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ताळगांव पठार,
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(Accredited by NAAC)

GU/Acad –PG/BoS -NEP/2025-26/188 Date: 27.06.2025

CIRCULAR

The Academic Council & Executive Council of the University has approved Ordinance OA-35A relating to PG Programmes offered at the University campus and its affiliated Colleges based on UGC 'Curriculum and Credit Framework for Postgraduate Programmes'. Accordingly, the University has proposed introduction of Ordinance OA-35A from the Academic year 2025-2026 onwards.

The Programme structure and syllabus of Semester I and II of the **Master of Science in Food Technology** Programme approved by the Academic Council in its meeting held on 13th & 14th June 2025 is attached.

The Principal of the Affiliated College offering the **Master of Science in Food Technology** Programme is requested to take note of the above and bring the contents of the Circular to the notice of all concerned**.**

ASHWIN VYAS LAWANDE
Digitally signed by ASHWIN VYAS LAWANDE
Date: 2025.06.27 17:26:05 +05'30'

(Ashwin V. Lawande)
Deputy Registrar – Academic

To,
1. The Dean, School of Biological Sciences and Biotechnology, Goa University.
2. The Vice-Dean (Academic), School of Biological Sciences and Biotechnology, Goa University.
3. The Principal of Affiliated Colleges offering the Master of Science in Food Technology Programme.

Copy to:
1. Chairperson, BoS in Food Technology, Goa University.
2. Controller of Examinations, Goa University.
3. Assistant Registrar Examinations (PG), Goa University.
4. Director, Directorate of Internal Quality Assurance, Goa University for uploading the Syllabus on the University website.

GOA UNIVERSITY

MASTER OF SCIENCE (M.Sc.) IN FOOD TECHNOLOGY

(Effective from the Academic Year 2025-26)

ABOUT THE PROGRAMME

Food scientists and technologists are versatile, interdisciplinary, and collaborative practitioners in a profession at the crossroads of scientific and technological developments. As the food system has drastically changed, from a family food production on individual farms and home food preservation to the modern system of today, most people are not connected to their food, nor are they familiar with agricultural production and food manufacturing designed for better food safety and quality. The programme equips students for higher research that will lead to a Ph.D. Degree or setting up an enterprise of their own, or for employment in Research Institutes, teaching, and Industry.

OBJECTIVES OF THE PROGRAMME

The objectives of M.Sc. (Food Technology) Programme are:

1. Provide students with theoretical knowledge and practical abilities required to work in the food industry, research centres, and food-related national and international organisations
2. Contribute to a healthier population by imparting education and understanding of nutritional science
3. Develop confident and competent individuals, able to adapt to the changing fabric of society through their professional expertise and personal traits

Exit Option

Student can opt for Exit option after completion of Semester 1 and 2 with completion of internship. The student will be awarded "PG diploma in Food Technology"

Approved by: Academic Council on 13th & 14th June 2025

PROGRAMME SPECIFIC OUTCOMES (PSO)	
PSO 1.	Demonstrate understanding of principles of food technology and processing.
PSO 2.	Apply standards and practices of food safety, hygiene, and quality assurance in compliance with National and International Regulatory bodies.
PSO 3.	Employ traditional and modern food processing and preservation methods to enhance shelf-life and nutritional value of food products.
PSO 4.	Utilise advanced analytical tools and laboratory techniques for assessment and evaluation of food components, adulterants and contaminants.
PSO 5.	Design and develop new food products based on consumer needs, nutritional value and market feasibility.
PSO 6.	Demonstrate understanding of food industry operations, project management and entrepreneurial skills required to start and manage food-related enterprises.
PSO 7.	Promote sustainable practices in food production and processing, while upholding ethical and environmental standards in the food industry.
PSO 8.	Conduct independent and collaborative research in food science using scientific methodologies, data analysis and report generation.

PROGRAMME STRUCTURE

M.Sc. Food Technology Syllabus Effective from Academic Year 2025-26

Bridge Course			
Sr. No.	**Course Code**	**Title of the Course**	**Credits**
1	FTC-1000	Essentials of Biomolecules	2
2	FTC-1001	Essentials of Microbiology	2
3	FTC-1002	Basics of Food Handling and Processing	2

Note:

- FTC-1000 can be opted by students who have not taken Biochemistry/Physiology Coursework during UG Programme.
- FTC-1001 can be opted by students who have not taken Microbiology Coursework during UG Programme.
- FTC-1002 can be opted by students who completed their UG from disciplines other than Home Science/Food Science/Food Technology/Culinary Science.
- This course work is to help students for better understanding of the Food Technology. Classes for the course work will be conducted during first week of 1st semester. There will be only one exam of 50 marks at the end of each course work. Students have to pass the examination to get 2 credits. The credits earned for this course work will not be counted for the award of degree of M.Sc. in Food Technology OR PG diploma in Food Technology. The credits earned are over and above the credits of M.Sc. in Food Technology OR PG diploma in Food Technology.

