). Tata McGraw-Hill Education.
6. Fellows, P. J. (2017). Food processing technology: Principles and practice (4th ed.). Woodhead Publishing.
7. De, S. (2015). Outlines of dairy technology (3rd ed.). Oxford University Press.
8. Vaclavik, V. A., & Christian, E. W. (2014). Essentials of food science (4th ed.). Springer.
9. Mudambi, S. R., & Rao, S. M. (2007). Food science. Oxford University Press
10. Singh, R. P., & Heldman, D. R. (2014). Food engineering: Fundamentals and applications (2nd ed.).
11. Sharma, D. (2018). The food industry in India: Challenges and opportunities.
12. Whitney, E. N., & Rolfes, S. R. (2018). Understanding nutrition (15th ed.).
13. McCain, V. B. (2010). Water in foods.
14. Walstra, P. (2003). Physical chemistry of foods.
15. Fennema, O. R. (Ed.). (1996). Food chemistry (3rd ed.).
16. deMan, J. M. (1999). Principles of food chemistry (3rd ed.). Springer.
17. Grumezescu, A. M., & Holban, A. M. (Eds.). (2019). Handbook of plant-based food and beverage technology.
18. Li, T. S. C. (2006). Vegetables and fruits: Nutritional and therapeutic values.
19. Walstra, P., Wouters, J. T. M., & Geurts, T. J. (2006). Dairy science and technology (2nd ed.).
20. Warriss, P. D. (2010). Meat science: An introductory text (2nd ed.).

21. Garg, M. L., & Berry Ottaway, P. (Eds.). (2011). Functional foods: Principles and technology.
22. Hui, Y. H. (Ed.). (2006). Handbook of food science, technology, and engineering (Vols. 1-4).
23. Brennan, J. G. (Ed.). (2006). Food processing handbook.
24. Hui, Y. H., Meunier-Goddik, L., Josephsen, J., Nip, W.-K., Stanfield, P. S., & Lam, A. S. T. (Eds.). (2004). Handbook of food and beverage fermentation technology.
25. Shortt, C., & O'Brien, J. (Eds.). (2004). Handbook of functional dairy products.
26. Shetty, K., Paliyath, G., Pometto, A., & Levin, R. E. (2008). Food biotechnology (2nd ed.). CRC Press.
27. Bagchi, D., Misra, L. K., Bagchi, M., & Kothari, S. C. (Eds.). (2014). Nutraceutical and functional food processing technology (2nd ed.). CRC Press.

MSFT412-24: Food Processing & Preservation

Total marks: 100	**L**	**T**	**P**
	4	**0**	**0**

Course objective:

Equip students with comprehensive knowledge of historical and modern food preservation techniques, including thermal and non-thermal methods, microbial control, and emerging technologies, to enhance food safety, quality, and shelf life.

Course outcome: At the end of the course, the students will be able to

CO1	Understand the historical evolution and principles of food preservation, recognizing its importance in extending shelf life and ensuring food safety.
CO2	Classify various types of foods based on perishability and comprehend the factors influencing their shelf life.
CO3	Identify and explain different types of food spoilage and contaminants, and understand the role of microorganisms in food preservation.
CO4	Analyze and apply thermal and non-thermal preservation methods to maintain food quality and safety.
CO5	Evaluate emerging preservation technologies and their impact on food quality and microbial control.

Mapping of Course Outcomes with Program Outcomes: Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)

PO / CO	PO1	PO2	PO3	PO4	PO5
CO1	3	2	1	3	2
CO2	2	2	1	2	3
CO3	3	2	1	2	3
CO4	3	3	2	2	3
CO5	3	3	2	2	3

Details of the Course Content - Food Processing & Preservation (MSFT412-24)

Unit	Contents	Contact Hours
I	**Introduction to Food Preservation** **1. Food Preservation:** Historical Perspectives**:** Early methods of food preservation; Evolution of food preservation technologies; Principles of Food Preservation: Importance and objectives of food preservation. **2. Types of Foods and Shelf Life:** Classification of foods: Perishable foods, Semi-perishable foods, Shelf-stable foods; Definition of shelf life **3. Food Spoilage and Contaminants:** Concept and types of spoilage (biological, chemical, physical); Concept, sources and types of contaminants. **4. Food Microbiology:** Microorganisms associated with foods: bacteria, yeast, mold and their importance in the food industry; Classification and growth curve of microorganisms; Food infection and food intoxication.	11
II	**Thermal Preservation Methods** **1. Heat Processing:** Thermal Processing: Principles of thermal processing, Thermal resistance of microorganisms, Thermal Death Time and Lethality concept, Characterization of heat penetration data, Thermal process calculations; Commercial Heat Preservation Methods: Sterilization and commercial sterilization, Pasteurization and Blanching. Effect of thermal processing on food. Process of canning, Equipment and materials used, Safety and quality control in canning. **2. Microwave and Ohmic Heating:** Mechanisms and applications, Advantages and limitations. Effects of microwave and ohmic heating on food. **3. Drying and Dehydration:** Definition, Principles of drying, heat and mass transfer, factors affecting rate of drying, normal drying curve, Types of dryers; Impact on food quality. Psychrometric Charts: Introduction, Data Interpretation and Application. **4. Evaporation:** Definition and factors affecting evaporation, Types of evaporators used in the food industry	13
III	**Non-Thermal Preservation Methods** **1. Food Preservation by Low Temperature:** Introduction to refrigeration, cool storage, and freezing; Refrigeration: Mechanism and effects on microbial growth, Types of refrigeration systems; Freezing: Principles and equipment, Types of freezing (slow, fast, cryogenic), Freezing curve and quality changes during freezing and storage, Introduction to thawing and its effects on food. **2. Chemical Preservation:** Types of preservatives, GRAS (Generally Recognized As Safe) substances, Use of chemical preservatives, Safety and regulatory aspects. **3. Biological Preservation:** Fermentation definition, Principles and benefits, Types of fermented foods.	12

	4. Modified Atmosphere Packaging (MAP): Definition, Principles and techniques, Applications and advantages.	
IV	**Emerging Technologies** **1. Pulsed Electric Fields (PEF):** Principles and applications, Effects on microorganisms and food quality. **2. Irradiation:** Mechanisms and types (gamma rays, X-rays, electron beams), Safety and regulatory concerns. **3. High-Pressure Processing (HPP):** Principles and mechanisms, Impact on microorganisms and food quality, Applications and limitations **4. Cold plasma technology:** Principles and potential applications,	12

Recommended Books and Resources

1. Potter, N. N., & Hotchkiss, J. H. (1998). Food Science (5th ed.). Springer.
2. Desrosier, N. W., & Desrosier, J. N. (1987). The Technology of Food Preservation (4th ed.). AVI Publishing Company.
3. Fellows, P. (2009). Food Processing Technology: Principles and Practice (4th ed.). Woodhead Publishing.
4. Rahman, M. S. (2020). Handbook of Food Preservation (3rd ed.). CRC Press.
5. Hui, Y. H. (2006). Handbook of Food Science, Technology, and Engineering (Vol. 4). CRC Press.
6. Barbosa-Cánovas, G. V., & Juliano, P. (2008). Food Engineering: Thermal Processing Systems. Springer.
7. Singh, R. P., & Heldman, D. R. (2022). Introduction to Food Engineering (6th ed.). Academic Press.
8. Heldman, D. R., & Lund, D. B. (2006). Handbook of Food Engineering (2nd ed.). CRC Press.
9. Leistner, L., & Gorris, L. G. M. (1995). Food Preservation by Combined Processes. CRC Press.
10. Gould, G. W. (2000). New Methods of Food Preservation. Springer.
11. Zhang, H. Q., Barbosa-Cánovas, G. V., Balasubramaniam, V. M., Dunne, C. P., Farkas, D. F., & Yuan, J. T. C. (2011). Nonthermal Processing Technologies for Food. Wiley-Blackwell.
12. Hendrickx, M., & Knorr, D. (2001). Ultra High Pressure Treatments of Foods. Springer.
13. Barbosa-Cánovas, G. V., Tapia, M. S., & Cano, M. P. (2004). Novel Food Processing Technologies. CRC Press.
14. Rosenthal, I. (2010). Pulsed Electric Fields Technology for the Food Industry. Springer.
15. Heldman, D. R. (2023). Food Preservation Process Design. Springer.
16. Ghosh, D., & Kumar, A. (2024). Emerging Technologies in Food Preservation. Wiley-Blackwell.
17. Datta, A. K. (2023). Food Processing and Preservation. CRC Press.
18. Smith, J. P., & Hongshun, Y. (2022). Food Processing: Principles and Applications (3rd ed.). Wiley-Blackwell.

MSFT413-24: Food Analysis and Preservation (Lab)

Total marks: 50	**L**	**T**	**P**
	0	**0**	**4**

Course objective:

To equip students with practical skills and comprehensive knowledge in the analysis and preservation of food products, ensuring proficiency in laboratory techniques, safety protocols, and quality evaluation methods essential for preserving the food products in the food technology field.

Course outcome: At the end of the course, the students will be able to

CO1	Demonstrate proficiency in using laboratory equipment and adhering to safety protocols in a food testing lab.
CO2	Apply fundamental techniques for food sampling, preparation, and proximate as well as physio-chemical analysis.
CO3	Perform microbial analysis, including total plate count, coliform, and E. coli detection, to ensure food safety and quality.
CO4	Evaluate the quality characteristics of various food products preserved by methods such as drying, freezing, blanching, pickling, and canning.
CO5	Compare and contrast conventional and modern food processing methods, and analyze their effects on the nutritional and microbial stability of food products.

Mapping of Course Outcomes with Program Outcomes: Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)

PO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	2	1	2	3
CO2	3	2	1	2	3
CO3	3	2	1	2	3
CO4	3	2	2	2	3
CO5	3	3	2	2	3

Details of the Course Content - Food Analysis and Preservation (Lab) (MSFT413-24)

Practical no.	Contents	Contact Hours
1*	Overview of the laboratory processes	1
2*	Introduction to the quality analysis process	1
3*	Attributes of an assistant lab technician -Food and Agricultural Commodities and laboratory ethics	1
4*	Prepare and Maintain Work Area and Equipment for Food Lab Testing (FIC/N7601)	1
5*	Prepare for Quality Analysis and Manage Housekeeping for Food Lab Activities (FIC/N7602)	1
6*	Food Safety, Hygiene and Sanitation for Food Lab Testing (FIC/N7605)	1
7*	Sampling and Quality Analysis for Food Lab Activities (FIC/N7603)	2
8*	Complete Documentation and Record Keeping Related to Performing Lab Activities (FIC/N7604)	2
9	Moisture and ash content determination in food samples (Gravimetric method).	2
10	Determination of pH in Various Foods Using pH Meter	2
11	Determination of protein content (Kjeldahl method).	2
12	Estimation of fat content (Soxhlet extraction method).	2
13	Determination of dietary fibre content in food samples.	2
14	Estimation of total carbohydrate content in food samples (Titrimetric or spectrophotometric method).	2
15	Identification and Classification of Cereals and Millets.	2
16	Quality Evaluation of Spices and Condiments.	2
17	Quality Characteristics of Foods Preserved by Drying/Dehydration.	2
18	Quality Characteristics of Frozen Foods.	2
19	Blanching of Vegetables and Its Effects.	2
20	Pickling Process and Quality Analysis.	2
21	Comparison of Conventional and Microwave Processing of Foods.	2
22	Preservation of Food by Canning and Cut-Out Analysis.	2

*Mandatory to teach from FIC/Q7601 manual

Recommended Books and Resources

1. FICSI. FIC/Q7601- Assistant Lab TechnicianFood and Agricultural Commodities.
2. Food Safety and Standards Authority of India (FSSAI). (n.d.). Manual of Methods of Analysis for Various Food Products. Retrieved from https://fssai.gov.in/cms/manuals-of-methods-of-analysis-for-various-food-products.php.
3. Food Analysis Laboratory Manual (In-house developed manual with specific methods).
4. American Public Health Association, American Water Works Association, & Water Environment Federation. (2017). Standard Methods for the Examination of Water and Wastewater (23rd ed.). Washington, DC: American Public Health Association.
5. Food Safety and Standards Authority of India (FSSAI). (2018). Manual on Food Safety Laboratory Practices. New Delhi, India: FSSAI.
6. International Organization for Standardization (ISO). (n.d.). ISO/IEC 17025:2017 General requirements for the competence of testing and calibration laboratories**.** Geneva, Switzerland: ISO.
7. AOAC International. (2019). Official Methods of Analysis of AOAC International (21st ed.). Gaithersburg, MD: AOAC International.
8. Prosky, L., Asp, N.-G., Schweizer, T. F., DeVries, J. W., & Furda, I. (1985). Determination of Insoluble, Soluble, and Total Dietary Fiber in Foods and Food Products: Interlaboratory Study. *Journal of the Association of Official Analytical Chemists*, *68*(4), 677-679.

9. American Spice Trade Association. (2000). ASTA Method of Analysis. Washington, DC: American Spice Trade Association.
10. Nielsen, S. S. (Ed.). (2010). *Food analysis* (4th ed.). Springer.
11. Sarker, D. K., & Nahar, N. (Eds.). (2016). *Handbook of food analysis* (3rd ed.). CRC Press.
12. BeMiller, J. N., & Whistler, R. L. (Eds.). (2009). *Carbohydrate chemistry for food scientists* (3rd ed.). AACC International.
13. Yanniotis, S., & Taoukis, P. (Eds.). (2013). *Food process monitoring and control* (1st ed.). Woodhead Publishing.
14. Wrolstad, R. E., Acree, T. E., Decker, E. A., Penner, M. H., Reid, D. S., Schwartz, S. J., Shoemaker, C. F., & Smith, D. M. (Eds.). (2019). *Handbook of food analytical chemistry* (1st ed.). Wiley.
15. Valero, D., & Valverde, J. M. (Eds.). (2012). *Postharvest biology and technology of horticultural crops: Principles and practices for quality maintenance* (1st ed.). Woodhead Publishing.
16. Nollet, L. M. L., & Toldrá, F. (Eds.). (2012). *Handbook of analysis of active compounds in functional foods* (1st ed.). CRC Press.
17. Smith, J. L., & Charter, E. R. (Eds.). (2012). *Food chemical safety* (1st ed.). Springer.
18. Velasco, V., & Meléndez-Martínez, A. J. (Eds.). (2010). *Handbook of food science, technology, and engineering* (4th ed.). CRC Press.
19. Nielsen, S. S. (Ed.). (2016). *Food analysis laboratory manual* (2nd ed.). Springer.

MSFT414-24: Food Microbiology

Total marks: 100	**L**	**T**	**P**
	4	**0**	**0**

Course objective:

To comprehensively understand the role, significance, and classification of microorganisms in food, their growth, nutrition, and impact, along with advanced practices for preservation, microbial inactivation, factors affecting microbial proliferation, spoilage, fermentation, public health implications, and adherence to food safety standards.

Course outcome: At the end of the course, the students will be able to

CO1	Demonstrate an understanding of the historical developments, classification systems, and differentiation between procaryotes and eucaryotes in microbiology.
CO2	Analyze the types of microorganisms associated with food and their impact on food contamination, spoilage, and safety during handling and processing.
CO3	Identify intrinsic and extrinsic factors affecting microbial growth and apply advanced preservation techniques to control food spoilage.
CO4	Evaluate the role and significance of fermentation in food microbiology, including the production of fermented foods and beverages.
CO5	Assess public health implications of foodborne illnesses, microbial toxins, and implement food safety standards such as HACCP and hurdle technology.

Mapping of Course Outcomes with Program Outcomes: Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)

PO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	2	1	2	2
CO2	3	2	1	2	3
CO3	3	2	1	2	3
CO4	3	2	2	2	3
CO5	3	2	2	2	3

Details of the Course Content - Food Microbiology (MSFT414-24)

Unit	Contents	Contact Hours
I	Introduction to microbiology: Historical developments, Classification – A brief account, basis of classification. Three and five kingdom classification, Procaryotes and Eucaryotes. Microbial growth and nutrition. Introduction to food microbiology: Classification of microbes, Types of micro-organism normally associated with food- mold, yeast, and bacteria. Contamination of foods- vegetables, cereals, pulses, oilseeds, milk and meat during handling and processing. Best Practices to Avoid Food Spoilage, Microbiological Hazards	12
II	Factors affecting microbial growth: Intrinsic and extrinsic factors, Biochemical changes caused by micro-organisms, deterioration of various types of food product. Microbiology of food preservation, heating process, irradiation, low temperature storage, chemical preservatives, high-pressure processing, control of water activity.	12
III	Fermented and microbial foods: Fermented milk and milk products, fermented fruits and vegetables, fermented meat and fish products, fermented beverages (beer, vinegar and wine), single cell protein.	12
IV	Food microbiology and public health: food poisoning and microbial toxins, types of food poisonings. Bacterial agents of food borne illness. Non-bacterial agents of food borne illness- poisonous algae, fungi and food borne viruses. Microbial standards for different foods. HACCP and food safety, hurdle technology and its applications. Microbiological Food Safety Standards and Regulations. Food Safety and Hygiene Audits	12

Recommended Books and Resources

1. Frazier, W. C., & Westhoff, D. C. (2015). Food Microbiology (5th ed.). Tata McGraw Hill Publication, New Delhi.
2. Adams, M. R., & Moss, M. O. (2016). Food Microbiology (4th ed.). Royal Society of Chemistry, Cambridge.
3. James, M. J., Loessner, M. J., & Golden, D. A. (2018). Modern Food Microbiology (8th ed.). Springer.
4. Stanier, R. Y. (2006). General Microbiology (5th ed.). MacMillan, Hampshire.
5. Creager, J. G., Black, J. G., & Davison, V. E. (1990). Microbiology: Principles & Applications. Prentice Hall, New Jersey.
6. Battcock, M., & Azam-Ali, S. (1998). Fermented Fruits and Vegetables: A Global Perspective. FAO Agricultural Services Bulletin No. 134.
7. Campbell-Platt, G. (2017). Fermented Foods of the World: A Dictionary and Guide. Butterworth-Heinemann.
8. Doyle, M. P., & Beuchat, L. R. (2019). Food Microbiology: Fundamentals and Frontiers (4th ed.). ASM Press.
9. Fellows, P. J. (2017). Food Processing Technology: Principles and Practice (4th ed.). Woodhead Publishing.
10. Forsythe, S. J. (2010). The Microbiology of Safe Food (2nd ed.). Wiley-Blackwell.
11. Leistner, L., & Gorris, L. G. M. (1995). Food Preservation by Hurdle Technology. Springer.
12. Madigan, M. T., & Martinko, J. M. (2018). Biology of Microorganisms (15th ed.). Pearson.
13. Madigan, M. T., Martinko, J. M., Bender, K. S., Buckley, D. H., & Stahl, D. A. (2018). Brock Biology of Microorganisms (15th ed.). Pearson.
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17. Ray, B., & Bhunia, A. (2013). Fundamental Food Microbiology (5th ed.). CRC Press.
18. Sperber, W. H., & Doyle, M. P. (2009). Compendium of the Microbiological Spoilage of Foods and Beverages. Springer.
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MSFT415-24: Food Microbiology (Lab)

Total marks: 50	**L**	**T**	**P**
	0	**0**	**4**

Course objective:

To equip students with the skills necessary to establish and sustain microbiological laboratories, encompassing the operation and maintenance of laboratory equipment, implementation of sterilization techniques, application of precise sampling methods, adherence to aseptic practices, maintenance of microbial cultures, and execution of comprehensive microbiological analyses for food and water quality assurance.

Course outcome: At the end of the course, the students will be able to

CO1	Gain proficiency in establishing and sustaining microbiological laboratories, including the operation and maintenance of essential lab equipment.
CO2	Develop the ability to maintain high standards of hygiene and sanitation within the work area to ensure a contamination-free environment.
CO3	Master the preparation of culture media, sterilization using autoclaves, and conducting aseptic sampling and inoculation procedures.
CO4	Acquire skills in various microbiological analysis techniques, including staining, dilution, bacterial isolation, and the testing of food and water samples.
CO5	Be capable of maintaining pure microbial cultures, accurately reporting test results, and conducting environmental monitoring in food processing units for quality assurance.

Mapping of Course Outcomes with Program Outcomes: Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)

PO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	2	2	2	3
CO2	3	2	2	2	3
CO3	3	2	1	2	3
CO4	3	2	2	2	3
CO5	3	2	2	2	3

Details of the Course Content - Food Microbiology (Lab) (MSFT415-24)

Practical no.	Contents	Contact Hours
1*	Prepare and Maintain Work Area and Lab Equipment (FIC/N7609) a. Setting up Microbiological Laboratory b. Working Principle, Operations and Maintenance of Tools, Equipment and Glassware c. Maintaining Hygiene and Sanitation at Work Area	3
2*	Culture Media Preparation	1
3*	Sterilization Using Autoclave	1
4*	Sampling for Microbiological Assay	1
5*	Preparation of the workspace (Laminar Air Flow Cabinet)	1
6*	Aseptic Sample Inoculation	1
7*	Pure Culture Maintenance	2
8*	Reporting Microbiological Test Results	2
9*	Environmental Monitoring in Food Processing Units	2
10*	Quality Assurance (QA) Programme for Food Microbiology Laboratory	2
11	Bright field microscopy and examination of living micro-organisms	2
12	Direct microscopic count of micro-organisms– use of Neubauer counting chamber	2
13	Staining techniques: a. Simple staining, b. Gram staining, c. Spore staining and d. Negative staining etc.,	4
14	Dilution technique.	2
15	Isolation of bacteria by a. Serial dilution (streak plate), b. Pour plating and spreading, c. Bacterial population count- standard plate count.	3
16	Microbiological analysis of food products- i. Bacterial count, ii.Yeast and mold count, iii.Coliform count, iv.Standard plate count of milk and direct microscopic count of milk, v.Reductase Test (MBRT).	4
17	Microbiological testing of water- I. Quantitative test, ii. Bacteriological quality testing (MPN).	2

*Mandatory to teach from FIC/Q7603 manual

Recommended Books and Resources

1. FICSI. FIC/Q7603- Food Microbiologist.
2. Food Safety and Standards Authority of India (FSSAI). (2021). Food Safety and Standards (Food Product Standards and Food Additives) Regulations. Retrieved from https://www.fssai.gov.in/
3. Bureau of Indian Standards (BIS). (2018). IS 5403: 1999 Methods for Yeast and Mould Count of Foodstuffs and Animal Feeds. Retrieved from https://www.bis.gov.in/
4. AGMARK. (2021). Agricultural Produce (Grading and Marking) Act, 1937. Retrieved from https://dmi.gov.in/gradesstandards.aspx

5. International Organization for Standardization (ISO). (2016). ISO 4833-1:2013 Microbiology of the food chain — Horizontal method for the enumeration of microorganisms — Part 1: Colony count at 30 degrees C by the pour plate technique. Retrieved from https://www.iso.org/
6. AOAC International. (2020). Official Methods of Analysis of AOAC INTERNATIONAL. Retrieved from https://www.aoac.org/official-methods-of-analysis-21st-edition-2019/
7. Vanderzant, C., & Splittstoesser, D. F. (1992). Compendium of methods for the microbiological examination of foods. American Public Health Association.
8. Adams, M. R., & Moss, M. O. (2008). Food Microbiology. Royal Society of Chemistry.
9. Jay, J. M., Loessner, M. J., & Golden, D. A. (2005). Modern Food Microbiology. Springer.
10. FSSAI. (2020). Manual of Methods of Analysis of Foods - Microbiological Testing. Retrieved from https://www.fssai.gov.in/
11. ISO. (2017). ISO 21528-2:2017 Microbiology of the food chain — Horizontal method for the detection and enumeration of Enterobacteriaceae — Part 2: Colony-count technique. Retrieved from https://www.iso.org/
12. Cappuccino, J. G., & Sherman, N. (2013). Microbiology: A Laboratory Manual. Pearson.
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14. FSSAI. (2021). Hygiene and Sanitation Guidelines for Food Processing Units. Retrieved from https://www.fssai.gov.in/
15. European Food Safety Authority (EFSA). (2019). Microbiological Risk Assessment Guidance for Food Safety. Retrieved from https://www.efsa.europa.eu/
16. National Center for Biotechnology Information (NCBI). (2020). Methods of Microbial Analysis. Retrieved from https://www.ncbi.nlm.nih.gov/
17. Food and Agriculture Organization (FAO). (2021). Food Microbiology and Safety. Retrieved from https://www.fao.org/
18. Bacteriological Analytical Manual (BAM). (2021). US FDA’s Bacteriological Analytical Manual. Retrieved from https://www.fda.gov/
19. National Institute of Food and Agriculture (NIFA). (2020). Food Safety and Microbiology. Retrieved from https://nifa.usda.gov/
20. Merck Microbiology Manual. (2018). Microbiological Culture Media: Principles and Practice. Retrieved from https://www.merckgroup.com/
21. Society for Applied Microbiology (SfAM). (2020). Guidelines for Microbiological Quality Assurance in Food Laboratories. Retrieved from https://www.sfam.org.uk/
22. Royal Society of Biology. (2021). Microbiology Teaching Resources. Retrieved from https://www.rsb.org.uk/
23. National Institute of Standards and Technology (NIST). (2020). Microbiological Testing Standards. Retrieved from https://www.nist.gov/
24. ASM International. (2021). Microbial Testing Guidelines. Retrieved from https://www.asm.org/
25. WHO. (2021). Guidelines for the Safe Use of Wastewater, Excreta and Greywater in Agriculture. Retrieved from https://www.who.int/
26. FDA. (2020). Guidance for Industry: Microbiological Considerations for Food and Beverages. Retrieved from https://www.fda.gov/

FIC/Q9005: Industrial Production Worker – Food Processing

Total marks: 100	**L**	**T**	**P**
	4	**0**	**0**

Course objective:

To equip students with comprehensive training aligned to the Qualification Pack for Industrial Production Worker - Food Processing (FIC/Q9005) and Food Product Handler (FIC/Q9010) at NSQF level 2, covering understanding of industry standards, proficiency in hygiene and safety, practical skills in machinery operation and maintenance, and knowledge of documentation and compliance practices.