SEMESTER I				
Discipline Specific Core (DSC) Courses (16 credits)				
Sr. No.	**Course Code**	**Title of the Course**	**Credits**	**Level**
1	FTC-5000	Food Chemistry and Nutritional Biochemistry	3	400
2	FTC-5001	Food Microbiology and Preservation	3	400
3	FTC-5002	Lab in Food Chemistry and Microbiology	2	400
4	FTC-5003	Food Processing and Packaging	3	400
5	FTC-5004	Food Quality, Safety Standards, and Laws	3	400
6	FTC-5005	Lab in Food Processing and Quality Management	2	400
Total Credits for DSC Courses in Semester I			**16**	
Discipline Specific Elective (DSE) Course (4 credits)				
Sr. No.	**Course Code**	**Title of the Course**	**Credits**	**Level**
1	FTC-5201	Food Industry Waste Management	3	400
2	FTC-5202	Lab in Food Industry Waste Management	1	400
3	FTC-5203	Food Additives, Adulteration and Toxicology	3	400
4	FTC-5204	Lab in Food Additives, Adulteration and Toxicology	1	400
Total Credits for DSE Courses in Semester I			**4**	
Total Credits in Semester I			**20**	

Note:

- Student who is opting FTC-5201 has to also take FTC-5202.
- Student who is opting FTC-5203 has to also take FTC-5204.

SEMESTER II				
Discipline-Specific Core (DSC) Courses				
Sr. No.	**Course Code**	**Title of the Course**	**Credits**	**Level**
1	FTC-5006	Food Biotechnology	3	500
2	FTC-5007	Lab in Food Biotechnology	2	500
3	FTC-5008	Normal and Clinical Nutrition	3	500
4	FTC-5009	Lab in Normal and Clinical Nutrition	2	500
5	FTC-5010	Bakery, Confectionery, and Convenience Food Technology	3	500
6	FTC-5011	Lab in Bakery, Confectionery, and Convenience Food Technology	1	500
7	FTC-5012	Food Engineering Principles and Applications	2	500
Total Credits for DSC Courses in Semester II			**16**	
Discipline-Specific Elective (DSE) Courses (4 credits)				
Sr. No.	**Course Code**	**Title of the Course**	**Credits**	**Level**
1	FTC-5205	Spice and Plantation Crop Technology	3	400
2	FTC-5206	Lab in Spice and Plantation Crop Technology	1	400
3	FTC-5207	Nutraceuticals and Health Foods	3	400
4	FTC-5208	Lab in Nutraceuticals and Health Foods	1	400
5	FTC-5209	Internship	4	400
Total Credits for DSE Courses in Semester II			**4**	
Total Credits in Semester II			**20**	

Note:

- Student who is opting FTC-5205 has to also take FTC-5206.
- Student who is opting FTC-5207 has to also take FTC-5208.
- Student who is opting FTC-5209 make note that the credits obtained for this course will not be counted for the award of M.Sc. in Food Technology OR PG Diploma in Food Technology.
- For PG Diploma in Food Technology FTC-5209 is an essential Exit Course.

Blooms Taxonomy Cognitive Levels	
Cognitive Level	**Notations**
K1	Remembering
K2	Understanding
K3	Applying
K4	Analyzing
K5	Evaluating
K6	Create

BRIDGE COURSES

Title of the Course	Essentials of Biomolecules
Course Code	FTC-1000
Number of Credits	2
Theory/Practical	Theory
Level	400
Effective from AY	2025-2026
New Course:	Yes
Bridge Course:	Yes
Course for advanced learners	No