Course outcome: At the end of the course, the students will be able to

CO1	Demonstrate comprehensive knowledge of the food processing industry, including its organizational standards, norms, and regulatory requirements.
CO2	Exhibit proficiency in maintaining high standards of personal hygiene and workplace ethics as per food safety guidelines.
CO3	Possess practical skills in cleaning, sanitizing, and maintaining work areas and processing machinery to ensure optimal production conditions.
CO4	Competently operate and troubleshoot various processing machinery used in bakery, fruits and vegetable processing, milk and milk products, and meat processing industries.
CO5	Understand the importance of documentation and record-keeping in maintaining quality standards and regulatory compliance within food processing operations.

Mapping of Course Outcomes with Program Outcomes: Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)

PO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	2	2	3	3
CO2	3	2	3	2	3
CO3	3	2	2	2	3
CO4	3	2	2	2	3
CO5	3	2	2	3	3

Details of the Course Content -Industrial Production Worker – Food Processing (FIC/Q9005)

Unit	Contents	Contact Hours
I	**Introduction to the Training Program of Industrial Production Worker - Food Processing and (based on the Qualification Pack (QP) code FIC/Q9005) and Overview of Food Processing Industry (FIC/N9020):** Introduction to the training program; Food Processing and Technology: An overview, Classification of Food and Agro-Processing Industry **Organizational Standards and Norms (CSC/N1336):** Roles and Responsibilities Industrial Production Worker - Food Processing; Knowledge and understanding of the organization; Workplace ethics; Personal hygiene guidelines for food handlers; Food Safety and hygienic standards for workplace	12
II	**Prepare And Maintain Work Area And Processing Machineries For Production (FIC/N9020):** Cleaning and sanitation; Prepare and maintain the work area and processing machineries for the production process; Machine maintenance and troubleshooting; Waste management **The Production Process (FIC/N9020):** Operation of machineries and equipment's; Post Production cleaning and storage of tools	12
III	**The Production Process (FIC/N9020):** Manufacturing Process and Controls in Bakery industry, Fruits and Vegetable Processing industry, milk and milk products processing industry, meat processing industry **Documentation And Record Keeping (FIC/N9020):** Need of documentation and record keeping; Process of documenting records	12
IV	**Basic Health And Safety Practices At Food Processing Workplace FIC/N9002):** Workplace safety, Types of Safety and safety measures, Methods to build safety in daily operations, Emergency response and evacuation, Rescue techniques during emergency, Basic first aid methods , Methods of accident prevention, Managing the safety hazards in different industries	12

Recommended Books and Resources

1. Food Industry Capacity & Skill Initiative (FICSI). (2023). Industrial Production Worker – Food Processing. https://www.ficsi.in/upload/participant_handbook/PH_English_Industrial%20Production%20Worker_FICQ9005_V3.0.pdf
2. F Food Industry Capacity & Skill Initiative (FICSI). (2023). Food Product Handler PH V.10: English. https://www.ficsi.in/upload/participant_handbook/Food%20Product%20Handler%20PH%20V.10-%20English.pdf
3. Food Safety and Standards Authority of India. (2022). Food Safety and Standards (Licensing and Registration of Food Businesses) Regulations, 2011. Retrieved from https://www.fssai.gov.in

4. Bureau of Indian Standards. (2018). IS 14596: Food Hygiene - General Principles - Code of Practice. Retrieved from https://www.bis.gov.in
5. AGMARK. (2021). Agricultural Produce (Grading and Marking) Act, 1937. Retrieved from https://agmarknet.gov.in
6. International Organization for Standardization. (2018). ISO 22000:2018 - Food Safety Management Systems - Requirements for Any Organization in the Food Chain. Retrieved from https://www.iso.org
7. International Organization for Standardization. (2018). ISO 19011:2018 - Guidelines for Auditing Management Systems. Retrieved from https://www.iso.org
8. Food Safety and Standards Authority of India. (2022). Training Videos. Retrieved from https://www.fssai.gov.in/home/training/videos.html
9. Bureau of Indian Standards. (2022). BIS Standards. Retrieved from https://www.standards.bis.gov.in
10. International Organization for Standardization. (2022). ISO Standards. Retrieved from https://www.iso.org/standards.html
11. Food Processing Machinery Standards. (2022). Retrieved from https://www.nsf.org/knowledge-library/food-equipment-standards
12. National Qualifications Register. (2022). FIC/N9020: Monitor the food production on a mechanized production line for processed food items. Retrieved from https://www.nqr.gov.in/qualification-title/nqr-title/fic/n9020
13. National Qualifications Register. (2022). FIC/N9002: Use basic health and safety practices at a food processing workplace. Retrieved from https://www.nqr.gov.in/qualification-title/nqr-title/fic/n9002
14. National Qualifications Register. (2022). CSC/N1336: Work effectively with others. Retrieved from https://www.nqr.gov.in/qualification-title/nqr-title/csc/n1336
15. FICSI - Food SSC (2022). Overview of Food Processing Industry. Retrieved from https://youtu.be/wMu0EpUgCd4
16. FICSI - Food SSC. (2022). Industrial Production Worker. Retrieved from https://youtu.be/0tThA3DYX2c
17. FICSI - Food SSC. (2022). Introduction to Bread & Bakery Industry. Retrieved from https://youtu.be/mcpVs3CVNIw
18. FICSI - Food SSC. (2022). Overview of fruits and vegetable processing. Retrieved from https://youtu.be/hW10tq2fWfY
19. FICSI - Food SSC. (2022). Overview of Dairy Industry. Retrieved from https://youtu.be/4XuvGYvKGnE
20. FICSI - Food SSC. (2022). Overview of Meat and Poultry Industry. Retrieved from https://youtu.be/UZ7nMyVQWCU
21. FICSI - Food SSC. (2022). Documentation and record keeping in food processing unit. Retrieved from https://youtu.be/HesWbNFSQS4
22. FICSI - Food SSC. (2022). Introduction to entrepreneurship. Retrieved from https://youtu.be/BzeoC3mSDgg
23. FICSI - Food SSC. Traits of Entrepreneur. Retrieved from https://youtu.be/3uEqWH9oWls

SEC111-24: Digital Fluency

Total marks: 100	**L**	**T**	**P**
	4	**0**	**0**

Course objective:

Equip students with comprehensive digital fluency, encompassing fundamental computer skills, effective digital communication and collaboration, office productivity tools, e-learning, digital content creation, e-commerce, cybersecurity, emerging technologies, and ethical considerations to proficiently navigate and leverage the digital landscape.

Course outcome: At the end of the course, the students will be able to

CO1	Demonstrate a thorough understanding of digital fluency, including the use of essential digital tools and platforms.
CO2	Exhibit proficiency in basic computer skills, operating systems, and file management.
CO3	Apply effective digital communication techniques and utilize office productivity tools for various professional tasks.
CO4	Create and manage digital content, engage in e-commerce transactions securely, and understand cybersecurity measures.
CO5	Analyze and evaluate the impact of digital emerging technologies on the food industry and society, while adhering to ethical and legal standards in the digital world.

Mapping of Course Outcomes with Program Outcomes: Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)

PO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	2	2	3	2	2
CO2	2	2	3	2	2
CO3	2	2	3	2	2
CO4	3	2	3	2	3
CO5	3	3	2	3	3

Details of the Course Content - Digital Fluency (SEC111-24)

Unit	Contents	Contact Hours
I	**Introduction to Digital Fluency and Basic Computer Skills** 1. **Introduction to Digital Fluency:** Importance of digital fluency, Overview of digital tools and platforms 2. **Basic Computer Skills:** An Overview of the Computer, Block Diagram of the Computer, Evolution and Generations of Computers, Software and its types, Operating systems: types of operating systems: Windows, macOS, Linux; major functions of the operating systems; File management and organization.	10
II	**Digital Communication and Collaboration** **1. Digital Communication:** Email etiquette and management; Online communication tools: messaging apps, and video conferencing; Netiquette and digital footprint **2. Office Productivity Tools**: Creating and Editing: Word processing (Microsoft Word, Google Docs), Spreadsheets (Microsoft Excel, Google Sheets), Presentations (Microsoft PowerPoint, Google Slides), Google form: Creating and analysis of response; Google Drive- uploading and sharing of files and folders.	12
III	**E-learning, Digital Content Creation, E-commerce and Security Aspects** **1. E-learning:** Introduction to e-learning platforms such as Swayam and MOOC. **2. Digital Content Creation**: Basics of graphic design (Canva); Video creation and editing **3. E-Commence:** Basic Web Commerce Concept, E- payment methods: E-cash Payment System, Credit Payment System, Types of Electronic Payment Systems: Credit Card • Debit Card • Smart Card • E-Money • Electronic Fund Transfer (EFT). **4. Cyber Security and Online Privacy:** Threats and Prevention, Viruses and its types, Antivirus, HTTP vs HTTPS, Firewall, Cookies, Hackers and Crackers, Safe browsing practices, Protecting personal information online	14
IV	**Emerging Technologies and Ethical Issues** **Emerging Technologies:** Introduction to emerging technologies and their applications in the food industry- Artificial Intelligence, IoT, Cloud Computing, Machine learning, Big Data, Blockchain, ChatGPT; Impact of emerging technologies on society; Future trends in technology **Ethical and Legal Issues in the Digital World:** Understanding digital rights and responsibilities; Intellectual property and copyright issues; Ethical considerations in digital technology	12

Recommended Books and Resources

1. Fundamentals of computers - V. Rajaraman - Prentice- Hall of India.
2. Computer Fundamentals - P. K. Sinha Publisher: BPB Publications
3. Digital Promise. Digital literacy. Retrieved from https://digitalpromise.org/initiative/digital-literacy/
4. Norton, P. (2018). Introduction to Computers. McGraw-Hill Education.
5. Shelly, G. B., & Vermaat, M. E. (2012). Discovering Computers: Fundamentals. Cengage Learning.
6. Coursera. Email Etiquette: Tips and Tricks for Professionals. Retrieved from https://www.coursera.org/learn/email-etiquette
7. Poatsy, M. A., & Mulbery, K. (2019). Exploring Microsoft Office 2019 Introductory. Pearson.
8. Microsoft Office Support. Retrieved from https://support.microsoft.com/en-us/office
9. LinkedIn Learning. Office 365 Essential Training. Retrieved from https://www.linkedin.com/learning/office-365-essentials
10. Bates, A. W. (2019). Teaching in a Digital Age: Guidelines for Designing Teaching and Learning. Tony Bates Associates Ltd.
11. SWAYAM. Retrieved from https://swayam.gov.in/ & https://www.aicte-india.org/bureaus/swayam
12. edX.Introduction to MOOCs. Retrieved from https://www.edx.org/
13. Canva Design School. Retrieved from https://www.canva.com/learn/
14. Adobe Creative Cloud. Video Production and Editing. Retrieved from https://www.adobe.com/creativecloud/video/discover.html
15. Laudon, K. C., & Traver, C. G. (2020). E-Commerce 2020: Business, Technology, Society. Pearson.
16. Coursera. Introduction to E-Commerce. Retrieved from https://www.coursera.org/learn/e-commerce
17. Stallings, W. (2020). Network Security Essentials: Applications and Standards. Pearson.
18. Cybersecurity & Infrastructure Security Agency (CISA). (n.d.). Retrieved from https://www.cisa.gov/
19. Russell, S., & Norvig, P. (2020). Artificial Intelligence: A Modern Approach. Pearson.
20. Coursera. Introduction to AI. Retrieved from https://www.coursera.org/learn/ai
21. Spinello, R. A., & Tavani, H. T. (2016). Cyberethics: Morality and Law in Cyberspace. Jones & Bartlett Learning.
22. Quinn, M. J. (2016). Ethics for the Information Age. Pearson.
23. edX. Cybersecurity and Privacy. Retrieved from https://www.edx.org/course/cybersecurity-and-privacy-in-the-iot.
24. Digital 101 Course offered by Future Skill Prime Platform https://learn.futureskillsprime.in/
25. Gmail Creating links:
26. https://clubrunner.blob.core.windows.net/00000000961/en-ca/files/homepage/how-to- create-a-gmail-account/HowtoCreateaGmailAccount.pdf
27. Google Forms: https://pdst.ie/sites/default/files/Google%20Drive_1.pdf
28. Google Meet: https://edvance.hawaii.hawaii.edu/wp-content/uploads/Google-Meet- Tutorial-Getting-Started-and-Recording-a-Lecture.pdf
29. Security Aspects - https://ncert.nic.in/textbook/pdf/lecs112.pdf
30. E-Commence: http://www.aagasc.edu.in/cs/msccs/ECommerce%20Unit%201.pdf
31. E- payment methods: http://www.dspmuranchi.ac.in/pdf/Blog/e%20business%20UnitIII,%20%202020.pdf

SEC112-24: Digital Fluency (Lab)

Total marks: 50	**L**	**T**	**P**
	0	**0**	**4**

Course objective:

To equip students with practical skills and comprehensive knowledge in the analysis and preservation of food products, ensuring proficiency in laboratory techniques, safety protocols, and quality evaluation methods essential for preserving the food products in the food technology field.

Course outcome: At the end of the course, the students will be able to

CO1	Demonstrate proficiency in using laboratory equipment and adhering to safety protocols in a food testing lab.
CO2	Apply fundamental techniques for food sampling, preparation, and proximate as well as physio-chemical analysis.
CO3	Perform microbial analysis, including total plate count, coliform, and E. coli detection, to ensure food safety and quality.
CO4	Evaluate the quality characteristics of various food products preserved by methods such as drying, freezing, blanching, pickling, and canning.
CO5	Compare and contrast conventional and modern food processing methods, and analyze their effects on the nutritional and microbial stability of food products.

Mapping of Course Outcomes with Program Outcomes: Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)

PO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	2	1	2	3
CO2	3	2	1	2	3
CO3	3	2	1	2	3
CO4	3	2	1	2	3
CO5	3	3	2	2	3

Details of the Course Content - Digital Fluency- Lab (SEC112-24)

Practical no.	Contents	Contact Hours
1	Identifying the configuration and version of a computer system (PC), laptop, and a mobile phone.	3
2	Finding the background and foreground processes on Task manager.	2
3	Translating English into Punjabi/Hindi words in Google embedded with AI.	2
4	Use Google assistant on any android smartphone to dictate commands and to launch apps	2
5	Downloading your e-aadhar, mask e-aadhar and locked e-aadhar.	2
6	Creating resume in Word processor.	2
7	Creating powerpoint presentation for your department introduction and apply transitions and animations.	2
8	Create your marksheet in Microsoft Excel.	2
9	Simple computation using spread sheet.	2
10	Create an email-ID and sending and forwarding.	2
11	Attaching files and downloading files in email.	2
12	Creating a Google form and send it to Ten users.	2
13	Scheduling a virtual meet and invite peoples to join the Google meet/Zoom/skype.	2
14	Creating a hotspot from a mobile phone, and allowing others to use the hotspot.	2
15	Sign in and create account e-learning platforms such as Swayam and MOOC.	2
16	Creating an account on the railway reservation website, IRCTC, and finding trains and running status.	2
17	Demo of online order placing for books using Flipkart/Amazon, etc.	2
18	Install any antivirus app on your mobile and scan.	2
19	Demonstrate unsecured (HTTP) and secured (HTTPS) websites	2
20	Demonstrate setup of printer, scanner and projector with laptop or PC	2

Recommended Books and Resources

1. Fundamentals of computers - V. Rajaraman - Prentice- Hall of India.
2. Computer Fundamentals - P. K. Sinha Publisher: BPB Publications
3. Digital Promise. Digital literacy. Retrieved from https://digitalpromise.org/initiative/digital-literacy/
4. Norton, P. (2018). Introduction to Computers. McGraw-Hill Education.
5. Shelly, G. B., & Vermaat, M. E. (2012). Discovering Computers: Fundamentals. Cengage Learning.
6. Coursera. Email Etiquette: Tips and Tricks for Professionals. Retrieved from https://www.coursera.org/learn/email-etiquette
7. Poatsy, M. A., & Mulbery, K. (2019). Exploring Microsoft Office 2019 Introductory. Pearson.
8. Microsoft Office Support. Retrieved from https://support.microsoft.com/en-us/office
9. LinkedIn Learning. Office 365 Essential Training. Retrieved from https://www.linkedin.com/learning/office-365-essentials
10. Bates, A. W. (2019). Teaching in a Digital Age: Guidelines for Designing Teaching and Learning. Tony Bates Associates Ltd.

11. SWAYAM. Retrieved from https://swayam.gov.in/ & https://www.aicte-india.org/bureaus/swayam
12. edX.Introduction to MOOCs. Retrieved from https://www.edx.org/
13. Canva Design School. Retrieved from https://www.canva.com/learn/
14. Adobe Creative Cloud. Video Production and Editing. Retrieved from https://www.adobe.com/creativecloud/video/discover.html
15. Laudon, K. C., & Traver, C. G. (2020). E-Commerce 2020: Business, Technology, Society. Pearson.
16. Coursera. Introduction to E-Commerce. Retrieved from https://www.coursera.org/learn/e-commerce
17. Stallings, W. (2020). Network Security Essentials: Applications and Standards. Pearson.
18. Cybersecurity & Infrastructure Security Agency (CISA). (n.d.). Retrieved from https://www.cisa.gov/
19. Russell, S., & Norvig, P. (2020). Artificial Intelligence: A Modern Approach. Pearson.
20. Coursera. Introduction to AI. Retrieved from https://www.coursera.org/learn/ai
21. Spinello, R. A., & Tavani, H. T. (2016). Cyberethics: Morality and Law in Cyberspace. Jones & Bartlett Learning.
22. Quinn, M. J. (2016). Ethics for the Information Age. Pearson.
23. edX. Cybersecurity and Privacy. Retrieved from https://www.edx.org/course/cybersecurity-and-privacy-in-the-iot.
24. Digital 101 Course offered by Future Skill Prime Platform https://learn.futureskillsprime.in/
25. Gmail Creating links:
26. https://clubrunner.blob.core.windows.net/00000000961/en-ca/files/homepage/how-to- create-a-gmail-account/HowtoCreateaGmailAccount.pdf
27. Google Forms: https://pdst.ie/sites/default/files/Google%20Drive_1.pdf
28. Google Meet: https://edvance.hawaii.hawaii.edu/wp-content/uploads/Google-Meet- Tutorial-Getting-Started-and-Recording-a-Lecture.pdf
29. Security Aspects - https://ncert.nic.in/textbook/pdf/lecs112.pdf
30. E-Commence: http://www.aagasc.edu.in/cs/msccs/ECommerce%20Unit%201.pdf
31. E- payment methods: http://www.dspmuranchi.ac.in/pdf/Blog/e%20business%20UnitIII,%20%202020.pdf

MSFT416-24: Industrial Visit and FoSTaC Course

Total marks: 40	**L**	**T**	**P**
	0	**0**	**3**

Course objective:

To equip students with practical industry exposure and essential food safety knowledge through industrial visits, expert lectures, and completion of the FoSTaC - Basic Manufacturing course, fostering their competence in food manufacturing, processing, and packaging practices.

Course outcome: At the end of the course, the students will be able to

CO1	Students will gain practical knowledge of food industry operations and standards through firsthand industrial exposure and expert insights.
CO2	Students will develop a comprehensive understanding of fundamental food safety principles, including personal hygiene and food handling practices.
CO3	Students will be proficient in managing food operations and controls, ensuring adherence to safety and quality protocols.
CO4	Students will acquire skills in proper packaging and distribution methods to maintain food integrity and safety during the supply chain.
CO5	Students will be able to compile and present detailed reports on their industrial visit/expert lecturer and FoSTaC course experiences, demonstrating their applied knowledge and analytical skills.

Mapping of Course Outcomes with Program Outcomes: Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)

PO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	2	2	3	3
CO2	3	3	2	3	2
CO3	2	2	3	3	3
CO4	2	2	2	3	3
CO5	3	3	2	2	2

Details of the Course Content - Industrial Visit and FoSTaC Course (MSFT416-24)

Unit	Contents	Contact Hours
I	Students are required to visit a food industry or attend a guest lecture by a food industry expert. Subsequently, they must submit a report to the Head of the Department and Course Coordinator.	10
II	Students must complete the FoSTaC - Basic Manufacturing course. This course should be completed through https://www.skillindiadigital.gov.in/courses/detail/43c98220-675c-4284-b998-7bd3d413d724 or https://fostac.fssai.gov.in/index or any FSSAI-recognized training center.	

Recommended Books and Resources

1. https://www.skillindiadigital.gov.in/courses/detail/43c98220-675c-4284-b998-7bd3d413d724
2. https://fostac.fssai.gov.in/index

SEMESTER- II

Program Scheme & Syllabus

Semester II

Course Code	Course Title	Course Type	Load			Marks Distribution		Total	Credits
			L	T	P	Internal	External		
MSFT421-24	Food Chemistry and Biochemistry	DSC	4	0	0	40	60	100	4
MSFT422-24	Principles of Food Engineering	DSC	4	0	0	40	60	100	4
MSFT423-24	Dairy Technology	DSE	4	0	0	40	60	100	4
MSFT424-24	Dairy Technology (Lab)	DSE	0	0	4	30	20	50	2
M/FIC/Q7006	Food Packer	DSC/ QP-NOS	4	0	0	40	60	100	4
M/FIC/Q7001	Food Products Packaging Technician (Lab)	DSC/ QP-NOS	0	0	4	30	20	50	2
M/FIC/Q9001	Processed Food Entrepreneur	SEC-SB/ QP-NOS	4	0	0	40	60	100	4
MSFT424-24	Industrial Visit with Cold Storage Technician Course	AECC	0	0	3	40[#]	--	40	3
	Total		**20**	**0**	**11**	300	340	640	27

[#] Indutsrial Visit with Cold Storage Technician Course will have internal evaluation only. Cold Storage Technician course must be completed and certified from https://www.skillindiadigital.gov.in or https://elearning.ficsi.in/ or any FICSI recognized Training center

MSFT421-24: Food Chemistry and Food Biochemistry

Total marks: 100	**L**	**T**	**P**
	4	**0**	**0**

Course objective:

To provide comprehensive knowledge of food chemistry and biochemistry, emphasizing the structural, functional, and metabolic roles of carbohydrates, proteins, lipids, vitamins, and minerals, along with their impact on food processing, nutrition, health, and associated deficiency diseases.

Course outcome: At the end of the course, the students will be able to

CO1	Analyze the structural and functional properties of carbohydrates, proteins, lipids, vitamins, and minerals, and their implications for food processing and nutrition.
CO2	Evaluate the role of enzymatic activities, food pigments, and additives in improving food quality and stability under various conditions.
CO3	Demonstrate understanding of the biochemical processes involved in fermentation and their applications in creating functional foods and probiotics.
CO4	Assess the impact of macro- and micronutrient deficiencies on human health and suggest dietary interventions to address these issues.
CO5	Explore advanced topics such as genetic engineering and omics technologies in food biochemistry to predict future trends in food science and technology.

Mapping of Course Outcomes with Program Outcomes: Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)

PO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	3	2	1	3
CO2	3	2	2	3	3
CO3	3	2	3	2	3
CO4	2	3	1	2	3
CO5	3	2	2	2	3

Details of the Course Content - Food Chemistry and Food Biochemistry (MSFT421-24)

Unit	Contents	Contact Hours
I	***Introduction to Food Chemistry and Biochemistry:*** Definition and scope of food chemistry and biochemistry.; Composition of food: Overview of carbohydrates, proteins, lipids, water, vitamins, and minerals.; Importance of food chemistry in food processing and preservation. Understanding relationship between food, nutrition and health. ***Carbohydrates in Foods:*** Structure and classification of carbohydrates. Monosaccharides, disaccharides, and polysaccharides. Functional properties of carbohydrates: Sweetness, viscosity, gelation, and water-binding. Carbohydrate metabolism and dietary fiber. Deficiency diseases caused by carbohydrate imbalances (e.g., ketosis). ***Proteins in Foods:*** Structure and classification of proteins. Amino acids: Essential and non-essential. - Functional properties of proteins: Solubility, gelation, emulsification, and foaming. Protein denaturation and enzymatic activity in food systems. Deficiency diseases caused by protein malnutrition (e.g., Kwashiorkor and Marasmus).	12
II	***Lipids in Foods:*** Structure and classification of lipids. Saturated, unsaturated, and trans fats. Functional properties of lipids: Emulsification, crystallization, and oxidation. Role of lipids in flavor and texture of foods. Diseases and health issues related to lipid imbalances (e.g., cardiovascular diseases, obesity). ***Vitamins and Minerals:*** Classification of vitamins: Water-soluble and fat-soluble. Functions, stability, and degradation of vitamins. Essential minerals in food: Macro and micro minerals. Bioavailability and factors affecting mineral absorption. Deficiency diseases due to vitamin and minerals imbalances (e.g., scurvy, beri-beri, Goitre, rickets, anemia, and osteoporosis).	11
III	***Enzymes in Foods:*** Nature and classification of enzymes. Mechanism of enzyme action. Enzyme activity in food processing: Proteases, amylases, lipases, and pectinases. Enzyme inhibition and its implications. ***Food Colors and Pigments:*** Natural pigments in food: Chlorophyll, carotenoids, anthocyanins, and betalains. Synthetic food colors and their regulations. Stability of food pigments under different conditions. Role of pigments in food quality and acceptability. ***Food Additives:*** Definition and classification of food additives. Preservatives, antioxidants, emulsifiers, and stabilizers. Safety and regulatory aspects of food additives. Role of additives in enhancing food quality and shelf life.	11
IV	***Food Flavors and Aromas:*** Chemical basis of food flavors. Natural and synthetic flavoring agents. Aroma compounds in food and their perception. Factors affecting flavor stability during processing and storage. ***Nutraceuticals and Functional Foods :*** Introduction to nutraceuticals and functional foods. Bioactive compounds in food: Polyphenols, phytosterols, and omega-3 fatty acids. Health benefits of functional foods. Regulatory aspects of nutraceuticals and functional foods. ***Food Biochemistry of Fermentation:*** Principles of fermentation and its applications in food. Role of microorganisms in fermentation. Biochemical changes during fermentation: Alcoholic, lactic acid, and acetic acid fermentation. Probiotics and their health benefits.	12

	Advanced Topics in Food Biochemistry: Recent advancements in food chemistry research. Impact of genetic engineering on food composition. Role of omics technologies in food biochemistry: Genomics, proteomics, and metabolomics. Future trends in food biochemistry.	

Recommended Books and Resources

1. Belitz, H.-D., Grosch, W., & Schieberle, P. (2009). Food Chemistry (4th ed.). Springer.
2. Damodaran, S., Parkin, K. L., & Fennema, O. R. (2017). Fennema's Food Chemistry (5th ed.). CRC Press.
3. Coultate, T. P. (2016). Food: The Chemistry of Its Components (6th ed.). Royal Society of Chemistry.
4. DeMan, J. M. (1999). Principles of Food Chemistry (3rd ed.). Springer.
5. Vaclavik, V. A., & Christian, E. W. (2014). Essentials of Food Science (4th ed.). Springer.
6. Nielsen, S. S. (Ed.). (2017). Food Analysis (5th ed.). Springer.
7. Hui, Y. H. (Ed.). (2006). Handbook of Food Science, Technology, and Engineering. CRC Press.
8. Yada, R. Y. (Ed.). (2004). Proteins in Food Processing. Woodhead Publishing.
9. Simpson, B. K., Aluko, R. E., & Aryee, A. N. (Eds.). (2019). Biochemistry of Foods (3rd ed.). Academic Press.
10. Shahidi, F., & Zhong, Y. (Eds.). (2018). Lipid Chemistry and Applications. Wiley.
11. Schaafsma, G., & Kok, F. J. (Eds.). (2006). Nutritional Biochemistry of the Vitamins. Cambridge University Press.
12. Campbell-Platt, G. (2017). Food Science and Technology (2nd ed.). Wiley-Blackwell.
13. Mann, J., & Truswell, S. (2017). Essentials of Human Nutrition (5th ed.). Oxford University Press.
14. Shils, M. E., Shike, M., Ross, A. C., Caballero, B., & Cousins, R. J. (Eds.). (2005). Modern Nutrition in Health and Disease (10th ed.). Lippincott Williams & Wilkins.
15. Whitney, E., & Rolfes, S. R. (2018). Understanding Nutrition (15th ed.). Cengage Learning.
16. Gibson, R. S. (2005). Principles of Nutritional Assessment (2nd ed.). Oxford University Press.
17. Allen, L., de Benoist, B., Dary, O., & Hurrell, R. (2006). Guidelines on Food Fortification with Micronutrients. World Health Organization (WHO).
18. MIT OpenCourseWare – Principles of Biochemical Engineering: https://ocw.mit.edu
19. NPTEL Online Courses – Food Chemistry and Biochemistry: https://nptel.ac.in

MSFT422-24: Principles of Food Engineering

Total marks: 100	**L**	**T**	**P**
	4	**0**	**0**

Course objective:

To equip students with a comprehensive understanding of the fundamental engineering principles and their applications in food processing, covering material and energy balances, heat and mass transfer, fluid flow, rheology, mechanical operations, and process control for the efficient design and optimization of food systems.

Course outcome: At the end of the course, the students will be able to

CO1	Develop a comprehensive understanding of food engineering principles, including the physical, gravimetric, optical, and thermal properties of food, and their applications in processing.
CO2	Apply concepts of material and energy balances, heat transfer, and fluid dynamics to analyze and optimize food processing systems effectively.
CO3	Demonstrate proficiency in mass transfer operations, rheology, and textural analysis for designing efficient food preservation and extraction processes.
CO4	Utilize knowledge of mechanical operations, process control, and automation for the design and operation of food processing equipment.
CO5	Incorporate sustainability and energy efficiency principles into the design and operation of food engineering systems while adhering to hygiene and safety standards.

Mapping of Course Outcomes with Program Outcomes: Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)

PO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	3	2	2	2
CO2	2	3	2	3	3
CO3	1	1	1	2	1
CO4	1	1	1	1	2
CO5	3	3	3	2	3

Details of the Course Content - Principles of Food Engineering (MSFT422-24)

Unit	Contents	Contact Hours
I	**Introduction to Food Engineering:** Definition and scope of food engineering. Overview of food processing industries and challenges. Units and dimensions in food engineering. **Physical and Gravimetric Properties:** Size, Shape, Volume, Density, Porosity, Specific Surface Area, Mass, Moisture Content, Water Activity (aw), Bulk Density, Specific Gravity. Application of Physical and Gravimetric Properties **Optical Properties:** Color, Transparency/Opacity, Reflectivity, Refractive Index. Application of Optical Properties	10
II	**Material and Energy Balances in Food Processing:** Basic concepts of material balance. Material balance in food processing systems., Energy balance: concepts and calculations. Applications of energy balance in food processing. **Heat Transfer in Food Processing – Fundamentals:** Modes of heat transfer: conduction, convection, and radiation. Fourier's law and thermal conductivity. Heat transfer equations and applications in food processing. Thermal Properties of food and their significance: Thermal Conductivity, Thermal Diffusivity, Specific Heat Capacity, Latent Heat, Enthalpy. Heat Transfer Applications in Food Engineering: **Aerodynamic and Hydrodynamic Properties:** Terminal Velocity, Drag Coefficient, Fluidization Characteristics. Application of Aerodynamic and Hydrodynamic Properties	11
III	**Mass Transfer in Food Processing – Fundamentals:** Mass Transfer Properties (Diffusivity, Permeability, Sorption Isotherms), Principles of diffusion and mass transfer., Fick's law of diffusion and its applications., Mass transfer coefficients in food systems., Significance of mass transfer in drying, extraction, and absorption. Mass Transfer Applications in Food Engineering **Fluid Flow in Food Processing:** Properties of fluids and types of flow (laminar and turbulent). Fluid flow in pipes and channels: continuity equation and Bernoulli's principle. Pumps and pumping systems in food processing. **Rheological and Textural Properties**: Viscosity, Elasticity, Plasticity, Hardness, Cohesiveness, Adhesiveness, Chewiness. Rheological Properties: Viscosity, Elasticity, Plasticity, Flow Behavior: Newtonian and non-Newtonian characteristics. Rheology of food products and its engineering implications.	12
IV	**Mechanical Operations in Food Engineering:** Mechanical Properties: Strength, Stiffness, Fracture Toughness, Compression/Tension Properties, Shear Force. Size reduction: principles and equipment (grinders, crushers, mills). Mixing of food materials: types and applications. Separation processes: centrifugation, filtration, and sieving. Emulsification and homogenization techniques.	12

	Food Process Control and Instrumentation: Basics of process control and automation in food engineering. Measurement of temperature, pressure, and flow in food processing. Control systems: feedback and feedforward control. Computer applications in food engineering. **Food Processing Equipment Design:** Principles of equipment design for food processing. Materials used in food processing equipment. Sanitary design and hygiene requirements. Energy efficiency in equipment design.	

Recommended Books and Resources

1. Heldman, D. R., & Singh, R. P. (2018). *Introduction to Food Engineering* (5th ed.). Academic Press.
2. Fellows, P. J. (2017). *Food Processing Technology: Principles and Practice* (4th ed.). Woodhead Publishing.
3. Rao, M. A., Rizvi, S. S. H., Datta, A. K., & Ahmed, J. (2014). *Engineering Properties of Foods* (4th ed.). CRC Press.
4. Toledo, R. T., Singh, R. K., & Narlikar, S. M. (2018). *Fundamentals of Food Process Engineering* (4th ed.). Springer.
5. Cengel, Y. A., & Ghajar, A. J. (2021). *Heat and Mass Transfer: Fundamentals and Applications* (6th ed.). McGraw-Hill Education.
6. Barbosa-Cánovas, G. V., & Juliano, P. (2005). *Food Powders: Physical Properties, Processing, and Functionality.* CRC Press.
7. McCabe, W. L., Smith, J. C., & Harriott, P. (2020). *Unit Operations of Chemical Engineering* (7th ed.). McGraw-Hill Education.
8. Singh, R. P., & Heldman, D. R. (2009). *Introduction to Food Process Engineering.* Springer.
9. Chandrasekaran, M., & Ramanathan, G. (2018). *Processing and Impact on Active Components in Food.* Academic Press.
10. Brennan, J. G., & Grandison, A. S. (2011). *Food Processing Handbook* (2nd ed.). Wiley-VCH.
11. Ranganna, S. (1986). *Handbook of Analysis and Quality Control for Fruit and Vegetable Products* (2nd ed.). Tata McGraw-Hill Education.
12. NPTEL Online Courses: Food Engineering and Process Control nptel.ac.in.

MSFT423-24: Dairy Technology

Total marks: 100	**L**	**T**	**P**
	4	**0**	**0**

Course objective:

To provide comprehensive knowledge of dairy technology, including milk composition, processing techniques, fermented and fat-rich dairy products, indigenous products, by-products, value-added dairy innovations, and adherence to standards and legislations, ensuring proficiency in sustainable and quality dairy production.

Course outcome: At the end of the course, the students will be able to

CO1	Understand the composition, properties, and processing techniques of milk and its derivatives, ensuring knowledge of quality assurance and safety.
CO2	Analyze and apply advanced methods for producing fermented dairy products, fat-rich products, and traditional dairy items.
CO3	Develop expertise in processing and utilizing dairy by-products and value-added products for sustainable dairy production.
CO4	Evaluate and implement technological interventions to improve shelf life, scalability, and compliance with dairy standards and legislations.
CO5	Gain practical insights into troubleshooting defects, optimizing production efficiency, and enhancing the nutritional and economic value of dairy products.

Mapping of Course Outcomes with Program Outcomes: Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)

PO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	2	1	1	3
CO2	2	3	1	2	3
CO3	2	3	1	1	3
CO4	3	2	2	**3**	3
CO5	3	3	1	2	3

Details of the Course Content - Dairy Technology (MSFT423-24)

Unit	Contents	Contact Hours
I	**Introduction to Dairy Technology:** Overview of the dairy industry: global and Indian perspectives, Importance of milk and dairy products in nutrition and economy, **Milk:** Definition, composition and nutritive value of milk and factors affecting it, Physicochemical properties of milk. Milk Lipids: Chemical and functional properties. Chemical reactions (hydrolysis, auto-oxidation), factors affecting oxidation, prevention methods, and measurement techniques. Milk Proteins: Types (caseins, whey proteins), micellar structure, protein precipitation mechanisms, functional roles in emulsification, foaming, and gelation. Milk Enzymes: Key enzymes (catalase, alkaline phosphatase, lipases, proteases) and their roles in milk processing, freshness indicators, and product quality. Coagulation of Milk: Enzymatic (rennet action) and acid-induced coagulation, casein aggregation, and gel formation in cheese and yogurt. **Milk Procurement and Quality Testing:** Clean milk production. Milk procurement systems, Milk collection and chilling centers, Quality and safety testing of raw milk: physical, chemical, and microbiological tests **Liquid Milk Products:** Standardization of milk: fat and SNF adjustment; fullcream, standard, Toned, double-toned, and skimmed milk, Flavoured milk, Reconstituted milk and recombined milk,; Fortification of milk: micronutrients and technologies. Adulteration of milk and its detection. Common preservative used in milk and their detection.	11
II	**Milk Processing Techniques:** Principles of milk processing, Various stages of processing such as Filtration, Clarification, Storage and processing of fluid milk i.e. Pasteurization, sterilization, UHT processing and aseptic packaging and homogenization: principles, types and applications. **Fermented Dairy Products:** **Cheese Technology:** Classification, Production Process, Characteristics, Health Benefits, Common cream defects, their causes, and remedies of various cheese (fresh, ripened, and processed), Microbiology and biochemistry of cheese ripening. **Yogurt and curd:** Definition, Types, Production Process, Characteristics, Health Benefits, Common cream defects, their causes, and remedies **Kumis, Kefir, acidophilus milk, and cultured buttermilk:** Definition, Production Process, Characteristics, Health Benefits, Common cream defects, their causes, and remedies	11
III	**Fat-Rich Dairy Products:** ***Cream:***Types of cream and their respective fat content, Composition and production methods of cream., Factors affecting the richness of cream during separation. Efficiency of cream separators and	12

	optimization techniques.Cream ripening for butter making:Natural ripening and ripening with starter cultures, Objectives and biochemical changes during cream ripening. Common cream defects, their causes, and remedies ***Butter:*** Types and composition of butter, Methods of butter preparation, Factors influencing cream churnability, Theories of churning, Butter grading, Common butter defects, their causes, and remedies. Butter standard and shelf life enhancement techniques. ***Ghee production:*** traditional and industrial methods, Common defects, their causes, and remedies Nutritional aspects and shelf-life enhancement of fat-rich products **Concentrated and Evaporated Milk Products:** Condensed milk and evaporated milk: processing, packaging and uses, Common condensed and evaporated defects, their causes, and remedies; **Dried Milk Products** (WMP, SMP): composition, nutritive value, process of manufacture, Common dry powder defects, their causes, and remedies, Instantization of milk powder. Infant milk food. **Ice Cream and Frozen Dairy products**- composition, nutritive value, process of manufacture, defects (their causes and prevention). Stabilizers and emulsifiers in frozen desserts	
IV	**Indigenous Dairy Products:** Production of khoa, paneer, chhana, shrikhand and traditional sweets (rasgulla, gulab jamun, peda and burfi**).** Technological interventions for scaling up production and shelf-life enhancement**,** Challenges in scaling up traditional dairy processes **By-Products and Value-Added Dairy Products:** Overview of Dairy By-Products- Definition, classification, Products Derived from Dairy By-Products, Challenges in processing and storage of by-products. and benefits of utilizing dairy by-products; Value-Added Dairy Products: Cream Powder, Sterilized Cream, Butter Powder, Butter Spread and Cheese Spread – Production and applications. **Standards and Legislations:** Milk and milk products standards and legislations – part III of Schedule 4 of Food Safety & Standards (Licensing & Registration of Food Businesses) Regulation, 2011, Dairy plant sanitation-hygiene in dairy industry, different types of cleansing and sanitizing agents, their applications, cleaning systems (cleaning in place, central cleaning system, self-contained cleaning system). Documentation and Record Keeping	12

Recommended Books and Resources

1. Walstra, P., Wouters, J. T., & Geurts, T. J. (2005). *Dairy Science and Technology*. CRC Press.
2. Tamime, A. Y., & Robinson, R. K. (2007). *Yoghurt: Science and Technology* (3rd ed.). Woodhead Publishing.
3. Chandan, R. C., Kilara, A., & Shah, N. P. (2015). *Dairy Processing and Quality Assurance* (2nd ed.). Wiley-Blackwell.

4. Fox, P. F., Guinee, T. P., Cogan, T. M., & McSweeney, P. L. (2017). *Fundamentals of Cheese Science* (2nd ed.). Springer.
5. Goff, H. D., & Hartel, R. W. (2013). *Ice Cream* (7th ed.). Springer.
6. Smith, G. (2021). *Milk Processing and Quality Management*. Wiley.
7. Tamime, A. Y. (2009). *Dairy Powders and Concentrated Products*. Wiley-Blackwell.
8. Aneja, R. P., Mathur, B. N., Chandan, R. C., & Banerjee, A. K. (2002). *Technology of Indian Milk Products*. Dairy India.
9. Khanal, A. R. (2020). *Technological Advances in Dairy Processing*. Springer.
10. Early, R. (2020). *The Technology of Dairy Products* (2nd ed.). Springer.
11. Handbook of Dairy Products. (2021). *Dairy Industry Handbook*. Elsevier.
12. International Dairy Federation (IDF) - https://www.fil-idf.org/
13. National Programme on Technology Enhanced Learning (NPTEL) - https://nptel.ac.in/
14. Codex Alimentarius - http://www.fao.org/fao-who-codexalimentarius/
15. Walstra, P., & Jenness, R. (2020). *Dairy Chemistry and Physics* (3rd ed.). Springer.
16. FICSI (2022). Butter and Ghee processing operator. FIC/Q2003
17. FICSI (2022). Ice Cream processing Technician. FIC/Q2004
18. FICSI (2020). Cottage Cheese Maker. FIC/Q2005
19. FSSAI (2011). Food Product Standards:Dairy Products And Analogueshttps://fssai.gov.in/upload/uploadfiles/files/2_%20Chapter%202_1%20%28Dairy%20products%20and%20analogues%29.pdf
20. FSSAI (2011). Table-2A Microbiological Standards for Milk and Milk Products –Process Hygiene Criteria. https://fssai.gov.in/upload/uploadfiles/files/Appendix%20B.pdf.
21. FSSAI (2011). Guidance document provides comprehensive instructions based on Part III of Schedule 4. https://fssai.gov.in/upload/uploadfiles/files/Guidance_Document_Milk_14_03_2019.pdf.
22. FSSAI (2011). Food Safety and Standards (Food Products Standards and Food Additives) Regulations, https://fssai.gov.in/upload/uploadfiles/files/Food_Additives_Regulations.pdf.
23. FSSAI (2018). National Milk Safety and Quality Survey. https://fssai.gov.in/upload/uploadfiles/files/Report_Milk_Survey_NMQS_18_10_2019.pdf.
24. FSSAI. Common Quick tests for detection of Food Adulterants at household. https://fssai.gov.in/upload/knowledge_hub/1878035b34b558a3b48DART%20Book.pdf.
25. Indian Council of Agricultural Research (ICAR) E-Learning Portal for Dairy Technology. Available at: https://ecourses.icar.gov.in

MSFT424-24: Dairy Technology (Lab)

Total marks: 50	**L**	**T**	**P**
	0	**0**	**4**

Course objective:

To develop proficiency in practical techniques for analyzing, processing, and ensuring the quality and safety of milk and milk products in alignment with FSSAI standards and global best practices.

Course outcome: At the end of the course, the students will be able to

CO1	Demonstrate proficiency in sampling, analyzing, and evaluating the physicochemical properties and quality parameters of milk and milk products.
CO2	Identify and detect common adulterants and microbial contaminants in dairy products, ensuring compliance with food safety and regulatory standards.
CO3	Develop skills in the preparation and quality assessment of various dairy products, including butter, paneer, cheese, yogurt, and ice cream.
CO4	Evaluate the thermal processing efficiency and packaging techniques to ensure the safety, stability, and shelf life of milk and milk-based products.
CO5	Apply knowledge of dairy technology in implementing FSSAI standards and quality control measures for market milk and milk products.

Mapping of Course Outcomes with Program Outcomes: Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)

PO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	2	1	2	3
CO2	2	1	2	3	3
CO3	3	2	2	2	3
CO4	3	2	1	3	3
CO5	2	3	2	3	3

Details of the Course Content - Dairy Technology (Lab) (MSFT424-24)

Practical no.	Contents	Contact Hours
1	Sampling Techniques for Milk and Milk Products	1
2	Determination of Specific Gravity of Milk	1
3	Analysis of Milk Fat Content and Solid-Not-Fat (SNF)	1
4	COB and Alcohol test	1
5	Milk Acidity and pH Determination	1
6	Detection of Adulterants in Milk	1
7	Methylene Blue Reduction Test (MBRT)	1
8	Preparation of flavoured milk	1
9	Cream Separation and Fat Testing	1
10	Preparation and Quality Evaluation of butter quality	1
11	Alkaline phosphatase test to determine the adequacy of pasteurization.	1
12	Preparation and Quality Evaluation of Ghee	1
13	Preparation and Quality Evaluation of Paneer	1
14	Preparation and Quality Evaluation of Cheese	1
15	Preparation and Quality Evaluation of Yogurt	1
16	Detection of Microbial Contamination	1
17	Determination of the Freezing Point of Milk	1
18	Shelf Life Study of Milk Products	1
19	Preparation and Quality Evaluation of Ice Cream	1
20	Quality Control of Market Milk	1
21	Determination of Milk Proteins	1
22	Analysis of packaging materials, shelf-life impact, and FSSAI labeling requirements.	1

Recommended Books and Resources

1. Bureau of Indian Standards (BIS) Specifications for Milk and Milk Products. Available at: https://bis.gov.in
2. FSSAI Dairy Products Manual (2022). Available at: https://fssai.gov.in
3. International Organization for Standardization (ISO) Guidelines for Milk and Dairy Products. Available at: https://iso.org
4. Association of Official Analytical Chemists (AOAC) Official Methods of Analysis. Available at: https://aoac.org
5. Handbook of Dairy Foods Analysis by Leo M.L. Nollet and Fidel Toldra.
6. Indian Council of Agricultural Research (ICAR) E-Learning Portal for Dairy Technology. Available at: https://ecourses.icar.gov.in
7. National Dairy Development Board (NDDB) Resources. Available at: https://nddb.coop
8. Khan Academy videos on Dairy Technology. Available at: https://khanacademy.org
9. YouTube Channels: NPTEL Dairy Technology Lectures by IITs and Infinity Richa (for competitive exam preparation).
10. Codex Alimentarius Standards for Milk and Milk Products. Available at: https://codexalimentarius.org
11. Practical Dairy Technology by Eiri Board of Consultants and Engineers.
12. "Outlines of Dairy Technology" by Sukumar De.
13. "Modern Dairy Technology" by Robinson, R.K.
14. Dairy Processing and Quality Assurance by Ramesh C. Chandan.