Pre-requisites for the Course:	Nil	
Course Objectives:	1. To provide foundational knowledge of major biomolecules—carbohydrates, proteins, lipids, nucleic acids, vitamins, and minerals—including their classification, structure, and biological roles. 2. To introduce the structural and chemical characteristics of biologically important molecules. 3. To explain the nutritional significance and physiological functions of biomolecules in maintaining human health. 4. To establish an understanding of how the molecular composition of food components influences their nutritional value, and role in genetic and cellular processes.	
Course Outcomes:	**On the completion of the course, the student will be able to:**	**Mapped to PSO**
	CO 1. Define and list the sources of the biomolecules	PSO1
	CO 2. Recall the classification of biomolecules	PSO1

	CO 3. Identify and describe the structures and functions of biomolecules			PSO1
	CO 4. Explain the chemical properties of biomolecules			PSO1
	CO 5. Relate the importance of biomolecules in human diet to health			PSO1
Content:	**Syllabus Content (30 hours)**	**No. of hours**	**Mapped to CO**	**Cognitive Level**
Module 1:	**Carbohydrates**			
	1.1 Definition, Classification and Sources of carbohydrates	1	CO 1, CO 2 CO 3, CO 4	K1, K2, K3
	1.2 Monosaccharides: Structures of aldoses and ketoses, Reducing and non-reducing disaccharides	2	CO 1, CO 2 CO 3, CO 4	K1, K2, K3
	1.3 Polysaccharides: Homo and Heteropolysaccharides, Structural and storage polysaccharides	2	CO 1, CO 2 CO 3, CO 4	K1, K2, K3
	1.4 Carbohydrates in human nutrition	2	CO 5	K4
Module 2:	**Proteins**			
	2.1 Amino acids: Structure, classification; Derivatives of amino acids and their biological role.	3	CO 2, CO 3	K1, K2, K3
	2.2 Proteins: Definition, Sources, Structure and Functions. Biologically important peptides and proteins.	2	CO 1, CO 2 CO 3, CO 4	K1, K2, K3, K4
	2.3 Amino acids and proteins in human nutrition	2	CO 4	K4
Module 3:	**Lipids**			
	3.1 Lipid Chemistry: Definition, Classification and functions of Lipids; Storage and Structural lipids; Lipids as signaling molecules, cofactors and pigments	3	CO 1, CO 2 CO 3	K1, K2, K3
	3.2 Fatty acids: Saturated, Unsaturated, MUFA, PUFA, factors affecting degree of saturation	2	CO 2, CO 3 CO 4	K1, K2, K3, K4

	3.3 Lipids in human nutrition	2	CO 4	K4
Module 4:	**Nucleic Acids**			
	4.1 Nucleotide Chemistry: Definition, Classification and functions of nucleotides and nucleic acids, Nucleic acid structure and chemistry	3	CO 1, CO 2 CO 3, CO 4	K1, K2, K3, K4
	4.2 DNA as genetic material: DNA structures and their importance; Different types of RNA	2	CO 1, CO 2 CO 3, CO 4	K1, K2, K3, K4
Module 5:	**Vitamins and Minerals**			
	5.1 Vitamins: Definition, Classification and role in human body	2	CO 1, CO 2 CO 3, CO 4	K1, K2, K3, K4
	5.2 Minerals: Definition, Classification and role in human body	2	CO 1, CO 2 CO 3, CO 4	K1, K2, K3, K4
Pedagogy:	Lectures, Seminars, Problem-based Learning, Mock Debates, Use of ICT Tools			
Texts:	1. Voet, D., Voet, J. G., & Pratt, C. W. (2016). *Fundamentals of Biochemistry* (5th ed.). John Wiley & Sons. Hoboken, NJ, USA. 2. Nelson, D. L. & Cox, M.M. (2000), *Lehninger's Principles of Biochemistry* (3rd ed.), Worth Publishers, New York, USA. 3. Stryer, L. (1995). *Biochemistry* (4th ed.), W.H. Freeman and Co., New York, USA. 4. Murray, R. K., Granner, D. K., Mayes, P. A., & Rodwell, V. W. (2003). *Harper's Illustrated Biochemistry* (26th ed.). McGraw-Hill. New York, USA. https://www.siaphysio.com/e-books/Biochemistry/Harper's_Illustrated_Biochemistry.pdf 5. Meyer, L.H. (2002). *Food Chemistry*. CBS publishers and Distributors, New Delhi. 6. Damodaran, S., Parkin, K. L., & Fennema, O. R. (2007). *Fennema's Food Chemistry* (4th ed.). CRC Press, USA. 7. Eskin, N. M. (1990). *Biochemistry of Foods* (2nd ed.). Academic Press. San Diego, CA, 8. deMan, J. M. (1999). *Principles of Food Chemistry* (3rd ed.). Aspen Publishers, Inc. Gaithersburg, Maryland, USA. https://www.oyschst.edu.ng/elib/dashboard/ebooks/IfqyrZjf.pdf			