M/FIC/Q7006: Food Packer

Total marks: 100	**L**	**T**	**P**
	4	**0**	**0**

Course objective:

To equip learners with comprehensive knowledge and practical skills in food packaging technologies, materials, machinery, safety standards, and regulatory compliance, ensuring effective packaging solutions that preserve food quality, enhance shelf life, and meet industry standards.

Course outcome: At the end of the course, the students will be able to

CO1	Students will understand the fundamentals of food packaging, including materials, types, and their properties, enabling them to make informed decisions on packaging solutions.
CO2	Learners will gain knowledge of advanced packaging technologies such as aseptic, active, intelligent packaging, and the application of edible films and coatings.
CO3	Students will develop hands-on expertise in operating and troubleshooting various packaging machines and systems used in the food industry.
CO4	Learners will demonstrate an understanding of safety considerations, environmental requirements, and waste management practices in food packaging operations.
CO5	Students will be proficient in adhering to quality standards and regulatory compliance under the Food Safety and Standards Act, for diverse food products.

Mapping of Course Outcomes with Program Outcomes: Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)

PO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	2	1	2	2
CO2	2	3	2	2	3
CO3	3	2	2	1	3
CO4	2	1	2	**3**	2
CO5	3	1	2	3	3

Details of the Course Content - Food Packer (M/FIC/Q7006)

Unit	Contents	Contact Hours
I	**Introduction to Food Packaging**: Definition, factors influencing the evolution and selection of food packaging, and functions of food packaging. Overview of the packaging industry. **Food Packaging Types**: Overview of various sectors in food processing and the packaging materials used. Properties of Packaging Materials: Migration aspects of packaging materials. **Paper and Paper-Based Packaging Materials**: Types, properties, testing methods, defects, and applications. **Plastic Packaging Materials**: Types, properties, and testing methods. Processing and conversion of thermoplastic polymers. Laminates in Packaging: Definition, composition (multi-layer structures combining plastic, paper, aluminum, etc.), properties, manufacturing processes, testing methods, and applications in flexible packaging.	10
II	**Metal Packaging**: Processes for container manufacturing (end-making, two-piece and three-piece can manufacture), coatings, functional properties, defects, application and quality control tests. **Aseptic Packaging**: Materials Used and application, sterilization of packaging materials. **Glass Packaging**: Composition, manufacturing process, closures, properties (mechanical, thermal, optical), applications, defects, and quality control tests. **Active and Intelligent Packaging**: Definition, scope, types, principles, and applications. **Edible Films and Coatings**: Materials Used, Properties, application.	11
III	**Food Packaging Line**: Characteristics and subsystems of packaging machines. **Types of Packaging Machines and Their Operating Parameters**: Blister packs, skin packs, and vacuum packaging machines. Aseptic packaging systems, shrink packaging, stretch wrapping. Bottle capping equipment, closures and closing operations. Seaming and sealing machines, wrapping and bagging equipment. Form-fill-seal machines, cartoning machines, filling machines for liquids, dry, and powdered products. Box, case, and tray forming. **Operating Parameters and Fault Diagnosis**: Identification of equipment faults and parameters required to correct them.	12
IV	**Safety Considerations**: Types of food safety problems associated with packaging. Environmental requirements for specific food packaging and waste management (waste reduction, recycling). Personal hygiene and	12

	sanitation guidelines. Cleaning and documentation of packaging machines after use. Use of personal protective equipment (PPE) in packaging operations. **Quality Criteria for Packaging**: Need for quality assurance in packaging. Significance of different quality tests for packaging materials. Integrity testing of packaging items and identification of discrepancies or non-standard outputs. Food packaging system along with packing specification. **Regulatory Compliance**: Food Safety and Standards Act, 2011 - Packaging and Labeling regulations specific to food items such as: Milk and milk products. Fruits and vegetable products. Fats, oils, and fat emulsions. Sweets, confectionery, meat, and poultry products. Fish, seafood, honey, spices, condiments, beverages, salt, and related products. Handling of food and related materials, along with housekeeping practices.	

Recommended Books and Resources

1. Ahvenainen, R. (2003). Novel Food Packaging Techniques. CRC Press.
2. Coles, R., McDowell, D., & Kirwan, M. J. (Eds.). (2003). Food Packaging Technology. Wiley-Blackwell.
3. Robertson, G. L. (2016). Food Packaging: Principles and Practice (3rd ed.). CRC Press.
4. Kirwan, M. J. (2011). Handbook of Paper and Paperboard Packaging Technology (2nd ed.). Wiley-Blackwell.
5. Han, J. H. (2013). Innovations in Food Packaging (2nd ed.). Academic Press.
6. Emblem, A., & Emblem, H. (Eds.). (2012). Packaging Technology: Fundamentals, Materials and Processes. Woodhead Publishing.
7. Soroka, W. (2009). Fundamentals of Packaging Technology (4th ed.). IoPP.
8. Yam, K. L. (2009). The Wiley Encyclopedia of Packaging Technology (3rd ed.). Wiley.
9. Lee, D. S., Yam, K. L., & Piergiovanni, L. (2008). Food Packaging Science and Technology. CRC Press.
10. Mahalik, N. P. (2014). Automation in Packaging and Food Processing. CRC Press.
11. Singh, S. P., & Singh, J. (2011). Packaging Materials and Systems for Food Products. Wiley-Blackwell.
12. Food Safety and Standards Authority of India (FSSAI). (2011). Packaging and Labeling Regulations. Accessible at www.fssai.gov.in.
13. YouTube Channel: Institute of Packaging Professionals (IoPP).: Video lectures on packaging technologies and industry practices.
14. Website: www.packagingdigest.com: Industry updates and innovations in food packaging.
15. Website: www.foodpackagingforum.org: Scientific insights into food packaging materials and safety regulations.
16. Food Packaging Developer, FIC/Q9302 (2022). Accesible at https://www.ficsi.in/upload/participant_handbook/Food%20Packaging%20Developer%20PHB%20English_Final.pdf
17. Food Packer, FIC/Q7006 (2023). Accesible at https://www.ficsi.in/upload/participant_handbook/Food%20Packer%20PH%20V1.0%20english.pdf
18. Food Products Packaging Technician, FIC/Q7001 (2016). Accesible at https://www.ficsi.in/upload/practical_guides/3f7942240cacd95c45a0c93b01d118c1.pdf

M/FIC/Q7001: Food Products Packaging Technician (Lab)

Total marks: 50	**L**	**T**	**P**
	0	**0**	**4**

Course objective:

To equip learners with the technical knowledge and practical skills required for effective food packaging operations, including material identification, quality testing, machinery operation, documentation, regulatory compliance, and shelf-life estimation of packaged foods.

Course outcome: At the end of the course, the students will be able to

CO1	Students will demonstrate the ability to clean, maintain, and operate packaging machinery and work areas to ensure efficiency and hygiene.
CO2	Learners will acquire skills in planning and calculating packaging materials, machinery, and manpower requirements for optimal production output.
CO3	Students will gain proficiency in testing and identifying various packaging materials, understanding packaging regulations, and addressing packaging defects.
CO4	Learners will perform quality tests on diverse packaging materials such as paper, plastic, metal, glass, and composites, ensuring compliance with industry standards.
CO5	Students will effectively document packaging processes, maintain records of packed products, and estimate shelf life using sorption isotherm curves for different packaged foods.

Mapping of Course Outcomes with Program Outcomes: Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)

PO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	2	1	2	3
CO2	2	3	2	2	3
CO3	3	2	3	3	3
CO4	3	2	1	3	3
CO5	3	1	2	2	3

Details of the Course Content - Food Products Packaging Technician (Lab) (M/FIC/Q7001)

Practical no.	Contents	Contact Hours
1	Demonstrate the appropriate method for cleaning and maintaining the work area and process machineries	1
2	Demonstrate how to plan and calculate packaging materials, machineries and Manpower required for getting desired quantity of finished product	1
3	Carry out the process of post-production cleaning and regular maintenance work	1
4	Demonstrate the process of maintaining documentation for packaging materials	1
5	Demonstrate the Records of Packed Products	1
6	Identification and testing of packaging materials used for different foods	1
7	Identify different types of food packaging and packing material with their Packaging Regulation	1
8	Sampling Plan and Condition of Test Specimen	1
9	Quality Tests for paper and paper boards	1
10	Quality Tests for Plastic Films and Laminates	1
11	Quality Tests for Aluminium Foils	1
12	Quality Tests for Glass Containers	1
13	Classification of Packaging defects	1
14	Quality Tests for Metal Containers	1
15	Quality Tests for Plastic Containers	1
16	Quality Tests for Kraft Liner, Fluting Media	1
17	Quality Tests for Corrugated Board, Folding Cartons, Lined Carton, Liners, Aseptic Cartons	1
18	Performance Tests of Corrugated Fibre Board Boxes	1
19	Quality Tests for Thermoformed Containers	1
20	Peel Test on Lid or Sealing Material	1
21	Peel Test of Adhesive Tapes	1
22	Tack Loop Test for Testing the Adhesive Strength of Adhesive Tape	1
23	Unscrewing Lids/Torsion Testing	1
24	Preparation sorption isotherm curve and estimation of shelf life various packaged foods	1

Recommended Books and Resources

1. Food Products Packaging Technician, FIC/Q7001 (2016). Accesible at https://www.ficsi.in/upload/practical_guides/3f7942240cacd95c45a0c93b01d118c1.pdf
2. Food Packaging Developer, FIC/Q9302 (2022). Accesible at https://www.ficsi.in/upload/participant_handbook/Food%20Packaging%20Developer%20PHB%20English_Final.pdf
3. Food Packer, FIC/Q7006 (2023). Accesible at https://www.ficsi.in/upload/participant_handbook/Food%20Packer%20PH%20V1.0%20english.pdf
4. Food Safety and Standards Authority of India (FSSAI). (2011). Packaging and Labeling Regulations. Accessible at www.fssai.gov.in.
5. Robertson, G. L. (2016). Food Packaging: Principles and Practice (3rd ed.). CRC Press.
6. Kirwan, M. J. (2011). Handbook of Paper and Paperboard Packaging Technology (2nd ed.). Wiley-Blackwell.

7. Emblem, A., & Emblem, H. (Eds.). (2012). Packaging Technology: Fundamentals, Materials and Processes. Woodhead Publishing.
8. Soroka, W. (2009). Fundamentals of Packaging Technology (4th ed.). IoPP.
9. Yam, K. L. (2009). The Wiley Encyclopedia of Packaging Technology (3rd ed.). Wiley.
10. YouTube Channel: Institute of Packaging Professionals (IoPP).: Video lectures on packaging technologies and industry practices.
11. Website: www.packagingdigest.com: Industry updates and innovations in food packaging.
12. Website: www.foodpackagingforum.org: Scientific insights into food packaging materials and safety regulations.
13. Bureau of Indian Standards (BIS): IS 8312: Specification for Food Packaging Materials
14. Indian Standards for Paper Testing - IS 1060 (Part 1 to 3): Testing of Paper and Paperboard.
15. Handbook of Packaging Technology by A. Emblem and H. Emblem, Woodhead Publishing.
16. Food Packaging: Principles and Practice by Gordon L. Robertson, CRC Press.
17. YouTube Channel: Institute of Packaging Professionals (IoPP) - Video tutorials on packaging machinery operation and testing.
18. Testing and Quality Assurance in Packaging - ASTM D4169 for Performance Testing of Shipping Containers.
19. Plastic Films and Laminates Testing - ASTM D882: Standard Test Method for Tensile Properties of Thin Plastic Films.
20. Handbook of Corrugated Fibreboard by McKinlay, American Forest & Paper Association.
21. Metal Containers Testing Standards - IS 14002: Testing of Tin and Steel Containers.
22. Peel Testing and Adhesive Strength Analysis - ASTM D3330: Standard Test Method for Peel Adhesion.
23. Practical Guide to Packaging Materials by Deborah L. Dull.
24. Sorption Isotherm and Shelf-Life Estimation - CRC Handbook of Food Science and Technology.
25. Singh, S. P., & Singh, J. (2011). Packaging Materials and Systems for Food Products. Wiley-Blackwell.

M/FIC/Q9001: Processed Food Entrepreneur

Total marks: 100	**L**	**T**	**P**
	4	**0**	**0**

Course objective:

To equip learners with comprehensive knowledge and skills in entrepreneurship, business planning, and operational management specific to the processed food industry, enabling them to establish and manage sustainable food processing enterprises with an emphasis on innovation, regulatory compliance, and market competitiveness.

Course outcome: At the end of the course, the students will be able to

CO1	Demonstrate a clear understanding of entrepreneurship concepts, roles, and opportunities, particularly in the processed food industry, while integrating innovation and sustainability into business practices.
CO2	Develop and evaluate business plans, conduct feasibility studies, and design strategies for product selection, costing, branding, and packaging tailored to market needs.
CO3	Gain proficiency in planning and establishing food processing units, including site selection, financing, documentation, and adherence to regulatory requirements.
CO4	Execute operational processes in food processing, including plant design, recruitment, production, quality assurance, and food safety practices, ensuring compliance with industry standards.
CO5	Apply effective marketing, sales, distribution, and sanitization strategies to manage and grow food processing enterprises, fostering competitiveness and sustainability in the marketplace.

Mapping of Course Outcomes with Program Outcomes: Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)

PO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	2	2	2	2
CO2	3	3	2	3	3
CO3	3	2	2	3	3
CO4	3	2	3	2	3
CO5	2	3	3	3	3

Details of the Course Content - Processed Food Entrepreneur (M/FIC/Q9001)

Unit	Contents	Contact Hours
I	**Introduction to Entrepreneurship** **Concepts of Entrepreneurship**: Definition, characteristics, and types of entrepreneurship. Innovation and sustainability in food businesses **Business Opportunities in Entrepreneurship**: Identification and evaluation of business ideas in the food industry. **Entrepreneur vs. Entrepreneurship**: Roles, characteristics, and significance. **Overview of the "Processed Food Entrepreneur" Role**: Responsibilities, challenges, and opportunities in the field. Overview of Processed Food Industry. Case studies of successful entrepreneurs. **Skills for Success**: Professional skills, IT skills for business, Core skills in food entrepreneurship **Evaluate and Develop Entrepreneurship Skills**: Identifying business opportunities, Conducting a market study, Preparing a business plan, Managing an enterprise, Utilizing online banking and digital tools for business operations.	11
II	**Selection of Product and Business Planning** **Business Planning**: Definition and importance of a business plan, Key components of a business plan, Understanding risks in small businesses, Steps to establish a business **Business Idea Generation and Validation:** Process for selecting the right product, Identifying market gaps and consumer needs Feasibility study for the product, Market research and analysis, Product development and testing methodologies **Costing, Branding, and Packaging**: Principles of product costing, Developing a branding strategy, Selecting appropriate packaging materials and designs	11
III	**Preparing for the Start-Up of a Food Processing Unit** **Site Selection for the Food Processing Unit**: Criteria for selecting a suitable site, Regulatory and logistical considerations **Finance Management**: Methods for arranging finance, Financial institutions offering loans, Requirements and procedures for securing loans, Types of loans available for food entrepreneurs	12

	Entrepreneur's Memorandum: Filing procedures for the Entrepreneur's Memorandum, Importance of the memorandum for business registration **Documentation and Record Keeping**: Maintaining accurate documentation for regulatory compliance and record-keeping best practices for food processing units.	
IV	**Starting a Food Processing Unit** **Food Processing Unit Design and Construction**: Designing food processing plants, Layout planning and optimization, Construction requirements for food safety compliance **Setting Up a Food Processing Unit**: Recruitment and training of manpower, Production processes and machinery selection, Obtaining necessary registrations and licenses, Labelling and packaging regulations for food products **Food Production and Testing**:Verifying raw materials, Conducting trial production runs, Food nutrition analysis and laboratory testing, Food Product Production, Food Product Inspection **Marketing and Sales**: Developing marketing strategies for food products, Setting up distribution channels, Managing logistics for efficient food distribution **Cleaning and Sanitization**: Implementing cleaning and sanitization processes, Sterilization and hygiene maintenance in food processing facilities.	12

Recommended Books and Resources

1. Acharya, S. S., & Agarwal, N. L. (1987). *Agricultural Marketing in India*. Oxford & IBH Publishing Co., New Delhi.
2. Chandra, P. (1996). *Projects: Planning, Analysis, Selection, Implementation and Review*. Tata McGraw-Hill Publishing Company Limited, New Delhi.
3. David, D., & Erickson, S. (1987). *Principles of Agri-Business Management*. McGraw Hill Book Co., New Delhi.
4. Desai, V. (2011). *The Dynamics of Entrepreneurial Development and Management*. Himalaya Publishing House Pvt. Ltd., Mumbai.
5. Desai, V. (2012). *Fundamentals of Entrepreneurship and Small Business Management*. Himalaya Publishing House Pvt. Ltd., Mumbai.
6. Fellows, P., & Axtell, B. (2012). *Setting up and Running a Small Food Business: A Guide for Food Entrepreneurs*. CTA.
7. Goyal, M., & Parkash, J. (2011). *Entrepreneurship Development*. Kalyani Publishers.
8. Hisrich, R. D., Peters, M. P., & Shepherd, D. A. (2020). *Entrepreneurship*. McGraw Hill.
9. Holt, D. H. (2002). *Entrepreneurship – A New Venture Creation*. Prentice Hall of India, New Delhi.
10. Kotler, P., Keller, K. L., & Chernev, A. (2021). *Marketing Management*. Pearson.
11. Osterwalder, A., & Pigneur, Y. (2010). *Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers*. Wiley.

12. Processed Food Entrepreneur - FIC/Q9001(2022). Accesible at https://www.ficsi.in/upload/participant_handbook/PH_English_Processed%20Food%20Entrepreneur_FICQ9001_Ver3.0.pdf.
13. Sivakumar, A. I. (2014). *Introduction to Food Manufacturing Engineering*. CRC Press.

MSFT425-24: Industrial Visit with Cold Storage Technician Course

Total marks: 40	**L**	**T**	**P**
	0	**0**	**3**

Course objective:

To provide students with practical exposure to food industry operations and/or cold storage technologies through industrial visits or expert interactions and completion of the FICSI - Cold Storage Technician Course, fostering technical skills in cold storage systems, equipment maintenance, temperature control, and industry standards compliance.

Course outcome: At the end of the course, the students will be able to

CO1	Demonstrate an understanding of food industry operations and cold storage technologies through hands-on exposure and expert-led interactions.
CO2	Develop technical proficiency in the maintenance and operation of cold storage systems, including temperature control and equipment management.
CO3	Acquire knowledge of industry standards, safety protocols, and best practices for cold chain management in the food sector.
CO4	Enhance report-writing and analytical skills by documenting and presenting findings from industrial visits or expert lectures.
CO5	Obtain FICSI certification as a Cold Storage Technician, ensuring industry-recognized competence and readiness for professional roles.

Mapping of Course Outcomes with Program Outcomes: Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)

PO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	2	1	1	2
CO2	3	2	2	1	3
CO3	3	1	2	2	3
CO4	2	1	3	2	2
CO5	3	1	3	2	3

Details of the Course Content - Industrial Visit with Cold Storage Technician Course (MSFT425-24)

Unit	Contents	Contact Hours
I	Students are required to visit any food industry or attend a guest lecture by a food industry expert. Subsequently, they must submit a report to the Head of the Department and Course Coordinator.	12
II	Cold Storage Technician course must be completed and certified from https://www.skillindiadigital.gov.in or https://elearning.ficsi.in/ or any FICSI recognized Training center	

Recommended Books and Resources

1. https://elearning.ficsi.in
2. https://www.skillindiadigital.gov.in

SEMESTER- III

Program Scheme & Syllabus

Semester III

Course Code	Course Title	Course Type	Load			Marks Distribution		Total	Credits
			L	T	P	Internal	External		
M/FIC/Q5005	Food Regulatory Affairs Manager	DSC/ QP-NOS	4	0	0	40	60	100	4
MSFT511-24	Comprehensive Technology of Fruits and Vegetables	DSE	4	0	0	40	60	100	4
MSFT512-24	Comprehensive Technology of Fruits and Vegetables (Lab)	DSE	0	0	4	30	20	50	2
MSFT513-24	Comprehensive Technology of Cereals, Pulses & Oilseeds	DSE	4	0	0	40	60	100	4
MSFT514-24	Comprehensive Technology of Cereals, Pulses & Oilseeds (Lab)	DSE	0	0	4	30	20	50	2
MSFT515-24	Bakery and Confectionery Technology	DSE	4	0	0	40	60	100	4
MSFT516-24	Bakery and Confectionery Technology (Lab)	DSE	0	0	4	30	20	50	2
	Select any from MSFT517-24 or MSFT518-24	SEC-SB	4	0	0	40	60	100	4
MSFT519-24	Industrial Visit with FoSTaC Course	AECC/ SEC-SB	0	0	3	40	--	40	3
	Total		**20**	**0**	**15**	330	360	690	29

[#] Students will learn the practical application of Food Regulatory Affairs Manager and FoSTaC-Advance Retail and Distribution skills in the food industry through industrial visits in third semester.

FoSTaC-Advance Retail and Distribution course must be completed from https://www.skillindiadigital.gov.in/home or FICSI or any FSSAI recognized Training center

Course Code	Course Title	Course Type	Load			Marks Distribution		Total	Credits
			L	T	P	Internal	External		
MSFT517-24	Applied Flavor Science for Food Innovation	SEC-SB	4	0	0	40	60	100	4
MSFT518-24	Artificial Intelligence in the Food Industry	SEC-SB	4	0	0	40	60	100	4

M/FIC/Q5005: Food Regulatory Affairs Manager

Total marks: 100	**L**	**T**	**P**
	4	**0**	**0**

Course objective:

To equip learners with a thorough understanding of food safety, quality assurance, regulatory frameworks, and managerial competencies necessary to implement, monitor, and lead effective food safety and regulatory compliance systems in the food industry.

Course outcome: At the end of the course, the students will be able to

CO1	Demonstrate comprehensive knowledge of food safety, quality assurance models, and international regulatory frameworks such as WTO and Codex Alimentarius.
CO2	Apply principles of food safety management systems, GMP, GHP, and FSSAI regulatory requirements effectively in food processing environments.
CO3	Develop, implement, and manage food regulatory policies, recall systems, and compliance strategies to ensure product safety and legal adherence.
CO4	Exhibit professional managerial skills including effective communication, training, audit management, and change facilitation in food regulatory affairs.
CO5	Critically analyze case studies of regulatory challenges, prepare documentation for licensing, and lead food safety teams to uphold industry standards.