References/ Readings:	1. Mariotti, F., & Gardner, C. D. (2019). Dietary Protein and Amino Acids in Vegetarian Diets—A Review. *Nutrients*, *11*(11), 2661. https://doi.org/10.3390/nu11112661 2. Kapoor, B., Kapoor, D., Gautam, S., Singh, R., & Bhardwaj, S. (2021). Dietary Polyunsaturated Fatty Acids (PUFAs): Uses and Potential Health Benefits. *Current Nutrition Reports*, *10*(3), 232–242. https://doi.org/10.1007/s13668-021-00363-3 3. Cheung, P. C. K., & Mehta, B. M. (2015). *Handbook of Food Chemistry*. Springer-Reference. Berlin, Germany. https://earthwormexpress.com/wp-content/uploads/2021/10/Handbook_of_Food_Chemistry.pdf 4. Fasman, G. D. (1975). *CRC Handbook of Biochemistry and Molecular biology*: *Lipids*, *Carbohydrates*, *Steroids* (3rd ed.). CRC Press, Taylor & Francis Group. New York, USA https://doi.org/10.1201/9780429264214 5. Fasman, G. D. (1976). *Handbook of Biochemistry*: *Section A—Proteins, volume I* (1st ed.). CRC Press, Taylor & Francis Group. New York, USA https://doi.org/10.1201/9780429487378 6. Berdanier, C. D., Dwyer, J. T., & Feldman, E. B. (2007). *Handbook of Nutrition and Food* (2nd ed.). CRC Press. Boca Raton, USA. https://doi.org/10.1201/9781420008890
Web Resources:	https://bio.libretexts.org/Bookshelves/Biochemistry

Title of the Course	Essentials of Microbiology
Course Code	FTC-1001
Number of Credits	2
Theory/Practical	Theory
Level	400
Effective from AY	2025-2026
New Course:	Yes
Bridge Course:	Yes
Course for advanced learners	No

Pre-requisites for the Course:	Nil	
Course Objectives:	1. To understand the different groups of microorganisms associated with food 2. To explain the structural differences between prokaryotic and eukaryotic microorganisms, including the ultrastructure of bacterial cells. 3. To apply microbiological techniques and media required for the isolation and identification of microorganisms in food samples 4. To understand the techniques used in microbiological laboratories and food environments.	
Course Outcomes:	**On the completion of the course, the student will be able to:**	**Mapped to PSO**
	CO 1. Recall the fundamental concepts and the techniques in food microbiology.	PSO 4
	CO 2. Explain the basic concepts of microbiology and describe the lab techniques used.	PSO 4

	CO 3. Apply microbial techniques to study food related microorganisms.			PSO 4
	CO 4. Categorise the microbes and techniques used in food microbiology.			PSO 4
	CO 5. Evaluate and identify the microbes in food and recommend control measures to be employed.			PSO 3, PSO 4
Content:	**Syllabus Content (30 hours)**	**No. of hours**	**Mapped to CO**	**Cognitive Level**
Module 1:	**Basics of Microbiology**			
	1.1 Introduction and historical developments in microbiology	1	CO 1, CO 2	K1, K2
	1.2 Classification of Microorganisms: Prokaryotes and eukaryotes; Yeast, Algae, Protozoa, Mould and Bacteria; Pathogenic and beneficial microorganisms	5	CO 1, CO 2	K1, K2
	1.3 Physiology of microbes, Gram positive and Gram-negative bacterial membrane, spore, pili, flagella, Prokaryotic cellular reserve materials.	9	CO 1, CO 2	K1, K2
Module 2:	**Microbiological Techniques**			
	2.1 General Microbiological Techniques: isolation, serial dilutions, streak plate, pour plate and spread plate methods, total viable counts.	3	CO 1, CO 2 CO 3	K3, K4
	2.2 Culture media and types of culture media, Nutritional requirements of microorganisms, components of media, natural and synthetic media, various media used for microbial analysis, sterilization of media	6	CO 1, CO 2 CO 3, CO 4	K1, K2, K3, K4
	2.3 Staining Techniques: Simple and differential, negative, structural staining - capsule, spore, flagella; Preservation of microbes.	3	CO 1, CO 2 CO 3, CO 4	K3, K4
	2.4 Methods of Disinfection, Sanitation and Asepsis: Definition and Principles.	3	CO 1, CO 2 CO 5	K3, K4
Pedagogy:	Lectures, Seminars, Problem-based Learning, Mock Debates, Use of ICT Tools			
Texts:	1. Frazier, W. C., & Westhoff, D. C. (2014). *Food Microbiology* (5th ed.). McGraw-Hill Education. New Delhi, India.			