Mapping of Course Outcomes with Program Outcomes: Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)

PO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	2	1	3	2
CO2	3	2	2	3	3
CO3	3	1	3	3	2
CO4	2	1	3	2	2
CO5	2	1	3	2	3

Details of the Course Content - Food Regulatory Affairs Manager (M/FIC/Q5005)

Unit	Contents	Contact Hours
I	Definition, objective, scope, and functions of food safety and quality assurance, Quality enhancement models, Statistical Quality Control for food industry like Quality control, Food Safety Management Systems, Production planning and Control; WTO, Codex Alimentarius Commission. Roles and Responsibilities of Food Regulatory Affairs Manager; Awareness of the nature and availability of job opportunities; Knowledge and Understanding of the Organization; Work Place Ethics; Personal Hygiene and Sanitation Guidelines to be followed by Food workers in the Organization; FSSAI Schedule 4 Requirements: General Hygienic and Sanitary practices to be followed by Food Business operators in the organization, GMP, GHP. Roles and Responsibilitieses Food Safety Team Leader.	12
II	Government and the Food Processing Industry: Industry and Institutions Association; Government Initiatives; FSSAI Initiatives; Special Rebates in Taxation for Food Processing Industry; Goods and Services Tax (GST) Introduction to the Food Regulations and Affairs: Terminology used in Food Regulatory Process; Indian Food Safety and Standards Regulations; Methods to Ensure Compliance of Food Regulations; Regulatory Policies of an Organization; Approaches to Regulation	12
III	Design, Develop and Implement a Regulatory System: Food Safety Regulations; Standardized or Non-Standardized Regulations; Development of Regulatory Policies; Food Recall; Role of the food authority; Traceability - The Backbone of Recall; Food Recall Plan; Cleaning and Sanitization in Food Processing Unit; Monitoring and Supervision by a Hygiene Coordinator Principles and Methods of Training: Effective Communication; The Different Methods of Training; Food Safety Training and Certification (FoSTaC). Significance of Training the Team on Food Safety Procedures Manage Change in Food Regulatory System: Identification, Challenges, Implementation Strategies by a Food Regulatory; Affairs Manager; Gap Analysis; Barriers to change in the regulatory system; Food Safety Audits Measures Management- ISO19011; Employee Recognition: An Insight	12
IV	Prepare Representations to Regulatory Authorities and for New Product Registrations: Practical approach to prepare, submit and review Licensing/ registration procedure by the managers.; FSSAI Registration/ License Procedure; Food Safety Audit; Documentation; Hierarchical document system; Case Studies of Food and Beverage Controversies in India in Recent Years: Impact on Regulations & Standards; Non-Compliances; Regulatory and Trade Associations; Information Required for FSSAI Product Approval	12

	Professional & Core skills: SWOT Analysis for Self- Assessment; Updated and concurrent Technical Knowledge: CCP, VACCP, TACCP, Food Regulatory Systems like FSSAI, HACCP, QMS, FSMS, OHSAS etc.; Developing Effective Managerial Competencies; Enhancing Managerial Skill Sets; Being a Leader & a Manager; Conflict Handling and Resolution; Problem Identification and Solving & Decision Making Skill; Communication Skills- Reading, Writing, Listening etc.; Pursuing Excellence- Wearing Different Hats, IT Skills.	

Recommended Books and Resources

1. Jay, J. M., Loessner, M. J., & Golden, D. A. (2017). *Modern Food Microbiology* (8th ed.). Springer.
2. Codex Alimentarius Commission. (2020). *Food Hygiene Basic Texts* (4th ed.). FAO/WHO. https://www.fao.org/fao-who-codexalimentarius/en/
3. Motarjemi, Y., & Lelieveld, H. (2014). *Food Safety Management: A Practical Guide for the Food Industry* (2nd ed.). Academic Press.
4. Wallace, C. A., Sperber, W. H., & Mortimore, S. E. (Eds.). (2018). *Food Safety for the 21st Century: Managing HACCP and Food Safety Throughout the Global Supply Chain* (2nd ed.). Wiley-Blackwell.
5. Food Safety and Standards Authority of India. (2023). *Food Safety and Standards (Licensing and Registration of Food Businesses) Regulations*. FSSAI. https://fssai.gov.in
6. ISO. (2018). *ISO 19011:2018 Guidelines for Auditing Management Systems*. International Organization for Standardization. https://www.iso.org/standard/70017.html
7. Bhushan, S., & Bhatia, V. (2022). *Food Regulatory Affairs in India: Legal & Compliance Guide*. Sage Publications.
8. Food Industry Capacity and Skill Initiative. (n.d.). *Food Regulatory Affairs Manager (FRAM) Participant Handbook*. Retrieved June 2, 2025, from https://www.ficsi.in/upload/participant_handbook/FRAM_English%20PH.pdf
9. Food Safety and Standards Authority of India (FSSAI). (n.d.). Retrieved June 2, 2025, from https://fssai.gov.in
10. Codex Alimentarius Commission. (n.d.). Retrieved June 2, 2025, from https://www.fao.org/fao-who-codexalimentarius/en/
11. World Trade Organization. (n.d.). Retrieved June 2, 2025, from https://www.wto.org
12. International Food Safety Authorities Network (INFOSAN). (n.d.). Retrieved June 2, 2025, from https://www.who.int/teams/food-safety/infosan
13. Coursera. (2024). *Food Safety and Quality Assurance* [Online course]. University of California, Davis. https://www.coursera.org/learn/food-safety-quality
14. Alison. (2023). *Introduction to Food Safety* [Online course]. https://alison.com/course/introduction-to-food-safety
15. Food Safety and Standards Authority of India (FSSAI). (n.d.). *Food Safety Training and Certification (FoSTaC)*. Retrieved June 2, 2025, from https://foodsmart.fssai.gov.in
16. Food Safety India. (n.d.). *YouTube Channel*. Retrieved June 2, 2025, from https://www.youtube.com/c/FoodSafetyIndia
17. Udemy. (2023). *Food Regulatory Affairs & Compliance* [Online course]. https://www.udemy.com/course/food-regulatory-affairs/

MSFT511-24: Comprehensive Technology of Fruits and Vegetables

Total marks: 100	**L**	**T**	**P**
	4	**0**	**0**

Course objective:

To equip learners with in-depth knowledge and practical understanding of the current trends, processing technologies, preservation methods, quality standards, and regulatory frameworks in the postharvest management and value addition of fruits and vegetables, emphasizing sustainable practices and food safety compliance.

Course outcome: At the end of the course, the students will be able to

CO1	Demonstrate comprehensive understanding of fruit and vegetable classification, chemical composition, and nutritional significance, along with current industry trends.
CO2	Analyze the physiological and biochemical changes during harvesting, ripening, and storage, and their impact on postharvest quality and shelf life.
CO3	Apply knowledge of preharvest and postharvest handling, minimal processing, preservation techniques, and packaging to maintain quality and safety.
CO4	Evaluate processing technologies for diverse fruit and vegetable products including juices, jams, pickles, and beverages, ensuring compliance with quality standards and regulations.
CO5	Develop sustainable approaches for waste management and implement food safety, hygiene, and regulatory standards, including FSSAI guidelines, in processing operations.

Mapping of Course Outcomes with Program Outcomes: Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)

PO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	2	1	3	2
CO2	3	3	1	2	3
CO3	3	2	2	3	3
CO4	3	2	2	3	3
CO5	3	3	2	3	3

Details of the Course Content - Comprehensive Technology of Fruits and Vegetables (MSFT511-24)

Unit	Contents	Contact Hours
I	Current Status and Overview: Trends in fruits and vegetables processing, classification, chemical composition, and nutritional importance. Harvesting and Postharvest Physiology: Preharvest factors affecting postharvest quality, physical and chemical maturity indices, crop maturity assessment, and ripening processes. Biochemical Changes: Changes in biochemical constituents during maturation, ripening, processing, and storage affecting quality and shelf life. Preharvest and Postharvest Handling: Harvest maturity, cleaning, sorting, grading, pre-packaging, and postharvest treatments including edible coatings. Importance and role of post harvest technology. Precooling and Cooling Systems: Methods like hydrocooling, forced-air, vacuum cooling, evaporative cooling, and cold chain management.	11
II	Fundamentals and Minimal Processing: General processing steps: washing, sorting, grading, peeling, blanching, coring, pitting; Minimal processing and quality factors Preservation Techniques Canning and bottling: selection, processes (conventional & aseptic), spoilage, labeling, Regulation Freezing: principles, equipment, storage, thawing, spoilage, labeling, Regulation Dehydration: drying methods, equipment, storage, reconstitution, spoilage, labeling, and Regulation Fruit Juice Processing: Definition and types of fruit juices (fresh, concentrates, squash, RTS, syrups, powders); Juice extraction methods and equipment; Preservation techniques (pasteurization, chemical preservatives, freezing, drying, aseptic/tetra-packing, carbonation); Clarification and concentration methods with flavor/aroma restoration; Packaging materials and storage conditions; Common defects and remedies; Quality and safety standards.	12
III	Fruits and Vegetable Derived Products: Jam, Jelly, and Marmalade Processing: Definitions, types, and role of pectin; Processing technology and equipment, Preservation principles (high sugar, thermal processing); Packaging and storage requirements; Common defects and corrective measures; Quality and safety standards.	14

	Preserved and Candied Fruits: Definition and types; Processing and equipment used; Preservation principles (osmotic dehydration, sugar crystallization); Packaging and storage; Defects and remedies; Quality and safety standards. Vegetable Juices and Derived Products: Types (puree, paste, ketchup, soup, sauces); Processing methods and equipment; Preservation techniques; Packaging materials and storage conditions; Defects and their remedies; Quality and safety standards Tomato Products Processing: Types: juice, puree, paste, ketchup, sauce, soup; Processing and equipment; Preservation principles; Packaging and storage; Defects and remedies; Quality and safety standards Potato Chips Processing: Definition and types; Equipment and processing steps; Preservation (frying, packaging); Storage conditions; Common defects and solutions; Quality and safety parameters Pickles, Chutneys, and Sauces: Types and definitions (fermented/non-fermented), Processing methods and equipment, Preservation (acidification, fermentation, salt), Packaging and storage, Spoilage causes and remedies, Quality and safety standards	
IV	Vinegar Processing (Synthetic & Brewed): Definition and types, Raw material selection, Processing methods and equipment, Preservation principles, Packaging materials and storage conditions, Common defects and remedies, Quality and safety standards Wine (Red & White Wines), Perry, Cider, Champagne and Brandy Processing: Definition and classification, Raw material selection and quality parameters, Processing methods and equipment (crushing, fermentation, aging), Preservation principles; Packaging materials and storage conditions; Common defects and remedies; Quality and safety standards Soft Drinks Processing: Definition and types (carbonated, non-carbonated); Raw materials and formulation; Processing methods and equipment; Preservation principles; Packaging materials and storage conditions; Common defects and remedies; Quality and safety standards Technology of coconut: chemical composition, processing, and processed products Storage Technologies: Ambient, refrigerated, modified atmosphere, controlled atmosphere (CA), and hypobaric storage—principles and applications. Packaging of fruits and vegetable products: materials, techniques, role in shelf-life extension, active and intelligent packaging. Controlled atmosphere packaging (CAP) and modified atmosphere packaging (MAP): Gas composition control (O_2, CO_2, N_2), effects on microbial growth, advantages, limitations, and commercial use. Emerging Technologies in Fruits and Vegetable Industry	12

	Waste Management:Utilization and disposal of processing wastes. by-products from fruit and vegetable wastes. Quality standards, plant sanitation, hygiene, and FSSAI regulations	

Note: Students must complete the following courses as part of their assignment requirements:

- Jam, Jelly Processing Technician (https://elearning.ficsi.in/courses/Jam-Jelly-and-Ketchup-Processing-Technician-62467cbf0cf25cc910623dbc or https://www.skillindiadigital.gov.in/courses/detail/ecf2ed16-115e-44a8-a817-ec6e1346be1a)
- Pickle-making technician (https://elearning.ficsi.in/courses/Pickle-Making-Technician-6246887a0cf296c1fab0380b or https://www.skillindiadigital.gov.in/courses/detail/24075142-ea6c-48f6-8526-c47b0c4e10ec)

Recommended Books and Resources

1. Yahia, E. M. (Ed.). (2019). *Postharvest Physiology and Biochemistry of Fruits and Vegetables*. Woodhead Publishing.
2. Kader, A. A. (Ed.). (2002). *Postharvest Technology of Horticultural Crops* (3rd ed.). University of California Agriculture and Natural Resources.
3. Singh, R. P., & Heldman, D. R. (2014). *Introduction to Food Engineering* (5th ed.). Academic Press.
4. Potter, N. N., & Hotchkiss, J. H. (1998). *Food Science* (5th ed.). Springer.
5. Verma, L. R., Joshi, V. K., & Srivastava, A. K. (2007). *Postharvest Technology of Fruits and Vegetables: Handling, Processing, Packaging and Storage*. Indus Publishing.
6. Lee, C. Y., & Coates, G. A. (Eds.). (2009). *Fruit and Vegetable Juice Processing Technology*. Wiley-Blackwell.
7. Bhat, R., & Shobha Rani, R. H. (2009). *Technology of Fruits and Vegetables: Processing and Preservation*. IK International Publishing.
8. Sablani, S. S., & Rahman, M. S. (Eds.). (2017). *Food Packaging: Principles and Practice* (3rd ed.). CRC Press.
9. Food Safety and Standards Authority of India. (2023). *Food Safety and Standards (Food Products Standards and Food Additives) Regulations*. Retrieved from https://fssai.gov.in/cms/food-safety-and-standards-regulations.php
10. United States Department of Agriculture. (2018). *Commercial Processing of Fruits and Vegetables* (Agricultural Handbook No. 66).
11. Food and Agriculture Organization of the United Nations. (2011). *Fruit and Vegetable Processing: Technology and Quality*. Retrieved from http://www.fao.org/3/i2877e/i2877e.pdf
12. Arora, A. (2021). *Fruit and Vegetable Processing Technology* [Video lectures]. National Programme on Technology Enhanced Learning (NPTEL). Retrieved from https://nptel.ac.in/courses/
13. Singh, J., & Kaur, L. (2015). *Advances in Fruit and Vegetable Processing*. Apple Academic Press.
14. Singh, R. K., & Pandey, R. K. (2020). *Waste Management in Fruit and Vegetable Processing Industry*. Springer.
15. FoodTech Solutions. (2023). *Modern Technologies in Fruits and Vegetables Processing* [Website]. Retrieved from https://www.foodtechsolutions.com/fruits-vegetables-processing

MSFT512-24: Comprehensive Technology of Fruits and Vegetables (Lab)

Total marks: 50	**L**	**T**	**P**
	0	**0**	**4**

Course objective:

To develop hands-on skills in the quantitative analysis, quality evaluation, processing, and preservation techniques of fruits and vegetables, enabling students to apply scientific methods for ensuring product quality, safety, and shelf-life enhancement.

Course outcome: At the end of the course, the students will be able to

CO1	Demonstrate proficiency in determining maturity indices, chemical properties, and enzymatic activities critical to fruit and vegetable quality assessment.
CO2	Apply quantitative techniques for estimating key nutritional and biochemical constituents, including sugars, acids, vitamins, and pigments.
CO3	Conduct preparation and quality evaluation of processed fruit and vegetable products such as jams, juices, candies, and canned goods.
CO4	Evaluate the effects of preservation methods, thermal processing, dehydration, and storage conditions on product safety and shelf life.
CO5	Implement postharvest handling practices including pre-cooling, coating, and packaging to enhance quality retention and reduce postharvest losses.

Mapping of Course Outcomes with Program Outcomes: Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)

PO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	2	1	2	3
CO2	3	3	1	2	3
CO3	3	2	2	3	3
CO4	3	3	2	3	3
CO5	3	2	2	3	3

Details of the Course Content - Comprehensive Technology of Fruits and Vegetables (Lab) (MSFT512-24)

Practical no.	Contents	Contact Hours
1	Determination of Maturity Indices for Fruits	2
2	Estimation of Total Soluble Solids (TSS) Using Refractometry	2
3	Estimation of pH and Titratable Acidity in Fresh Produce	2
4	Calculation of Brix to Acidity Ratio in Fruit Samples	2
5	Determination of Moisture Content and Total Solids in Fruits and Vegetables	2
6	Determination of Enzymatic Activity (PPO, Peroxidase, Pectinase) in Ripe Fruit Samples	2
7	Estimation of Ascorbic Acid (Vitamin C) and Its Stability on Heat Treatment	2
8	Estimation of Total and Reducing Sugars by Lane and Eynon Method	2
9	Estimation of Non-Enzymatic Browning in Processed Fruit Products	2
10	Quantification of Total Polyphenolic Compounds and Tannins	2
11	Estimation of Total Carotenoids in Fruits and Vegetables	2
12	Determination of Volatile Acids by Steam Distillation	2
13	Determination of Ethanol Content in Fermented Fruit Products	2
14	Determination of Pectin Content in Fruit Products	2
15	Colour Measurement of Fruits and Vegetable Products Using Colorimetry/Tintometer	2
16	Cutout Analysis and Quality Evaluation of Canned Fruits and Vegetables	2
17	Analysis of Ash Insoluble in Hydrochloric Acid in Processed Products	2
18	Preparation and Evaluation of Pectin-Based Products: Jam, Jelly, Marmalade	2
19	Preparation and Quality Testing of Fruit Juice Products: Squash, Nectar, Cordial, Fruit Bar, Murabba, Tomato Puree, Paste, and Sauce	2
20	Preparation and Analysis of Candy and Preserved Fruits	2
21	Enzyme Extraction and Clarification of Fruit Pulp and Juice	2
22	Dehydration and Rehydration of Fruits and Vegetables Using Sun and Mechanical Drying Methods	2
23	Thermal Processing and Its Effect on Quality of Fruit and Vegetable Products	2
24	Study of the Effect of Pre-Packing and Pre-Cooling on the Quality and Shelf Life of Fruits and Vegetables	2
25	Evaluation of Wax Coating and Low-Temperature Storage on the Shelf Life of Fresh Produce	2

Recommended Books and Resources

1. FSSAI Manual of Methods of Analysis of Foods – Fruits and Vegetable Products (PDF) https://fssai.gov.in/upload/uploadfiles/files/Manual_Fruits_Veg_25_05_2016.pdf?utm_source=chatgpt.com
2. Girdharilal, Siddappaa, G.S and Tandon, G.L.1998. Preservation of fruits & Vegetables, ICAR, New Delhi
3. W B Crusess.2004. Commercial Unit and Vegetable Products, W.V. Special Indian Edition, Pub: Agrobios India

4. Manay, S. & Shadaksharaswami, M.2004. Foods: Facts and Principles, New Age Publishers.
5. Ranganna S.1986. Handbook of analysis and quality control for fruits and vegetable products, Tata Mc Graw-Hill publishing company limited, Second edition.
6. Srivastava, R.P. and Kumar, S. 2006 . Fruits and Vegetables Preservation- Principles and Practices. 3rd Ed. International Book Distributing Co.

MSFT513-24: Comprehensive Technology of Cereals, Pulses & Oilseeds

Total marks: 100	**L**	**T**	**P**
	4	**0**	**0**

Course objective:

TTo empower learners with comprehensive expertise in the production, processing, quality assessment, and value addition of cereals, pulses, and oilseeds, integrating biochemical, technological, and nutritional principles with advanced milling, extraction, and product innovation aligned to industry benchmarks and global market dynamics.

Course outcome: At the end of the course, the students will be able to

CO1	Demonstrate comprehensive knowledge of the production, grading, and processing technologies of major cereals, pulses, and oilseeds, including wheat, rice, corn, barley, millets, and soybeans.
CO2	Analyze the biochemical, physical, and technological properties affecting quality, functionality, and nutritional value of cereals, pulses, and oilseeds and their products.
CO3	Apply advanced milling, extraction, and product development techniques to optimize value addition and efficient utilization of by-products in line with industry standards.
CO4	Evaluate quality control parameters and implement standardized testing methods for cereals, pulses, oilseeds, and their processed products ensuring compliance with national and international regulations.
CO5	Develop innovative cereal, pulse, and oilseed-based food products incorporating emerging technologies and market trends to meet consumer demands and enhance food security.

Mapping of Course Outcomes with Program Outcomes: Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)

PO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	2	1	3	3
CO2	3	3	1	2	3
CO3	3	3	2	2	3
CO4	3	2	2	3	3
CO5	2	3	3	3	3

Details of the Course Content - Comprehensive Technology of Cereals, Pulses & Oilseeds (MSFT513-24)

Unit	Contents	Contact Hours
I	**Wheat:** Wheat production, varieties, grading, and quality criteria (physical, chemical, molecular basis of hardness/softness); grain structure, composition, and environmental effects on processing quality; enzymes in wheat and their technological roles; cleaning, conditioning, dry and wet milling principles, machine operations, flour streams, air fractionation of flours including composition, application and flour treatment; dough rheology and instrumental testing such as Farinograph, Extensiograph, Amylograph, Mixograph, Rapid Visco Analyzer, Alveograph; functional properties of wheat components in bakery products; manufacturing and applications of vital wheat gluten; durum wheat chemistry and pasta production technology, industrial starch and gluten production including functional properties and uses, advances in milling machinery and techniques, value addition and utilization of wheat milling by-products, quality control and evaluation standards for wheat and wheat products. Durum wheat- chemistry, quality and technology of pasta products like macaroni, noodles and sphagatti. Processing of wheat flakes.	12
II	**Rice:** Rice production, varieties, grain structure, proximate composition, chemical distribution, rice milling machinery and operations including dehusking, polishing, grading, milling yield, nutritional effects, rice bran stabilization methods, parboiling technology including traditional and CFTRI methods with effects on nutrition and quality, aging and accelerated aging of rice, cooking quality evaluation, enrichment of rice with vitamins and minerals, production of rice starch with properties and applications, rice convenience foods such as quick cooking rice, infant foods, flakes, puffed and extruded cereals, rice in brewing and beer manufacture, utilization of rice milling by-products, advances in rice milling machinery and techniques, value addition and utilization of rice milling by-products, quality control and evaluation standards for rice and processed rice products. **Corn:** Corn grain structure, proximate composition, types, and quality evaluation, dry and wet milling processes of corn, functional properties and modification of corn starch, wet milling products including syrups, corn oil, gluten, and by-product utilization, alkaline cooked corn products such as tortillas, nixtamalized corn flour, tortilla chips, processing of cornflakes and extruded snacks, corn germ oil composition, processing and applications, advances in corn milling machinery and techniques, value addition and utilization of corn milling by-products - corn starch modification and uses, corn sweeteners such as glucose syrup, high fructose corn syrups, dextrose and maltodextrin., quality control and evaluation standards for corn and corn products.	12
III	**Barley and Oats:** Barley milling including pearl barley, flakes, flour production, malting of barley covering steeping, germination, drying, malt product classification, nutritive value and applications, oats	12

	production, trade, grain structure, composition, chemistry and technology, dry and wet milling technologies for barley and oats, advances in barley and oat milling machinery, value addition and utilization of barley and oat by-products, quality control and evaluation standards for barley and oat products. **Cereal-based alcoholic beverages:** Definition, Manufacturing Steps, Storage, Packaging, and Regulation of Beer, Whiskey, Rum, Vodka and Distilled Spirits. **Pulses and Legume:** Production, trade, major varieties, grain structure, chemical composition, milling processes including dry milling, wet milling, improved milling methods, quality evaluation criteria for pulses, nutritional aspects of raw, cooked, canned, sprouted legumes, anti-nutritional factors and elimination methods, technology of legume protein flour, isolates, concentrates including preparation, uses, functional properties, functional properties of pulse starch and protein, product development of cereals and pulse-based processed foods, advances in pulse milling machinery and processing techniques, value addition and utilization of pulse milling by-products, quality control and evaluation standards for pulses and pulse products.	
IV	**Sorghum, Millets, Rye, and Triticale:** Production, processing of sorghum and millets including traditional and commercial milling, chemical, technological and nutritional aspects of coarse grains, rye and triticale milling and utilization, dry and wet milling technologies for sorghum, millets, rye, and triticale, advances in milling machinery and techniques for these coarse grains, value addition and utilization of by-products from these grains, quality control and evaluation standards for sorghum, millets, rye and triticale. **Soybean Processing:** Soybean processing including production of soymilk, tofu, soy protein concentrates and isolates, **Oilseeds Processing:** Oilseeds production, trade and composition, oil extraction methods including expeller pressing and solvent extraction, oil refining covering purification, hydrogenation, interesterification, protein sources from oilseeds such as defatted flours, concentrates and isolates, protein texturization and fiber spinning technologies, significance of oilseed processing in India, product development including cereals and pulse-based processed foods with soy and oilseed products, advances in oilseed extraction and refining machinery and processing, value addition and utilization of oilseed by-products, quality control and evaluation standards for oilseeds and derived products, role of cereals, pulses and oilseeds in Indian diet and global markets.	12

Note: Students must complete the two or more following courses as part of their assignment requirements:

- Traditional Snacks and Savoury Maker (https://www.skillindiadigital.gov.in/courses/detail/33a0028c-746f-474a-a4fa-70937b2cdb3a or https://elearning.ficsi.in/courses/Traditional-Snack-and-Savoury-624ab08c0cf25b9b1b584166)

- Rice Fortification (https://www.skillindiadigital.gov.in/courses/detail/95a27739-019b-4ae3-8c9d-b26d1b556eb1)
- Plant Base Proteins (https://www.skillindiadigital.gov.in/courses/detail/72a5806e-db84-4d9f-a365-e4ea7f13263b or https://elearning.ficsi.in/courses/Plant-Based-Proteins-63c8d99ee4b0efecdd8838a2)

Recommended Books and Resources

1. Shewry, P. R., & Hey, S. J. (2015). *The wheat grain: Chemistry and technology* (3rd ed.). Woodhead Publishing.
2. Juliano, B. O. (2010). *Rice chemistry and technology* (3rd ed.). American Association of Cereal Chemists, Inc.
3. Singh, V., & Singh, B. (2019). *Corn processing technology*. Wiley-Blackwell.
4. Ward, A. D., & Briggs, D. E. (2017). *Barley: Chemistry and technology* (2nd ed.). American Association of Cereal Chemists, Inc.
5. Wood, P. J., & Beer, M. U. (2018). *Oat chemistry and technology*. Woodhead Publishing.
6. Deshpande, S. S., & Salunkhe, D. K. (2016). *Pulses: Processing, quality and nutritional aspects*. CRC Press.
7. Rooney, L. W., & Serna-Saldivar, S. O. (Eds.). (2000). *Sorghum and millets: Chemistry and technology*. American Association of Cereal Chemists, Inc.
8. Hou, G., & Frazier, R. (2020). *Soybean processing and utilization*. Elsevier.
9. Gunstone, F. D. (Ed.). (2011). *Vegetable oils in food technology: Composition, properties and uses* (2nd ed.). Wiley-Blackwell.
10. Food and Agriculture Organization. (2018). *FAO cereal supply and demand brief*. http://www.fao.org/worldfoodsituation/csdb/en/
11. Indian Institute of Food Processing Technology. (2021). *Handbook on cereal, pulse and oilseed processing*. https://www.iifpt.edu.in/resources/handbooks
12. Food Safety and Standards Authority of India. (2022). *Manual on quality control for cereals and pulses*. https://www.fssai.gov.in/cms/quality-standards.php
13. International Maize and Wheat Improvement Center. *Wheat and maize resources*. https://www.cimmyt.org/
14. International Rice Research Institute. *Rice production and processing*. https://www.knowledgebank.irri.org/
15. PulseNet India.. *Pulses and legumes information*. https://www.pulsenetindia.org/
16. Singh, R. K. (Instructor). (2021). *Food processing technology* [NPTEL online course]. https://nptel.ac.in/courses/
17. University of Illinois Extension. (2020). *Corn and grain processing video series* [Video playlist]. YouTube. https://www.youtube.com/user/UIExtension/videos
18. American Association of Cereal Chemists International. (n.d.). *Webinars on cereal and grain science*. https://www.aaccnet.org/events/webinars/
19. Wrigley, C. W., Corke, H., & Walker, C. E. (Eds.). (2017). *Encyclopedia of cereal science* (2nd ed.). Elsevier.
20. Fellows, P. J. (2017). *Food processing technology: Principles and practice* (4th ed.). Woodhead Publishing.
21. Kent, N. L. (2012). *Technology of cereals: An introduction for students of food science and agriculture* (5th ed.). Woodhead Publishing.
22. Singh, U., & Kaur, M. (2019). *Pulses: Nutritional, processing and technology*. CRC Press.
23. Bagchi, D. (Ed.). (2015). *Handbook of food science, technology, and engineering* (3rd ed.). CRC Press.
24. Gunstone, F. D. (Ed.). (2011). *The chemistry of oils and fats: Sources, composition, properties and uses*. Wiley.
25. Chakraverty, A. (2001). *Post-harvest technology of cereals, pulses and oilseeds* (2nd ed.). Oxford & IBH Publishing.
26. Peterson, D. G. (Ed.). (2014). *Food biotechnology: Principles and practices*. Wiley-Blackwell.