	2. Pelczar, M. J., Chan, E. C. S., & Krieg, N. R. (2002). *Microbiology* (5th ed.). Tata McGraw-Hill. New Delhi, India. 3. Willey, J. M., Sandman, K. M., & Wood, D. H. (2020). *Prescott's Microbiology* (11th ed.). McGraw-Hill Education. New York, USA. 4. Banwart, G. J. (2004). *Basic Food Microbiology*. (2nd ed). CBS Publishers. New Delhi, India. 5. Jay, J. M. (2000). *Modern Food Microbiology* (5th ed.). CBS Publishers. New Delhi, India. 6. Trivedi, P. C., Panjey, S., & Bhaduaria, S. (2010). *Textbook of Microbiology*. Aavishkar Publishers. Jaipur, India. https://rlmc.edu.pk/themes/images/gallery/library/books/Microbiology/Text_Book_of_Microbiology.pdf
References/ Readings:	1. Corry, J. E. L., Curtis, G. D. W., & Baird, R. M. (2011). *Handbook of Culture Media for Food and Water Microbiology* (3rd ed.). Royal Society of Chemistry, UK. 2. Adams, M. R., McClure, P. J., & Moss, M. O. (2023). *Food Microbiology* (5th ed.). Royal Society of Chemistry, UK. https://doi.org/10.1039/9781837673698 3. Atlas, R. M. (2006). *Handbook of Microbiological Media for the Examination of Food* (2nd ed). CRC Press. Boca Raton, USA. 4. Barkodia, M., Khichi, S., & Wati, L. (2018). *A Handbook on Basic Microbiological Techniques*. LAP Lambert Academic Publishing. Germany 5. Xu, Y., Xie, C., Liu, Y., Qin, X., & Liu, J. (2023). An update on our understanding of Gram-positive bacterial membrane vesicles: Discovery, functions, and applications. *Frontiers in Cellular and Infection Microbiology, 13*, 1273813. https://doi.org/10.3389/fcimb.2023.1273813 6. Sanders, E. R. (2012). Aseptic laboratory techniques: Plating methods. *Journal of Visualized Experiments, 63*, 3064. https://doi.org/10.3791/3064
Web Resources	1. Microbiology Info. https://microbiologyinfo.com/ 2. Microbe Notes. https://microbenotes.com/ 3. Institute of Food Science and Technology https://www.ifst.org/ 4. Microbiology Society. https://microbiologysociety.org/

Title of the Course	Basics of Food Handling and Processing
Course Code	FTC-1002
Number of Credits	2
Theory/Practical	Theory
Level	400
Effective from AY	2025-2026
New Course:	Yes
Bridge Course:	Yes
Course for advanced learners	No

Pre-requisites for the Course:	Nil	
Course Objectives:	1. To explain the principles and significance of food processing and preservation, including their functions, benefits, and influence on flavour components. 2. To describe and differentiate various unit operations such as slicing, dicing, mincing, maceration, liquefaction, emulsification, and separation, including their underlying mechanisms and industrial applications. 3. To analyse the impact of processing techniques on physical changes, flavour extraction, emulsion stability, and food quality outcomes. 4. To identify and compare the types, forms, and functions of food packaging, emphasising their role in protecting and preserving food products.	
Course Outcomes:	**On the completion of the course, the student will be able to:**	**Mapped to PSO**
	CO 1. Recall and explain the principles and objectives of food processing and preservation, and analyse	PSO 1,

	their impact on nutritional, sensory, and quality attributes of food.			PSO 3
	CO 2. Describe and compare mechanical and physical food processing techniques on food properties and processing efficiency.			PSO 1
	CO 3. Apply knowledge of emulsion and separation technologies to food systems, identifying suitable equipment and processing conditions for optimal product quality.			PSO 1
	CO 4. Identify the functions and forms of food packaging and sealing systems, and justify their selection based on food type, safety, convenience, and shelf-life.			PSO 1
	CO 5. Evaluate the role and effectiveness of different packaging closures and systems in preserving product integrity, ensuring safety, and meeting industry-specific needs.			PSO 1
Content:	**Syllabus Content (30 hours)**	**No. of hours**	**Mapped to CO**	**Cognitive Level**
Module 1:	**Fundamentals of Food Processing**			
	1.1 Food Processing and Preservation: Definition and Difference, Functions, Benefits and Drawbacks of Food Processing; Effect of Processing on Flavour Components	3	CO 1	K1, K2
	1.2 Dicing, Slicing, Mincing: Principles, equipment used, and applications in different food categories (fruits, vegetables, meats). Impact on surface area and subsequent processing.	4	CO 1, CO 2	KI, K2, K4
	1.3 Macerating and Grinding: Definition, techniques (physical crushing, enzymatic action), and applications (flavour extraction, tenderization).	4	CO 1, CO 2	KI, K2, K4
	1.4 Liquefaction: Definition, methods (blending, pureeing), and applications (soups, sauces, beverages).	4	CO 1, CO 2	KI, K2, K4
	1.5 Emulsification: Principles of emulsion formation (oil-in-water, water-in-oil), role of emulsifying agents (natural and synthetic), equipment (homogenisers, blenders), and applications (mayonnaise, dressings).	5	CO 1, CO 3	K1, K2, K3
Module 2:	**Components of Food Packages**			

	2.1 Food Packaging: Role, Types, Function, Importance	2	CO 4	K1, K2
	2.2 Forms of Packaging: Introduction, Types (rigid, semi-rigid, flexible), and Applications across various Food Industries	2	CO 4	K1, K2
	2.3 Packaging closures: Importance, roles, types (Screw Caps, Lids, Crown Caps, Corks, Stoppers and Plugs, Roll-on Closures), advantages and limitations	3	CO 5	K1, K2
	2.4 Packaging Sealing Systems: Heat Sealing, Adhesive Sealing, Crimping, Sewing, Adhesive Tapes, Shrink Wrapping	3	CO 5	K1, K2
Pedagogy:	Lectures, Seminars, Problem-based Learning, Mock Debates, Use of ICT Tools			
Texts:	1. Ramaswamy, H. S., & Marcotte, M. (2005). *Food Processing* (1st ed.). CRC Press. USA. https://doi.org/10.1201/9780203485248 2. Fellows, P. (2022). *Food processing technology: Principles and Practice* (5th edition). Woodhead Publishing, UK. 3. Robertson, G. L. (2016). *Food packaging* (3rd ed.). CRC Press, USA. https://doi.org/10.1201/b21347 4. Natarajan, S., Govindarajan, M., & Kumar, B. (2014). *Fundamentals of Packaging Technology* (2nd ed.). PHI Learning Private Limited, New Delhi. 5. Clark, S., Jung, S., & Lamsal, B. (Eds.). (2014). *Food Processing: Principles and Applications* (1st ed.). Wiley USA. https://doi.org/10.1002/9781118846315			
References/ Readings:	1. Amit, S. K., Uddin, Md. M., Rahman, R., Islam, S. M. R., & Khan, M. S. (2017). A review on mechanisms and commercial aspects of food preservation and processing. *Agriculture & Food Security*, *6*(1), 51. https://doi.org/10.1186/s40066-017-0130-8 2. Awuah, G. B., Ramaswamy, H. S., & Economides, A. (2007). Thermal processing and quality: Principles and overview. *Chemical Engineering and Processing: Process Intensification*, *46*(6), 584–602. https://doi.org/10.1016/j.cep.2006.08.004 3. Arora, A., & Padua, G. W. (2010). Review: Nanocomposites in food packaging. *Journal of Food Science*, *75*(1). https://doi.org/10.1111/j.1750-3841.2009.01456.x 4. Wyrwa, J., & Barska, A. (2017). Innovations in the food packaging market: Active packaging. *European Food Research and Technology*, *243*(10), 1681–1692. https://doi.org/10.1007/s00217-017-2878-2			
Web Resources:	1. National Institute of Food Technology, Entrepreneurship and Management, Thanjavur (NIFTEM-T), https://niftem-			

	t.ac.in/ 2. Institute of Food Technologists, https://www.ift.org/ 3. CSIR - Central Food Technological Research Institute, https://cftri.res.in/