MSFT514-24: Comprehensive Technology of Cereals, Pulses & Oilseeds (Lab)

Total marks: 50	**L**	**T**	**P**
	0	**0**	**4**

Course objective:

To enable learners to perform standardized sampling, compositional analysis, processing techniques, and quality control evaluations of cereals, pulses, and oilseeds in accordance with FSSAI protocols, ensuring industry-aligned competency in analytical and practical food technology skills.

Course outcome: At the end of the course, the students will be able to

CO1	Demonstrate proficiency in standardized sampling and physical grading of cereals, pulses, and oilseeds as per FSSAI guidelines.
CO2	Accurately perform moisture, protein, starch, and enzyme activity analyses using validated methods to assess raw material and processed product quality.
CO3	Execute milling, extraction, and product preparation techniques for cereals, pulses, and oilseeds, evaluating yield and functional properties.
CO4	Identify and quantify anti-nutritional factors and adulterants in pulses and oilseeds, applying quality control measures consistent with regulatory standards.
CO5	Analyze and interpret rheological, chemical, and sensory data to ensure compliance with food safety and quality benchmarks in cereal, pulse, and oilseed-based products

Mapping of Course Outcomes with Program Outcomes: Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)

PO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	1	1	3	2
CO2	3	2	1	3	3
CO3	3	2	2	2	3
CO4	3	2	1	3	3
CO5	3	2	2	3	3

Details of the Course Content - Comprehensive Technology of Cereals, Pulses & Oilseeds (Lab) (MSFT514-24)

Practical no.	Contents	Contact Hours
1	Sampling of cereals, pulses, and oilseeds as per FSSAI guidelines.	1
2	Determination of moisture content in wheat, rice, pulses, millets, and oilseeds by oven drying method.	2
3	Physical grading, test weight, and kernel size determination of wheat and pulses.	1
4	Determination of crude protein content in wheat, rice, pulses, barley, oats, and oilseed flours by Kjeldahl method.	2
5	Flour milling of wheat (dry milling): extraction rate and flour yield calculation.	2
6	Gluten content and gluten index determination in wheat flour.	1
7	Dough rheology testing: Farinograph and Extensiograph analysis for wheat dough.	2
8	Alpha-amylase activity estimation in wheat flour by falling number method.	1
9	Determination of damaged starch content in wheat flour.	1
10	Preparation and quality evaluation of pasta products (macaroni, noodles) from durum wheat semolina.	2
11	Rice milling operations: dehusking, polishing, grading, and milling yield calculation.	2
12	Total starch and amylose content estimation in rice.	1
13	Rice bran stabilization by heat treatment and free fatty acid analysis.	1
14	Parboiling of paddy rice (traditional and CFTRI method) and evaluation of nutritional and milling quality.	2
15	Cooking quality evaluation of rice: cooking time, water absorption, and texture analysis.	1
16	Preparation and quality evaluation of rice convenience foods: rice flakes and quick cooking rice.	1
17	Physical grading and proximate analysis (moisture, protein, starch) of maize.	1
18	Dry and wet milling of corn: starch extraction and functional properties analysis.	2
19	Extraction and quality evaluation of corn oil: acid value and peroxide value.	1
20	Determination of dextrose equivalent in corn sweeteners like glucose syrup and HFCS.	1
21	Milling and proximate analysis of barley and oats: pearl barley, flakes, and flour.	1
22	Malting of barley: steeping, germination percentage, drying, and malt quality evaluation.	2
23	Sampling and grading of pulses; moisture and crude protein determination.	1
24	Determination of anti-nutritional factors in pulses: tannins and phytates.	1
25	Preparation and functional property analysis of pulse protein isolates and concentrates.	2
26	Milling and proximate analysis of millets, rye, and triticale grains.	1
27	Oil extraction from oilseeds by expeller and solvent extraction; oil yield and quality parameters.	2

28	Preparation and proximate analysis of defatted oilseed meals and protein concentrates.	1
29	Functional property testing of oilseed protein concentrates: solubility, foaming, emulsification.	1
30	Detection of adulterants and quality control tests in cereals, pulses, and oilseeds as per FSSAI standards.	2

Recommended Books and Resources

1. Shewry, P. R., & Hey, S. J. (2015). *The wheat grain: Chemistry and technology* (3rd ed.). Woodhead Publishing.
2. Juliano, B. O. (2010). *Rice chemistry and technology* (3rd ed.). American Association of Cereal Chemists, Inc.
3. Singh, V., & Singh, B. (2019). *Corn processing technology*. Wiley-Blackwell.
4. Ward, A. D., & Briggs, D. E. (2017). *Barley: Chemistry and technology* (2nd ed.). American Association of Cereal Chemists, Inc.
5. Wood, P. J., & Beer, M. U. (2018). *Oat chemistry and technology*. Woodhead Publishing.
6. Deshpande, S. S., & Salunkhe, D. K. (2016). *Pulses: Processing, quality and nutritional aspects*. CRC Press.
7. Rooney, L. W., & Serna-Saldivar, S. O. (Eds.). (2000). *Sorghum and millets: Chemistry and technology*. American Association of Cereal Chemists, Inc.
8. Hou, G., & Frazier, R. (2020). *Soybean processing and utilization*. Elsevier.
9. Gunstone, F. D. (Ed.). (2011). *Vegetable oils in food technology: Composition, properties and uses* (2nd ed.). Wiley-Blackwell.
10. Food Safety and Standards Authority of India. (2022). *Manual of methods of analysis for cereals, pulses, oilseeds, and their products*. https://fssai.gov.in/cms/manuals-of-methods-of-analysis-for-various-food-products.php
11. Kent, N. L. (2012). *Technology of cereals: An introduction for students of food science and agriculture* (5th ed.). Woodhead Publishing.
12. Fellows, P. J. (2017). *Food processing technology: Principles and practice* (4th ed.). Woodhead Publishing.
13. Wrigley, C. W., Corke, H., & Walker, C. E. (Eds.). (2017). *Encyclopedia of cereal science* (2nd ed.). Elsevier.
14. Singh, U., & Kaur, M. (2019). *Pulses: Nutritional, processing and technology*. CRC Press.
15. Bagchi, D. (Ed.). (2015). *Handbook of food science, technology, and engineering* (3rd ed.). CRC Press.

MSFT515-24: Bakery and Confectionery Technology

Total marks: 100	**L**	**T**	**P**
	4	**0**	**0**

Course objective:

To equip students with comprehensive theoretical knowledge and practical understanding of bakery and confectionery science, technology, ingredients, processing methods, quality control, advanced innovations, and regulatory frameworks to prepare competent professionals for the food industry..

Course outcome: At the end of the course, the students will be able to

CO1	Understand the fundamentals of bakery and confectionery industries, including raw materials, ingredient functionality, and key processing techniques.
CO2	Analyze and apply advanced baking and confectionery technologies, ensuring quality control, sensory evaluation, and compliance with regulatory standards.
CO3	Demonstrate expertise in formulation, processing, and troubleshooting of bakery products such as breads, cakes, biscuits, pastries, and confectionery items.
CO4	Evaluate novel ingredients, emerging trends, and sustainable practices to innovate gluten-free, functional, and health-oriented bakery and confectionery products.
CO5	Develop entrepreneurship skills and implement food safety systems, including HACCP and GMP, for effective bakery and confectionery industry management.

Mapping of Course Outcomes with Program Outcomes: Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)

PO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	2	1	2	3
CO2	3	3	2	3	3
CO3	**3**	2	2	2	3
CO4	2	3	1	3	2
CO5	1	1	3	2	2

Details of the Course Content - Bakery and Confectionery Technology (MSFT515-24)

Unit	Contents	Contact Hours
I	**Fundamentals of Bakery Technology** **Overview of Bakery Industry:** History, Scope, and Market Trends; Emerging Trends and Innovations **Raw Materials and Ingredients:** Flour Types and Milling; Sugar Types and Refining; Fats and Oils; Dairy Ingredients; Additives and Improvers **Functional Properties of Ingredients:** Gluten Development and Dough Rheology; Emulsifiers and Stabilizers **Leavening Agents:** Yeast, Baking Powder, Chemical Leaveners – Mechanisms and Applications **Mixing Methods:** Straight Dough, Sponge, No-Time Dough – Techniques and Impact **Fermentation Process:** Biochemistry, Control Parameters, and Quality Impact **Baking Process Fundamentals:** Heat Transfer Mechanisms; Oven Types; Advances in Equipment and Automation: Modern Industrial Baking Solutions; Common Baking Defects.	12
II	**Bread, Buns, Biscuits, Cookies, Cakes, and Pastries** **Bread Technology:** Types (White, Whole Wheat, Multigrain, Specialty Breads); Raw Materials and Ingredients; Formulation; Nutritional Aspects; Fortification; Processing; Packaging; Storage; Faults and Remedies; Shelf Life; Quality Control and Sensory Evaluation; Regulatory Standards and Labeling. **Pizza base:** Raw Materials and Ingredients; Formulation; Nutritional Aspects; Processing; Packaging; Storage; Faults and Remedies; Shelf Life; Quality Control and Sensory Evaluation; Regulatory Standards and Labeling. **Buns and Rolls:** Raw Materials and Ingredients; Formulation; Nutritional Aspects; Processing; Packaging; Storage; Faults and Remedies; Shelf Life; Quality Control and Sensory Evaluation; Regulatory Standards and Labeling. **Biscuits and Cookies:** Types and Classification; Raw Materials and Ingredients; Formulation; Nutritional Aspects; Fortification; Manufacturing Processes (Dough Preparation, Molding, Baking); Packaging; Storage; Faults and Remedies; Shelf Life; Quality Control and Sensory Evaluation; Regulatory Standards and Labeling	13

	Cake Technology: Types and Classification; Raw Materials and Ingredients; Formulation; Nutritional Aspects; Processing; Packaging; Storage; Faults and Remedies; Shelf Life; Quality Control and Sensory Evaluation; Regulatory Standards and Labeling. Cake Decoration and Icing**:** Techniques and Principles **Pastry Technology :** Types (Puff, Shortcrust, Choux, Filo); Laminated Dough Technology (Croissants, Danish Pastries); Raw Materials and Ingredients; Formulation; Nutritional Aspects; Processing; Packaging; Storage; Faults and Remedies; Shelf Life; Quality Control and Sensory Evaluation; Regulatory Standards and Labeling. **Gluten-Free, Fortification, and Alternative Baking Technologies**: Ingredients, Processing Challenges, Regulatory Standards and Labeling	
III	**Confectionery Science and Technology** **Overview of Confectionery Industry:** History, Scope, and Market Trends; Emerging Trends and Innovations **Sugar Confectionery Ingredients and Chemistry:** Basic Ingredients (sucrose, glucose syrup, invert syrup, sugar alcohols); Sugar Crystallization and Texture Control. **Sugar Panning Process:** Principles and Applications **Confectionery Products:** Raw Materials and Ingredients, Formulation, Nutritional Aspects, and Processing, Packaging, Storage, Faults and Remedies, Shelf life, Quality Control and Sensory Evaluation and Regulatory Standards and Labeling; Classification of Confectionery Products**:** Crystalline Sugar Confectionery (fondant, hard boiled candy, caramel, toffee, fudge, nut brittles, krokant, praline, truffles, pulled sugar, marshmallows); Non-Crystalline Sugar Confectionery (gums, jellies, pastilles, Turkish delight, marzipan); Sugar-Free and Functional Confectionery Products; **Chewing Gum and Bubble Gum:** Raw Materials and Ingredients, Formulation, Nutritional Aspects, and Processing, Packaging, Storage, Faults and Remedies, Shelf life, Quality Control and Sensory Evaluation and Regulatory Standards and Labeling. **Chocolate Confectionery:** Cocoa Bean Processing (Harvesting, Fermentation, Roasting, Grinding); Chocolate Refining and Conching; Tempering, Molding, Enrobing, and Panning Techniques; Ingredients (Cocoa Butter etc.); Formulation; Nutritional Aspects; Processing; Packaging; Storage; Faults and Remedies; Shelf Life; Quality Control and Sensory Evaluation; Regulatory Standards and Labeling	11
IV	**Advanced and Emerging Technologies and Regulation in Bakery and Confectionery** **Enzymes in Baking:** Types, Applications, and Benefits	10

	Novel and Functional Ingredients: Fiber, Protein Enrichment, Plant-Based Alternatives **Sugar Reduction Strategies:** Techniques in Bakery and Confectionery **Advances in Freeze-Dried and Extruded Confectionery** **3D Printing and Smart Technologies** **Innovations in Gluten-Free and Vegan Baking** **Fermented and Sourdough-Based Products:** Health Benefits and Processing **Entrepreneurship and Business Development in Bakery and Confectionery industry** **Food Safety Systems and regulation for Bakery and Confectionery:**HACCP, GMP, Quality Certifications **Sustainability and Waste Management:** Energy Efficiency and Waste Reduction in Bakery and confectionary indutsry	

Note: Students must complete two or more of the following courses as an assignment:

- FoSTaC - Advanced Manufacturing Bakery Level 2 (https://www.skillindiadigital.gov.in/courses/detail/1d77f86d-ffb9-4e4e-a03b-76764aeb2a62 or https://elearning.ficsi.in/courses/Food-Safety-Supervisor---Bakery-Level-II-6241798b0cf273ed339b28a7)
- Craft Baker (https://www.skillindiadigital.gov.in/courses/detail/be252d85-6542-4e07-b493-ab48f2547e04 or https://elearning.ficsi.in/courses/Craft-Baker-FICQ5002-NSQF-Level-4-6242ab4b0cf2a3b282f50cb6)
- Master Class on Bakery Products (https://elearning.ficsi.in/courses/Masterclass-on-Bakery-Products-63d8ab2de4b0b6e547fa6c5c)

Recommended Books and Resources

1. Edwards, W. P. (2010). *The Science of Sugar Confectionery* (3rd ed.). The Royal Society of Chemistry.
2. Gelinas, M., & Mazza, G. (Eds.). (2012). *Handbook of Gluten-Free Bread and Biscuit Technology*. Wiley-Blackwell.
3. Gobbetti, M., & De Angelis, E. (Eds.). (2019). *Sourdough Microbiology*. Springer.
4. Hootman, J. D. (2009). *Chewing Gum Technology* (2nd ed.). Springer.
5. Karakaya, H. P., & Schlüter, S. (Eds.). (2023). *3D Food Printing: Fundamentals and Applications*. Springer.
6. Larsen, J. (2014). *Gluten-Free Baking*. Wiley.
7. Levin, R. E. (Ed.). (2012). *Shelf Life Evaluation of Foods*. Woodhead Publishing.
8. Manley, M. (2000). *Breadmaking: Improving Quality* (2nd ed.). Woodhead Publishing.
9. Minifie, B. W. (1999). *Chocolate, Cocoa and Confectionery Science and Technology* (3rd ed.). Springer.
10. Motarjemi, Y., & Lelieveld, H. (Eds.). (2014). *Food Safety Management: A Practical Guide for the Food Industry* (2nd ed.). Academic Press.
11. Matz, S. A. (1992). *Bakery Technology and Engineering* (3rd ed.). Springer.

12. Payne, G. O. (1987). *Biscuits, Crackers and Cookies*. Springer.
13. Pyler, E. J., & Gorton, L. A. (2008). *Baking Science & Technology* (4th ed.). Sosland Publishing.
14. Pyler, N. M., & Gorton, L. A. (2008). *Technology of Biscuits, Crackers and Cookies* (4th ed.). Sosland Publishing.
15. Rinaldi, S. (2013). *Patisserie and Baking Foundations*. Delmar Cengage Learning.
16. Robertson, G. L. (2016). *Food Packaging: Principles and Practice* (3rd ed.). CRC Press.
17. Saravacos, G. D., & Kostaropoulos, A. E. (2002). *Handbook of Food Processing Equipment*. Springer.
18. Sun, D.-W. (2016). *Sustainable Food Processing*. Wiley-Blackwell.
19. Tiwari, B. K., & Pant, A. K. (Eds.). (2020). *Entrepreneurship in Food and Beverage Industry*. Springer.
20. Ward, E. G. R. (1983). *The Technology of Sugar Confectionery* (4th ed.). Chapman & Hall.
21. Whitehurst, R. J., & Whitaker, J. R. (Eds.). (1997). *Enzymes in Food Technology* (2nd ed.). CRC Press.
22. Wrigley, C., & Delcour, J. A. (Eds.). (2006). *Principles of Cereal Science and Technology* (3rd ed.). AACC International.
23. Young, L. S., & Cauvain, S. P. (2011). *Technology of Breadmaking* (3rd ed.). Springer.

MSFT516-24: Bakery and Confectionery Technology (Lab)

Total marks: 50	**L**	**T**	**P**
	0	**0**	**4**

Course objective:

To equip students with practical skills and comprehensive knowledge in the analysis and preservation of food products, ensuring proficiency in laboratory techniques, safety protocols, and quality evaluation methods essential for preserving the food products in the food technology field.

Course outcome: At the end of the course, the students will be able to

CO1	Demonstrate proficiency in using laboratory equipment and adhering to safety protocols in a food testing lab.
CO2	Apply fundamental techniques for food sampling, preparation, and proximate as well as physio-chemical analysis.
CO3	Perform microbial analysis, including total plate count, coliform, and E. coli detection, to ensure food safety and quality.
CO4	Evaluate the quality characteristics of various food products preserved by methods such as drying, freezing, blanching, pickling, and canning.
CO5	Compare and contrast conventional and modern food processing methods, and analyze their effects on the nutritional and microbial stability of food products.

Mapping of Course Outcomes with Program Outcomes: Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)

PO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	2	1	2	3
CO2	3	2	1	2	3
CO3	3	2	1	2	3
CO4	3	2	1	2	3
CO5	3	3	2	2	3

Details of the Course Content - Bakery and Confectionery Technology (MSFT516-24)

Practical no.	Contents	Contact Hours
1	Identification and characterization of flour types (physical, chemical properties).	2
2	Sampling and quality analysis of wheat flour and sugar (moisture, ash content) per FSSAI methods.	2
3	Sugar analysis — basic physical tests and solubility determination.	2
4	Determination of gluten content and gluten index in wheat flour; study of dough rheology using Farinograph.	2
5	Functional properties of ingredients: emulsifiers, stabilizers, and fats.	2
6	Leavening agents study: yeast viability using microscope/staining; chemical tests for baking powder.	2
7	Preparation and evaluation of straight dough and sponge dough – impact on fermentation.	2
8	Bread preparation: white bread baking and physical evaluation.	2
9	Whole wheat and multigrain bread preparation with sensory analysis.	2
10	Buns and rolls preparation, baking, and shelf life study.	2
11	Biscuits and cookies: dough preparation, baking, and texture analysis.	2
12	Cake preparation: sponge cake by creaming and whisking; volume and texture analysis.	2
13	Cake decoration and icing techniques; sugar crystallization and stability tests.	2
14	Pastry preparation: puff and shortcrust pastry with lamination quality evaluation.	2
15	Preparation of gluten-free bakery products; texture and sensory evaluation.	2
16	Shelf life study of any bakery product: microbial and sensory changes.	2
17	Sensory and visual analysis of various baked goods using standard scales.	2
18	Sugar confectionery preparation: fondant and caramel making with texture evaluation.	2
19	Nut brittles preparation and quality assessment.	2
20	Gel-based confectionery preparation: jelly and marshmallow textural and pH analysis.	2
21	Chocolate processing: tempering, molding, and polymorphism study per FSSAI methods.	2
22	Chocolate refining, conching, and enrobing practicals.	2
23	Enzyme applications in baking: amylase activity assay and bread quality impact study.	2
24	Baking defect identification and troubleshooting (e.g., cracking, hardness).	2
25	Study of baking powder and chemical leavening efficacy and kinetics.	2
26	Application of HACCP and GMP in bakery and confectionery production: hazard analysis and control measures.	2
27	Freeze-dried and extruded confectionery products: preparation and quality evaluation.	2
28	Preparation and proximate analysis of fortified bakery products (fiber, protein enrichment).	2
29	Food safety systems and waste management practices in bakery industry: lab demonstration.	2

30	Sensory evaluation and shelf life analysis of confectionery and bakery products.	2

Recommended Books and Resources

1. Food Safety and Standards Authority of India (FSSAI). (2022). *Manual of methods of analysis for bakery and confectionery products*. https://fssai.gov.in/cms/manuals-of-methods-of-analysis-for-various-food-products.php
2. American Association of Cereal Chemists International (AACC). (2000). *Approved methods of analysis* (11th ed.). AACC International.
3. Pyler, E. J., & Gorton, L. A. (2008). *Baking science & technology* (4th ed.). Sosland Publishing.
4. Pomeranz, Y., & Meloan, C. E. (1994). *Food analysis: Theory and practice* (3rd ed.). Springer.
5. Hui, Y. H. (Ed.). (2012). *Handbook of food science, technology, and engineering* (4th ed.). CRC Press.
6. Furia, T. E. (Ed.). (1973). *CRC handbook of food additives*. CRC Press.
7. Belitz, H.-D., Grosch, W., & Schieberle, P. (2009). *Food chemistry* (4th ed.). Springer.
8. Waniska, R. D., & Biliaderis, C. G. (2008). *Breadmaking: Improving quality*. In Y. H. Hui (Ed.), *Handbook of food science, technology and engineering* (Vol. 1). CRC Press.
9. Beckett, S. T. (2008). *Industrial chocolate manufacture and use* (4th ed.). Wiley-Blackwell.
10. Lopez, S., & Frøst, M. B. (2013). *Sensory analysis of bakery products*. Woodhead Publishing.
11. Kulp, K., & Ponte Jr., J. G. (2000). *Handbook of dough fermentations*. Marcel Dekker.
12. Cauvain, S. P., & Young, L. S. (2007). *Technology of breadmaking* (2nd ed.). Springer.
13. Coultate, T. P. (2009). *Food: The chemistry of its components* (5th ed.). Royal Society of Chemistry.
14. Sahin, S., & Sumnu, G. (Eds.). (2006). *Physical properties of foods*. Springer.
15. American Institute of Baking (AIB). (2015). *Baking process troubleshooting guide*. AIB International.
16. Kulp, K. (1995). *Gluten and glutenin: Their role in dough and breadmaking*. Food Technology.
17. Belitz, H.-D., & Grosch, W. (1999). *Food chemistry* (3rd ed.). Springer.
18. Furia, T. E. (1972). *Sweeteners*. CRC Press.
19. O'Brien, R. D. (2008). *Fats and oils: Formulating and processing for applications*. CRC Press.
20. Goff, H. D., & Hill, A. R. (1993). *Milk proteins: Properties and processing*. Springer.
21. Mortensen, A. (2006). *Food Safety Management and HACCP*. Blackwell Publishing.
22. Aguilera, J. M., & Stanley, D. W. (1999). *Microstructure and texture in food*. CRC Press.
23. Morello, M., & Palla, G. (2004). *Handbook of confectionery and bakery technologies*. Wiley.
24. Lee, C. M., & Wrolstad, R. E. (2004). *Food colorants: Anthocyanins, carotenoids and betalains*. CRC Press.
25. Arendt, E. K., & Dal Bello, F. (2008). *Gluten-free cereal products and beverages*. Elsevier.

MSFT517-24: Applied Flavor Science for Food Innovation

Total marks: 100	**L**	**T**	**P**
	4	**0**	**0**

Course objective:

To develop a deep understanding of the science, chemistry, physiology, analytics, and regulations of flavour, empowering students to innovate, extract, and evaluate flavours across diverse food systems using advanced sensory and technological methods

Course outcome: At the end of the course, the students will be able to

CO1	Demonstrate a thorough understanding of the chemical, physiological, and sensory dimensions of flavour perception and classification.
CO2	Analyze the biochemical pathways and processing factors influencing flavour formation, modification, and retention in diverse food matrices.
CO3	Apply advanced extraction, analytical, and biotechnological techniques for flavour isolation, synthesis, and encapsulation.
CO4	Evaluate regulatory frameworks and sensory methodologies essential for flavour innovation, safety, and consumer acceptance.
CO5	Integrate multidisciplinary approaches, including digital sensory technologies and consumer psychology, to drive product development and flavour optimization in food systems.

Mapping of Course Outcomes with Program Outcomes: Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)

PO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	2	2	3	2
CO2	3	3	1	2	3
CO3	3	3	1	2	3
CO4	2	2	2	3	2
CO5	2	3	3	3	3

Details of the Course Content - Applied Flavor Science for Food Innovation (MSFT517-24)

Unit	Contents	Contact Hours
I	**Foundations of Flavour Science** • **Introduction to Flavour:** Definition, historical evolution, flavour characteristics and role of flavours in modern food systems • **Sensory Dimensions of Flavour:** Differentiating taste, aroma, mouthfeel, chemesthesis; interdependence in perception • **Classification of Flavours:** Natural, nature-identical, synthetic, and artificial flavouring agents • **Physiology of Taste and Smell:** Signal transduction, taste buds, olfactory epithelium; neuroanatomy of flavour perception. • **Mechanisms of Flavour Perception:** Roles of olfaction, gustation, and trigeminal nerve. • **Neuroscience and Consumer Behaviour:** Neural mapping of flavour perception and implications for product development • **Individual Variation:** Genetic polymorphisms, age, cultural context, and learned behavior in flavour preference • **Thresholds and Modifiers:** Detection, recognition, and difference thresholds; flavour potentiators and suppressors • **Volatile vs Non-Volatile Compounds:** Role in aroma and taste respectively; physical-chemical properties • **Cross-Modal Interactions:** Influence of visual, tactile, and auditory stimuli on perceived flavour	12
II	**Chemistry and Formation of Flavours** • **Major Chemical Classes:** Aldehydes, ketones, esters, acids, alcohols, sulfur compounds, terpenes, lactones, pyrazines • **Flavor Modifiers and Enhancers:** Monosodium glutamate (MSG), purine 5'-ribonucleotides, and related substances; Maltol and ethyl maltol; Furanones and cyclopentenolones; Vanillin and ethyl vanillin; Sodium chloride and its influence on flavor perception; Other synthetic and natural flavor modifiers; Mechanisms of action and application in food formulations • **Natural Formation Pathways:** *Enzymatic*: Lipoxygenase, glycosidase, and protease-related flavour development; *Non-Enzymatic*: Maillard reaction, caramelization, lipid oxidation • **Thermal Reactions:** Degradation of amino acids, sugars, and vitamins influencing desirable and off-flavours • **Biochemical Pathways in Foods:** Fermented (Hydrolysed vegetable proteins, Chocolate, Tea, Coffee, Beer, Wine); dairy (Cream, butter and Cheese), meat, fruits (Apples, Pears, Grapefruit, Blackcurrant, Raspberry, Strawberry, Apricot and peach, Citrus and citrus processing), and vegetables (Vanilla Spice flavours, Garlic, ginger, onion and related flavours, Brassica flavours, including mustard and horseradish; 'Fresh/green/grassy'—precursors and resulting profiles, Herbs and Spices (Classification of spices based on sensory profiles, Flavor character of commonly used culinary herbs)	12

	• **Processing-Induced Flavour Modulation:** Effect of baking, roasting, extrusion, and drying on aroma compounds • **Food Matrix-Flavour Interactions:** Protein-fat-water matrix effects on volatility and retention; Lipid–Flavour Interactions; Emulsion–Flavour Interactions; Protein–Flavour Interactions; Carbohydrate–Flavour Interactions • **Emerging Tools:** Application of computational chemistry and cheminformatics in predicting novel flavour molecules	
III	**Extraction, Synthesis & Encapsulation of Flavours** • **Extraction of Flavour Compounds:** Traditional: Solvent extraction, steam distillation; Modern: Supercritical CO_2, Headspace analysis, SPME; Essential Oils; Oleoresins, Tinctures and Extracts • **Analytical Techniques:** Gas Chromatography–Mass Spectrometry (GC-MS), HPLC, FTIR, electronic nose, e-tongue • **Biotechnological Approaches:** Microbial fermentation, enzyme-assisted bioconversion, metabolic engineering • **Synthetic and Biomimetic Approaches:** Advances in flavour synthesis using AI/ML models • **Encapsulation Techniques:** Spray drying, freeze drying, complex coacervation, liposomes, cyclodextrins • **Stability Factors:** pH, oxygen, light, temperature; interactions with excipients and matrices • **Controlled Release Systems:** Innovations in functional foods, nutraceuticals, and sensory-targeted delivery • **Smart Packaging:** Nanoencapsulation, intelligent materials, and release-triggered systems	12
IV	**Application, Legislation & Sensory Evaluation** • **Applications in Food Systems:** Customisation of flavours for dairy, beverages, bakery, confectionery, meat analogues • **Product Innovation:** Role of flavours in R&D, reformulation, masking off-notes, and consumer appeal • **Natural vs Artificial Flavouring:** Trends in clean-label, plant-based, and minimal processing claims • **Regulatory Frameworks:** Overview of safety standards and approval processes: Indian (FSSAI), US (FDA, FEMA), Codex and European (EFSA) guidelines; GRAS lists, TTB flavouring restrictions, labelling norms • **Sensory Science Methodologies:** Descriptive analysis (QDA, Spectrum), discrimination (triangle, duo–trio), hedonic testing • **Panel Management:** Selection, training, calibration, and statistical evaluation • **Texture–Aroma Interactions:**Influence of rheological behavior on flavour release; Texture measurements and perceived aroma intensity • **Odour–Taste Interactions**:Mechanisms and origins of odour-taste interactions; Impact on flavour perception and consumer experience • **Digital Sensory Technologies:** AI/ML for flavour profile prediction, electronic nose & tongue, virtual panels	12

	• **Consumer Behaviour & Psychology:** Emotional response, cultural drivers, and data-driven flavour mapping	

Recommended Books and Resources

1. Ashurst, P. R. (Ed.). (2008). *Food flavourings*. Springer.
2. Baldwin, E. A., & Bai, J. (2010). Influence of thermal processing on flavor and aroma compounds. *Critical Reviews in Food Science and Nutrition*, 50(1), 1–18. https://doi.org/10.1080/10408390802574232
3. Berger, R. G. (2015). *Flavours and fragrances: Chemistry, bioprocessing and sustainability*. Springer.
4. Breslin, P. A. S., & Beauchamp, G. K. (1997). Suppression of bitterness by sodium: variation among bitter taste phenotypes. *Chemical Senses*, 22(2), 127–135. https://doi.org/10.1093/chemse/22.2.127
5. Cardello, A. V. (2007). Consumer expectations and their role in food acceptance. In R. MacFie (Ed.), *Understanding consumers of food products* (pp. 91–114). Woodhead Publishing.
6. Codex Alimentarius Commission. (2017). *General standard for food additives (GSFA)*. FAO/WHO. http://www.fao.org/fao-who-codexalimentarius/codex-texts/dbs/gsfa/en/
7. Draper, J. (2013). Computational approaches for aroma prediction. In *Flavour Science* (pp. 177–197). Elsevier.
8. FDA. (2020). *Code of Federal Regulations Title 21*. U.S. Food and Drug Administration. https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/cfrsearch.cfm
9. Fennema, O. R. (1996). *Food chemistry* (3rd ed.). Marcel Dekker.
10. Gutiérrez, M., et al. (2014). Advances in microbial production of flavors and fragrances. *Biotechnology Advances*, 32(2), 414–425. https://doi.org/10.1016/j.biotechadv.2013.11.002
11. Hollowood, T., Linforth, R., & Taylor, A. J. (2002). Flavour in food: Measurement and perception. Woodhead Publishing.
12. Kemp, H. A. (2010). *Gas chromatography and mass spectrometry: A practical guide* (2nd ed.). Wiley.
13. Kuswandi, B., et al. (2011). Smart packaging: sensors for monitoring of food quality and safety. *Sensors*, 11(4), 4744–4765. https://doi.org/10.3390/s110404744
14. Lawless, H. T., & Heymann, H. (2010). *Sensory evaluation of food: Principles and practices* (2nd ed.). Springer.
15. Meilgaard, M., Civille, G. V., & Carr, B. T. (2007). *Sensory evaluation techniques* (4th ed.). CRC Press.
16. Mottram, D. S. (1994). The Maillard reaction: Chemistry, biochemistry, and implications. *Food Chemistry*, 49(3), 371–375. https://doi.org/10.1016/0308-8146(94)90138-8
17. Mottram, D. S., & Edwards, R. A. (2005). The flavor of meat and meat products. In *Chemistry of food flavor*.
18. Pawliszyn, J. (2012). *Handbook of solid phase microextraction*. Elsevier.
19. Reineccius, G. (2006). *Flavor chemistry and technology* (2nd ed.). CRC Press.
20. Rowe, D. J. (2017). *Chemistry and technology of flavours and fragrances*. Wiley.
21. Sankaran, S., et al. (2019). Electronic noses and tongues: A review on recent advances for food quality evaluation. *Sensors*, 19(22), 5056. https://doi.org/10.3390/s19225056
22. Shepherd, G. M. (2006). Smell images and the flavour system in the human brain. *Nature*, 444(7117), 316–321. https://doi.org/10.1038/nature05405
23. Small, D. M., & Prescott, J. (2005). Odor/taste integration and the perception of flavor. *Experimental Brain Research*, 166(3-4), 345–357. https://doi.org/10.1007/s00221-005-2380-0
24. Spence, C. (2015). Multisensory flavor perception. *Cell*, 161(1), 24–35. https://doi.org/10.1016/j.cell.2015.03.007
25. Stone, H., & Sidel, J. L. (2004). *Sensory evaluation practices* (3rd ed.). Academic Press.
26. Taylor, A. J., & Linforth, R. S. T. (2010). *Food flavour technology* (2nd ed.). Wiley-Blackwell.

27. Yaylayan, V. A. (2006). *Maillard reaction: Chemistry, biochemistry and implications*. Royal Society of Chemistry.
28. Reineccius, G. (2006). *Flavor Chemistry and Technology* (2nd ed.). Taylor & Francis.
29. Voilley, A., & Etiévant, P. (Eds.). (1996). *Flavour in Food*. CRC Press.
30. Ashurst, P. R. (Ed.). (1999). *Food Flavorings* (3rd ed.). Aspen Publishers.
31. Ziegler, H. (Ed.). (2001). *Flavourings: Production, Composition, Applications, Regulations* (2nd ed.). Wiley-VCH.

MSFT518-24: Artificial Intelligence in the Food Industry

Total marks: 100	**L**	**T**	**P**
	4	**0**	**0**

Course objective:

To equip students with foundational knowledge and practical skills in artificial intelligence, machine learning, IoT, big data, and blockchain technologies, enabling their effective application for innovation, quality control, automation, and sustainable management across the food supply chain.

Course outcome: At the end of the course, the students will be able to

CO1	Demonstrate foundational understanding of AI concepts, machine learning algorithms, and their applications in the food industry.
CO2	Utilize AI tools, IoT, and sensor technologies for real-time quality monitoring, automation, and intelligent food processing.
CO3	Analyze big data, cloud computing, and blockchain integration for enhancing traceability, supply chain management, and food safety.
CO4	Apply advanced AI techniques, including robotics and predictive modeling, to optimize sector-specific food operations and innovation.
CO5	Evaluate ethical, privacy, and regulatory considerations in deploying AI solutions within the food industry's ecosystem.

Mapping of Course Outcomes with Program Outcomes: Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)

PO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	2	1	2	2
CO2	3	3	1	2	3
CO3	3	3	1	3	3
CO4	3	3	2	2	3
CO5	2	2	3	3	2

Details of the Course Content - Artificial Intelligence in the Food Industry (MSFT518-24)

Unit	Contents	Contact Hours
I	**Fundamentals of Artificial Intelligence and Tools for the Food Industry** **Core Concepts and Foundations:** Introduction to AI: Need, Components, and Applications in the Food Industry; AI vs Machine Learning vs Deep Learning; Types of AI: Narrow, General, and Super AI; Core Algorithms: Supervised, Unsupervised, Reinforcement Learning. **AI Tools and Development Frameworks:** Python for AI: Basics, NumPy, Pandas; TensorFlow and Keras for Food Applications; Scikit-learn and OpenCV for Quality Detection; Enterprise Platforms: IBM Watson, Azure ML, RapidMiner. **IoT and Sensor Integration:** Overview of Sensors and Sensing Techniques in Food Processing; Smart Cameras and IoT Architecture; Applications of IoT in the Food Industry; Electronic Tongue and Real-Time Detection; Integration of AI, ML and E-Tongue Fusion. **Big Data in the Food Industry:** Understanding Big Data: Nature, Analytics, and Applications. **Robotics and Automation:** Basic Concepts, Classification, and Applications in Food Operations; Robotics in In-Process Controls **Cloud Computing in Food Systems:** Architecture, Service Models, and Deployment Models; Significance in Food Data Storage and Access. **Blockchain in Supply Chain:** Introduction and Working Mechanism; Three Pillars of Blockchain Technology; Applications and Challenges in the Food Supply Chain.	12
II	**AI in Food Processing, Quality Control, and Safety** **AI for Quality and Safety Monitoring:** Predictive Microbiology and Shelf-Life Estimation; Vision-Based Systems: Grading and Sorting; Defect and Contaminant Detection (Image Processing); Spoilage and Contamination Monitoring; Non-Destructive Evaluation (e.g., Hyperspectral Imaging) **Sector-Specific Applications:** Dairy Industry: Milk Quality, Supply Chain Monitoring; Beverage Industry: Quality Control & Process Monitoring; Bakery Products: Shape, Texture, Cooking Accuracy; Fruits & Vegetables: Sorting, Cutting, Ripeness Detection; Restaurant AI: Customer Prediction, Behavior	12

	Analysis; 3D Food Printing: Customization & AI in Design; AI in Food Packaging: Intelligent Sensing & Shelf-Life Extension; Precision Pest Management using AI and Automation **Advanced Techniques:** Time-Delayed Neural Network (TDNN) for Shelf-Life; Robotic Integration in Food Processing.	
III	**AI in Food Supply Chain, Logistics & Traceability** **Supply Chain Intelligence:** Overview of Food Supply Chain Structure; AI in Demand Forecasting and Order Fulfillment; Predictive Modeling: Inventory & Pricing; Smart Warehousing and Cold Chain Optimization **Transparency & Blockchain Integration:** Food Fraud Detection and Traceability; AI + Blockchain Synergy for Secure Data; AI in Waste Management and Sustainable Logistics **Agricultural & Raw Material Monitoring:** AI in Pesticide and Fertilizer Application; AI in Crop Monitoring and Raw Material Planning	12
IV	**Case Studies, Emerging Trends, and Ethics** **Industry Use-Cases: Nestlé, PepsiCo, Tyson Foods;** IBM Food Trust; Walmart Supply Chain; BigBasket AI Logistics. **Next-Gen AI Applications:** Personalized Nutrition and AI Recommendations; Smart Kitchens and Home Food Automation; AI in Consumer Behavior Analysis; Robotics in Cooking, Packaging, Smart Vending. **Ethics, Privacy, and Regulation:** Introduction to AI Ethics; Responsible AI in Society; Principles of Ethical AI; Approaches for Designing Ethical AI; Data Protection and AI, Ethical Concerns in AI Deployment; Data Protection and GDPR Compliance; Risk Management and Bias Mitigation Strategies	12

Recommended Books and Resources

1. Russell, S. J., & Norvig, P. (2016). *Artificial intelligence: A modern approach* (3rd ed.). Pearson.
2. Goodfellow, I., Bengio, Y., & Courville, A. (2016). *Deep learning*. MIT Press.
3. Misra, N. N., Dixit, Y., Al-Mallahi, A., Sinha, N., & Dwivedi, D. (2020). Applications of artificial intelligence in food engineering. *Trends in Food Science & Technology*, 102, 274–287. https://doi.org/10.1016/j.tifs.2020.06.012

4. Lohumi, S., Lee, S., Lee, H., & Cho, B. K. (2015). Nondestructive quality assessment of food products using hyperspectral imaging: A review. *Trends in Analytical Chemistry*, 66, 111–117. https://doi.org/10.1016/j.trac.2014.11.009
5. Kamble, S. S., Gunasekaran, A., & Dhone, N. C. (2020). A machine learning-based approach for demand forecasting in the food supply chain. *Computers & Industrial Engineering*, 140, 106104. https://doi.org/10.1016/j.cie.2019.106104
6. Min, H. (2010). Artificial intelligence in supply chain management: Theory and applications. *International Journal of Logistics: Research and Applications*, 13(1), 13–39. https://doi.org/10.1080/13675560902736537
7. Zahoor, I., Wani, S. A., & Ganaie, T. A. (Eds.). (2024). *Artificial intelligence in the food industry: Enhancing quality and safety*. Routledge. https://www.routledge.com/Artificial-Intelligence-in-the-Food-Industry-Enhancing-Quality-and-Safety/Zahoor-AhmadWani-Ganaie/p/book/9781032613147
8. Ilyas, M., & Babar, M. (2021). *AI and big data in agriculture and food supply chain*. Elsevier. https://doi.org/10.1016/C2020-0-02056-0
9. Jain, A. (2020). *Practical artificial intelligence: An enterprise playbook*. O'Reilly Media.
10. Abiodun, O. I., Jantan, A., Omolara, A. E., Dada, K. V., Mohamed, N. A., & Arshad, H. (2018). State-of-the-art in artificial neural network applications: A survey. *Heliyon*, 4(11), e00938. https://doi.org/10.1016/j.heliyon.2018.e00938
11. FAO. (2021). *Ethical considerations in artificial intelligence applications in food systems*. Food and Agriculture Organization of the United Nations. https://www.fao.org/3/cb5844en/cb5844en.pdf
12. Mittelstadt, B. D., Allo, P., Taddeo, M., Wachter, S., & Floridi, L. (2016). The ethics of algorithms: Mapping the debate. *Big Data & Society*, 3(2), 2053951716679679. https://doi.org/10.1177/2053951716679679
13. European Commission. (n.d.). *General Data Protection Regulation (GDPR)*. Retrieved from https://ec.europa.eu/info/law/law-topic/data-protection_en
14. Food Safety and Standards Authority of India (FSSAI). (n.d.). *Food safety and standards regulations*. Retrieved from https://www.fssai.gov.in/cms/food-safety-and-standards-regulations.php
15. Anandharamakrishnan, C., & Moses, J. A. (Eds.). (2023). *Emerging technologies for the food industry, Volume 3: ICT applications and future trends in food processing*. Apple Academic Press.
16. Hefft, D., & Adetunji, C. O. (Eds.). (2022). *Sensing and artificial intelligence solutions for food manufacturing*. CRC Press.
17. Piramuthu, S., & Zhou, W. (2016). *RFID and sensor network automation in the food industry: Ensuring quality and safety through supply chain visibility*. Wiley-Blackwell.

MSFT519-24: Industrial Visit and FoSTaC Course

Total marks: 40	**L**	**T**	**P**
	0	**0**	**3**

Course objective:

To equip students with practical industry exposure and essential food safety knowledge through industrial visits, expert lectures, and completion of the FoSTaC - Food Safety Supervisor - Advance Storage and Transportation course, fostering their competence in food Storage and Transportation practices.

Course outcome: At the end of the course, the students will be able to

CO1	Students will gain practical knowledge of food industry operations and standards through firsthand industrial exposure and expert insights.
CO2	Students will develop a comprehensive understanding of fundamental food safety principles, including personal hygiene and food handling practices.
CO3	Students will be proficient in managing food operations and controls, ensuring adherence to safety and quality protocols.
CO4	Students will acquire skills in proper packaging and distribution methods to maintain food integrity and safety during the supply chain.
CO5	Students will be able to compile and present detailed reports on their industrial visit/expert lecturer and FoSTaC course experiences, demonstrating their applied knowledge and analytical skills.

Mapping of Course Outcomes with Program Outcomes: Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)

PO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	2	2	3	3
CO2	3	3	2	3	2
CO3	2	2	3	3	3
CO4	2	2	2	3	3
CO5	3	3	2	2	2

Details of the Course Content - Industrial Visit and FoSTaC Course (MSFT519-24)

Unit	Contents	Contact Hours
I	Students are required to visit a food industry or attend a guest lecture by a food industry expert. Subsequently, they must submit a report to the Head of the Department and Course Coordinator.	10
II	Students must complete the FoSTaC - Advance Retail and Distribution. This course should be completed through https://www.skillindiadigital.gov.in/courses/detail/98f276bf-baf6-4433-a6b8-faabcf78f833 or https://elearning.ficsi.in/courses/Food-Safety-Supervisor---Retail-and-Distribution-Advanced-Level-II-6242a8390cf2d3e7695238a6 or any FSSAI-recognized training center.	
III	Students are required to submit a detailed daily in-plant training diary along with a comprehensive training report documenting the in-plant training they completed during the summer vacation after the second semester. Subsequently, a seminar presentation and viva-voce will be conducted by the Course Coordinator based on their training experience and report.	

Recommended Books and Resources

1. https://www.skillindiadigital.gov.in/courses/detail/98f276bf-baf6-4433-a6b8-faabcf78f833
2. https://elearning.ficsi.in/courses/Food-Safety-Supervisor---Retail-and-Distribution-Advanced-Level-II-6242a8390cf2d3e7695238a6

SEMESTER- IV

Program Scheme & Syllabus

Semester IV

Course Code	Course Title	Course Type	Load			Marks Distribution		Total	Credits
			L	T	P	Internal	External		
MSFT521-24	Applied Research Methodology in Food Science	DSC	4	0	0	40	60	100	4
M/FIC/Q 9301	Food Product developer	DSE	4	0	0	40	60	100	4
MSFT522- 24	Seminar	SEC-AB	0	0	2	30	20	50	1
MSFT523- 24	Dissertation	Project	0	0	24	200	100	300	12
M/FoSTaC	Food Safety Supervisor - Advance Manufacturing	SEC-SB	0	0	1	20	--	20	1
	Total		8	0	27	330	240	570	22

MSFT521-24: Applied Research Methodology in Food Science

Total marks: 100	**L**	**T**	**P**
	4	**0**	**0**

Course objective:

To equip students with comprehensive research methodology skills, including statistical analysis, experimental design, and scientific writing, tailored for food science and technology applications, with a focus on ethical practices, data interpretation, and research proposal development.

Course outcome: At the end of the course, the students will be able to

CO1	Apply fundamental and advanced research methodologies to address challenges in food science and technology.
CO2	Analyze and interpret food science data using appropriate statistical tools, including parametric, non-parametric tests, and Principal Component Analysis (PCA).
CO3	Develop research proposals, conduct literature reviews, and write scientifically sound papers adhering to ethical guidelines.
CO4	Demonstrate proficiency in data collection methods and the use of statistical software like SPSS and Excel in food research.
CO5	Understand and uphold research ethics, intellectual property rights, and the responsible conduct of research in the food industry.

Mapping of Course Outcomes with Program Outcomes: Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)

PO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	2	2	1	3
CO2	3	3	2	1	3
CO3	2	2	3	2	2
CO4	3	2	2	1	3
CO5	2	2	3	3	2

Details of the Course Content - Applied Research Methodology in Food Science (MSFT521-24)

Unit	Contents	Contact Hours

I	**Fundamentals of Research Methodology**
	
	• **Introduction to Research**: Definition, objectives, and significance in food science and technology
	• **Types of Research**: Exploratory, descriptive, experimental, applied, fundamental research
	• **Research Design**: Formulating research problems, hypothesis development
	• **Experimental Design in Food Research**:
	  o Completely randomized design
	  o Factorial design
	  o Randomized block design
	  o Response surface methodology (RSM)
	• **Literature Review**: Sources, citation styles (APA, MLA), systematic reviews, meta-analysis
	• **Data Collection Methods**: Surveys, interviews, observations, laboratory experiments in food technology
		12

II	**Statistical Analysis and Techniques**
	
	• **Sampling Techniques**: Probability and non-probability sampling, sample size determination
	• **Biostatistics in Food Science**: Normal distribution, hypothesis testing fundamentals
	• **Statistical Tools and Tests**:
	  o Descriptive statistics (mean, median, mode, variance, standard deviation)
	  o **Correlation Analysis**: Pearson correlation, Spearman rank correlation, partial correlation, and their use in food science research (e.g., testing the relationship between ingredient concentrations and sensory quality)
	  o **Parametric Tests**: Assumptions, t-tests (independent, paired), ANOVA (one-way, two-way), regression analysis
	  o **Principal Component Analysis (PCA)**: Introduction, applications in food science (e.g., sensory evaluation, ingredient profiling, quality control)
	• **Data Visualization Techniques**: Box plots, histograms, scatter plots, error bars
	• **Software Applications for Data Analysis**: SPSS, Excel
		12

III	**Advanced Statistical Techniques and Research Ethics**
	
	• **Non-parametric Tests**:
	  o Mann-Whitney U Test: Comparing consumer preferences (e.g., salted vs unsalted snacks).
	  o Wilcoxon Signed-Rank Test: Comparing before-and-after moisture content or texture measurements in food.
		12

	○ Kruskal-Wallis H Test: Sensory scores comparison across multiple product formulations (e.g., gluten-free vs regular). ○ Chi-Square Test: Analyzing categorical data, such as packaging defects in food products. ○ Spearman's Rank Correlation: Assessing the relationship between product ratings and characteristics like taste or texture. • **Research Ethics**: Plagiarism, integrity in scientific publishing, ethical considerations specific to food research (human/animal trials, GMO studies) • **Responsible Conduct of Research (RCR)**: Data management, authorship ethics, conflict of interest, reproducibility • **Intellectual Property Rights (IPR)**: Patents, copyrights, trademarks, geographical indications, commercialization of food innovations	
IV	**Scientific Writing and Research Proposal Development** • **Scientific Writing Overview**: Research papers, thesis, dissertations, patents, technical reports • **Research Proposal Development**: Components, objectives, feasibility, timeline, and budgeting • **Data Interpretation and Report Writing**: Organizing findings, structuring reports, writing abstracts and conclusions • **Scientific Writing Standards**: Structure of manuscripts, writing for food science journals, citation management, avoiding plagiarism • **Presentation Skills**: Preparing impactful oral presentations, poster design, and defense techniques • **Publication Process**: Journal selection, manuscript submission, peer review, understanding impact factor • **Funding and Grants**: Identifying funding sources, writing successful grant proposals, project management basics	12

Recommended Books and Resources

1. Babbie, E. (2014). *The practice of social research* (13th ed.). Cengage Learning.
2. Belcher, W. L. (2009). *Writing your journal article in twelve weeks: A guide to academic publishing success*. Sage Publications.
3. Bickman, L., & Rog, D. J. (2009). *The SAGE handbook of applied social research methods*. Sage Publications.
4. Brown, C. (2008). *Ethics in intellectual property*. Routledge.
5. Chang, W. (2013). *R graphics cookbook*. O'Reilly Media.
6. Creswell, J. W. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches* (4th ed.). Sage Publications.
7. Day, R. A., & Gastel, B. (2012). *How to write and publish a scientific paper* (7th ed.). Cambridge University Press.
8. Everitt, B. S., & Hothorn, T. (2011). *An introduction to applied multivariate analysis with R*. Springer.
9. Field, A. (2013). *Discovering statistics using IBM SPSS statistics* (4th ed.). Sage Publications.

10. Field, A., Miles, J., & Field, Z. (2012). *Discovering statistics using SPSS* (4th ed.). Sage Publications.
11. Fink, A. (2017). *How to conduct surveys: A step-by-step guide* (6th ed.). Sage Publications.
12. Gupta, S. P. (2014). *Statistical methods* (41st ed.). Sultan Chand & Sons.
13. Jasanoff, S. (2007). *The ethics of invention: Technology and the human future*. W.W. Norton & Company.
14. Jolliffe, I. T. (2002). *Principal component analysis*. Springer.
15. Kothari, C. R. (2004). *Research methodology: Methods and techniques* (2nd ed.). New Age International.
16. Kumar, R. (2019). *Research methodology: A step-by-step guide for beginners* (5th ed.). Sage Publications.
17. Lipson, C. (2005). *How to write a thesis*. University of Chicago Press.
18. Lockett, A., & Brown, D. (2017). *The complete guide to grant writing: How to write a successful proposal*. Wiley.
19. MacMillan, J. H., & Schumacher, S. (2010). *Research in education: Evidence-based inquiry* (7th ed.). Pearson.
20. Mertens, D. M. (2014). *Research and evaluation in education and psychology: Integrating diversity with quantitative, qualitative, and mixed methods* (4th ed.). Sage Publications.
21. Montgomery, D. C. (2017). *Design and analysis of experiments* (9th ed.). Wiley.
22. Montgomery, D. C., & Runger, G. C. (2014). *Applied statistics and probability for engineers* (6th ed.). Wiley.
23. O'Neill, M. (2015). *Excel for scientists and engineers: Numerical methods*. Springer.
24. Peat, J., Elliott, E., & Baur, L. A. (2013). *Scientific writing: Easy when you know how* (2nd ed.). Wiley.
25. Park, W. G. (2012). *Intellectual property rights and international trade: The WTO and developing countries*. Cambridge University Press.
26. Piers, J., & Burnett, L. (2019). *Ethics in research and publication* (2nd ed.). Academic Press.
27. Richardson, D. (2013). *Intellectual property and food law*. Oxford University Press.
28. Robson, C. (2011). *Real world research* (3rd ed.). Wiley.
29. Russell, L. M. (2019). *Effective grant writing and program evaluation for human service professionals*. Pearson.
30. Siegel, S., & Castellan, N. J. (1988). *Nonparametric statistics for the behavioral sciences* (2nd ed.). McGraw-Hill.
31. Smith, G. L. (2008). *Patent law and food science: Innovation in food production*. Wiley-Blackwell.
32. Tam, M. (2008). *Writing up your university assignment and research projects: A practical handbook* (3rd ed.). Oxford University Press.
33. Trochim, W. M. (2006). *Research methods knowledge base*. Atomic Dog Publishing.
34. Wiersma, W., & Jurs, S. G. (2009). *Research methods in education: An introduction* (9th ed.). Pearson.
35. Zar, J. H. (2010). *Biostatistical analysis* (5th ed.). Pearson.

M/FIC/Q9301: Food Product developer

Total marks: 100	**L**	**T**	**P**
	4	**0**	**0**

Course objective:

To equip learners with comprehensive knowledge and skills in food product development, covering the entire process from ideation, recipe formulation, and scaling-up to commercialization, while ensuring regulatory compliance, sustainability, and innovation in food production.

Course outcome: At the end of the course, the students will be able to

CO1	Students will acquire a thorough understanding of the global food processing industry, including the role of food product developers in driving innovation and sustainability.
CO2	Learners will gain expertise in recipe formulation, sensory science, and the application of food science principles to develop nutritious, balanced, and market-acceptable food products.
CO3	Students will develop skills in scaling up food products from small-scale formulations to large-scale production, including process optimization and equipment selection.
CO4	Learners will understand the regulatory frameworks and food safety standards, enabling them to ensure compliance with global and local regulations in product development.
CO5	Students will be equipped with the knowledge of commercialization strategies, including packaging, labeling, and market integration, along with practical skills in entrepreneurship and sustainable food production.

Mapping of Course Outcomes with Program Outcomes: Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)

PO / CO	PO1	PO2	PO3	PO4	PO5
CO1	3	2	2	3	2
CO2	3	2	2	3	3
CO3	3	3	2	2	3
CO4	2	2	3	3	2
CO5	2	3	3	3	2

Details of the Course Content - Food Product Developer (M/FIC/Q9301)

Unit	Contents	Contact Hours
I	Foundations of Food Processing & Product Innovation: Overview of the global food processing industry; Role of food product developers in innovation and sustainability; Creativity, Resourcefulness, communication, and Teamwork as essential skills.; Market trends and consumer behavior in food product development; Fundamentals of food science, including food chemistry and microbiology and their Impact on Product Development; Ethical considerations and environmental impact in food production; Various Processes in Food Product Formulation; Product Development Steps as per SOP; Significance of Maintaining a List of Multiple Tasks	11
II	Recipe Formulation & Sensory Science Principles of Recipe Development & Formulation: Recipe formulaion (Ideation, Market Research, and Concept Testing); Formulation Design - How to Set Up Experiments and Track Variables; Functional Roles of Ingredients and Their Interactions; Functional roles of ingredients in product structure and stability; Techniques for balancing taste, texture, and nutritional value; Genesis Software to Generate Nutrition Facts Panels.; Industrial Ingredients – Purpose, Sourcing and Conversion; Modifying traditional recipes for innovation and health benefits; Material Availability for Future and Current Trials; Use of alternative ingredients for sustainable food processing; Prototype Development; Recipe Costing and Sizing; Standardized Weights, Measures, Weight Range, and Sensory Scales for Food Products; Document and Record Maintenance for Product Development Process Sensory Analysis & Consumer Testing: Sensory evaluation methodologies for food product acceptance; Consumer Concept Testing & JAR Attribute Testing.; Quality benchmarking of texture, flavor, and appearance; Continuous improvement strategies based on sensory feedback.	12
III	Scale-Up, Innovation, and Regulatory Compliance Scale-Up Process for Food Product Manufacturing: Transitioning from small-scale formulation to commercial production; Scale-Up Expectations and Value; Steps for Large Scale Production; Processing Equipment Considerations & SOP Writing- Various Food Production Process; Batch Sheet Construction & Ingredient Specifications; Halal and Haram Ingredients and Process; Process of Handling Plant Trials of Food Product; Managing Vendor Selection for Procurement and ingredient standardization; Analytical Testing-Sensory Analysis for Scaleup Products, micriobiogical testing, Proximate and Ultimate Analysis; Process control measures for consistency; Equipment selection and optimization in food production; Developing Guidelines for Innovative Food Products: Quality Testing Parameters for Desired Product; Exploring emerging trends in food	12

	product development; Fortification strategies for nutrient-enriched food products; Use of alternative ingredients for sustainable food processing; Advanced ingredient functionality and new formulation technologies; Consumer-driven product development and market adaptation; Emerging technologies in food formulation (e.g., extrusion, microencapsulation) Regulatory Guidelines & Benchmarking for Product Development: Basic Seven Quality Management Tools; Need and Importance of Food Safety Standards in Food Industry and Mandated by Government Regulations; Global food regulations for Development of New Recipes (FSSAI, FDA, EFSA, Codex Alimentarius) and compliance standards; Mixing of Permited and Non-Permited Ingredients in Food Product with their maximum limit as per FSSAI; Allergen Management; Labeling, packaging, and shelf-life optimization; Industry standards for food safety (HACCP, ISO 22000); Benchmarking against industry standards and competitor analysis	
IV	Commercialization, Practical Applications & Industry Integration Commercialization: Commercialization overview; Home Use Tests; Shelf Life and Abuse Testing; Finished Product Specification; Choosing Packaging for Your Product; Regulations specific to packed food products; Designing a Package Label; Calculating Suggested Retail Price (SRP) Practical Applications & Industry Integration: Organizing and executing tasks for product development; Analytical techniques for food quality evaluation; Maintaining material availability and inventory management; Sustainable food production and waste management strategies; Entrepreneurship and business development in food innovation- Business Development, Funding, and Pitching Ideas.	12

Recommended Books and Resources

1. Food Industry Capacity & Skill Initiative. (2022). *Participant Handbook: Food Product Developer (M/FIC/Q9301)*. FICSI. Retrieved from https://www.ficsi.in/upload/participant_handbook/89e209e71a877b679694394aad3195c7.pdf
2. Food Industry Capacity & Skill Initiative. (2022). *Facilitator Guide: Food Product Developer (M/FIC/Q9301)*. FICSI. Retrieved from https://ficsi.justlearnindia.in/courses/Convenience-Food-Maker-PH-and-FG-603c6cd70cf231c2e0f188ce
3. Fuller, G. W. (2016). *New Food Product Development: From Concept to Marketplace* (3rd ed.). CRC Press.
4. Prusa, K., & Gilbert, K. (2021). *Food Product Development Lab Manual*. Iowa State University. Retrieved from https://iastate.pressbooks.pub/foodproductdevelopment/chapter/chapter-1/
5. Side, C. (2019). *Food Product Development: Based on Consumer Demand*. Wiley.
6. Smith, J., & Charter, E. (2010). *Handbook of Food Product Development*. Wiley-Blackwell.
7. Moskowitz, H. R., Beckley, J. H., & Resurreccion, A. V. A. (2008). *Food Product Development: A Manual for Entrepreneurs*. Springer.
8. Macfie, H. J. H. (2012). *Food Product Development: Case Studies and Applications*. Woodhead Publishing.
9. Moskowitz, H. R., Beckley, J. H., & Resurreccion, A. V. A. (2012). *Sensory and Consumer Research in Food Product Design and Development*. Wiley.
10. Rahman, M. S. (2014). *Advances in Food Product Development and Processing*. CRC Press.

11. Meilgaard, M., Civille, G. V., & Carr, B. T. (2016). *Sensory Evaluation Techniques* (5th ed.). CRC Press.
12. Fellows, P. J. (2017). *Food Processing Technology: Principles and Practice* (4th ed.). Woodhead Publishing.
13. Hui, Y. H. (2006). *Handbook of Food Science, Technology, and Engineering* (Vols. 1-4). CRC Press.
14. Robertson, G. L. (2016). *Food Packaging: Principles and Practice* (3rd ed.). CRC Press.
15. Motarjemi, Y., & Lelieveld, H. (2013). *Food Safety Management: A Practical Guide for the Food Industry*. Academic Press.
16. Food and Agriculture Organization (FAO) & World Health Organization (WHO). (2020). *Codex Alimentarius: International Food Standards*. FAO/WHO. Retrieved from https://www.fao.org/fao-who-codexalimentarius/en/
17. Teagasc. (2020). *Food Development Webinar - Introduction to New Product Development*. Retrieved from https://www.youtube.com/watch?v=oHM1Sr9p60Y
18. Herring, J. (2018). *From Concept to Consumer: Food Product Development*. Retrieved from https://www.youtube.com/watch?v=Ferc75yZtWU
19. FoodGrads. (2017). *10 Facts About Food Research and Development*. Retrieved from https://www.youtube.com/watch?v=Hs8bSkRcO4Q
20. Harvest Public Media. (2016). *Developing A New Food Product: The Art + Technique Of Food Science*. Retrieved from https://www.youtube.com/watch?v=xOXnrKy17s0
21. Alison. (2024). *Fundamentals of Food Product Development*. Retrieved from https://alison.com/course/fundamentals-of-food-product-development

MSFT-522-24: Seminar

Total marks: 50	**L**	**T**	**P**
	0	**0**	**2**

Course objective:

To develop students' presentation skills by encouraging them to present on a chosen research topic in Food Science and Technology, enhancing their ability to communicate research findings and demonstrate expertise in emerging trends and specialized fields.

Course outcome: At the end of the course, the students will be able to

CO1	Students will develop the ability to critically analyze and present research findings on their chosen topic in Food Science and Technology, whether it be a literature survey, mini research assignment, or advanced topic.
CO2	Students will enhance their skills in structuring and delivering clear, comprehensive presentations tailored to their selected topic.
CO3	Students will gain the ability to identify research gaps, trends, and propose future directions based on their chosen area of focus.
CO4	Students will demonstrate expertise in presenting emerging trends and specialized topics within the field of Food Science and Technology.
CO5	Students will effectively communicate complex research concepts and engage in academic discussions with confidence and clarity.

Mapping of Course Outcomes with Program Outcomes: Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)

PO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	2	2	3	2
CO2	2	2	3	3	2
CO3	3	3	2	2	3
CO4	2	3	3	3	2
CO5	2	2	3	3	3

Details of the Course Content - Presentation (MSFT-522-25)

Unit	Contents	Contact Hours
I	Students will be encouraged to present on any of the following key topics: 1. **Literature Survey Presentations**: Analyzing and presenting existing literature on a chosen research topic, identifying key research gaps, trends, and proposing potential future directions or areas of innovation within the discipline. 2. **Mini Research Assignment Presentations**: Structuring and delivering a presentation based on a comprehensive mini research assignment, detailing the research question, methodology, results, analysis, and implications for future work or practical applications in the field of Food Science and Technology. **3. Thrust Areas of Discipline-Specific Advanced Topics**: Presenting advanced research topics at the forefront of Food Science and Technology, focusing on emerging trends, groundbreaking developments, and specialized areas such as food safety, food biotechnology, nutrition, food processing, and food engineering. This enables students to demonstrate their in-depth knowledge and expertise in both cutting-edge technologies and specific sub-fields of the discipline.	2

MSFT-523-24: Dissertation

Total marks: 300	**L**	**T**	**P**
	0	**0**	**24**

Course objective:

To develop the ability to conduct independent research in Food Technology by applying scientific principles, analytical skills, and critical thinking to address real-world challenges through a structured dissertation project.

Course outcome: At the end of the course, the students will be able to

CO1	Identify and define a relevant research problem in the field of Food Science and Technology.
CO2	Review scientific literature critically to establish the research gap and justify the study.
CO3	Design and execute experimental protocols or analytical methods appropriate to the research objectives.
CO4	Analyze and interpret research data using appropriate tools and draw valid conclusions.
CO5	Prepare a structured dissertation report and effectively communicate the research findings through written and oral presentation.

Mapping of Course Outcomes with Program Outcomes: Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)

PO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	2	3	2	1	3
CO2	2	3	2	1	2
CO3	3	3	2	1	3
CO4	3	3	2	1	3
CO5	2	2	3	1	2

Details of the Course Content - Dissertation (MSFT-523-24)

Unit	Contents	Contact Hours

I	As part of the dissertation component of the M.Sc. Food Technology programme, each student is required to identify a suitable research topic under the guidance of an approved faculty supervisor.
	
	• The research topic must be **scientifically sound**, **academically relevant**, and **feasible** within the available timeframe, infrastructure, and laboratory resources.
	• Topic selection must be based on current trends, emerging technologies, or identified gaps in the domain of **Food Science and Technology**.
	• The topic may pertain to, but is not limited to, the following thrust areas:
	  o Food Chemistry and Nutritional Analysis
	  o Food Microbiology and Safety Assessment
	  o Processing and Preservation Technologies
	  o Functional Foods and Nutraceutical Development
	  o Fermentation and Enzyme Technology
	  o Food Packaging and Storage Stability
	  o Product Development and Sensory Evaluation
	  o Waste Management and By-product Utilization
	  o Quality Control, HACCP, and Food Regulations
	  o Emerging Techniques in Food Processing (e.g., non-thermal, nano-tech, etc.)
	• Any work involving **ethical clearance** (human/animal studies, genetically modified organisms, etc.) must obtain proper approval before data collection begins.
		24

M/FoSTac: Food Safety Supervisor - Advance Manufacturing

Total marks: 20	**L**	**T**	**P**
	0	**0**	**1**

Course objective:

To equip students with practical industry exposure and essential food safety knowledge through industrial visits, expert lectures, and completion of the FoSTaC - Food Safety Supervisor - Advance Storage and Transportation course, fostering their competence in food Storage and Transportation practices.

Course outcome: At the end of the course, the students will be able to

CO1	Students will gain practical knowledge of food industry operations and standards through firsthand industrial exposure and expert insights.
CO2	Students will develop a comprehensive understanding of fundamental food safety principles, including personal hygiene and food handling practices.
CO3	Students will be proficient in managing food operations and controls, ensuring adherence to safety and quality protocols.
CO4	Students will acquire skills in proper packaging and distribution methods to maintain food integrity and safety during the supply chain.
CO5	Students will be able to compile and present detailed reports on their industrial visit/expert lecturer and FoSTaC course experiences, demonstrating their applied knowledge and analytical skills.

Mapping of Course Outcomes with Program Outcomes: Formulation of Course Outcomes-Program Outcomes matrix with correlation values as 1 (Low), 2 (Medium), 3 (High)

PO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	2	2	3	3
CO2	3	3	2	3	2
CO3	2	2	3	3	3
CO4	2	2	2	3	3
CO5	3	3	2	2	2

Details of the Course Content - Food Safety Supervisor - Advance Manufacturing (M/FoSTac)

Unit	Contents	Contact Hours
I	Students must complete the FoSTaC - Food Safety Supervisor - Advance Manufacturing. This course should be completed through https://www.skillindiadigital.gov.in/courses/detail/64f19f0e-0f1c-4c70-8088-96d291255095 or https://elearning.ficsi.in/courses/Food-Safety-Supervisor---Advance-Manufacturing-Level-II-624172080cf2308f46fdce58 or https://elearning.ficsi.in/courses/Assessment-for-Food-Safety-Supervisor---Advance-Manufacturing-Level-II-624eb3010cf2605490c43098 or any FSSAI-recognized training center.	6

Recommended Books and Resources

1. https://www.skillindiadigital.gov.in/courses/detail/64f19f0e-0f1c-4c70-8088-96d291255095
2. https://elearning.ficsi.in/courses/Food-Safety-Supervisor---Advance-Manufacturing-Level-II-624172080cf2308f46fdce58
3. https://elearning.ficsi.in/courses/Assessment-for-Food-Safety-Supervisor---Advance-Manufacturing-Level-II-624eb3010cf2605490c43098