SEMESTER I

Discipline Specific Core Courses

Title of the Course	Food Chemistry and Nutritional Biochemistry	
Course Code	FTC-5000	
Number of Credits	3	
Theory/Practical	Theory	
Level	400	
Effective from AY	2025-2026	
New Course:	No	
Bridge Course:	No	
Course for advanced learners	No	
Pre-requisites for the Course:	Nil	
Course Objectives:	1. To provide foundational knowledge of food constituents and nutrients, including their classification, physiological functions, and interactions affecting food stability and human health. 2. To explain the digestion, absorption, metabolism, and physiological roles of carbohydrates, proteins, lipids, vitamins, and minerals, along with associated health outcomes from their deficiencies or excesses. 3. To describe key biochemical and metabolic pathways associated with macronutrients and relate them to energy production and nutrient utilization in the body. 4. To introduce functional and non-nutrient components of foods, such as antioxidants, pigments, anti-nutritional factors, and synthetic food components, and their influence on food quality, safety, and health.	
Course Outcomes:	**On the completion of the course, the student will be able to:**	**Mapped to**

				PSO
	CO 1. Define and classify major food constituents (carbohydrates, proteins, lipids, vitamins, minerals) and describe their physiological functions in human health.			PSO 1
	CO 2. Sketch the basic skeleton of biochemical pathways			PSO 1
	CO 3. Explain digestion, absorption and transport of dietary biomolecules			PSO 1
	CO 4. Identify and analyse diseases resulting from deficiencies or excess essential nutrients in the human diet.			PSO 1
	CO 5. Evaluate the physicochemical interactions of nutrients during food processing and their influence on functional and nutritional properties			PSO 1
Content:	**Syllabus Content (45 hours)**	**No. of hours**	**Mapped to CO**	**Cognitive Level**
Module 1:	**Constituents of Food**			
	1.1 Food and Nutrients: Definition, Classification, and Functions	2	CO 1	K1
	1.2 Role of Water in Food and Human Health: Interaction with food components and food stability	2	CO 5	K5
	1.3 Pigments, Phytonutrients, Antioxidants, Flavour Components: Definition, Classification, and Functions	2	CO 1	K1
	1.4 Anti-nutritional Factors in Foods: Classification, sources, mechanism of action, methods of reduction	2	CO 1	K1
	1.5 Digestion, Absorption, and Transport of Foods and Nutrients	2	CO 3	K2
Module 2:	**Carbohydrates**			
	2.1 Carbohydrates: Role in human body, Dietary Sources, Digestion and fate of carbohydrate, Deficiencies and Excess, Recommended Dietary Allowances	3	CO 1, CO 3 CO 4	K1, K3, K4
	2.2 Reducing and Non-Reducing Sugars: classification, structures, function Browning Reactions in Foods – formation and control	2	CO 5	K5

	2.3 Starch, Resistant Starches and Dietary Fibre: Definition, Sources, Granule Structure, Properties, Functions, and Native and Modified Starches	2	CO 1, CO 3 CO 5	K1, K2, K5
	2.4 Metabolic Pathways: Glycolysis, lactic acid and ethanol fermentation, Gluconeogenesis, Glycogenesis, Glycogenolysis, Citric Acid Cycle	3	CO 2	K2, K5
Module 3:	**Proteins**			
	3.1 Proteins: Definition, Structures, Properties, Dietary Sources, Digestion and fate	2	CO 1, CO 3	K1, K2
	3.2 Deficiencies and Excess, Recommended Dietary Allowances	2	CO 4	K3, K4
	3.3 Metabolic Pathways: Transamination, Deamination, Decarboxylation, Urea Cycle	2	CO 2	K2, K3
	3.4 Stress and Anti-freeze Proteins; Protein Isolates and Concentrates	2	CO 5	K5
	3.5 Denaturation of Proteins, Evaluation of Protein Quality	2	CO 5	K5
Module 4:	**Lipids**			
	4.1 Lipids: Definition, Structures, Properties, Dietary Sources, Digestion and fate, Deficiencies and Excess, Recommended Dietary Allowances	3	CO 1, CO 3	K1, K2
	4.2 Metabolic Pathways: Fatty Acid Oxidation, Biosynthesis of Fatty Acids, Synthesis and Functions of Cholesterol; Ketogenesis	3	CO 2	K2, K3
	4.3 Rancidity and Hydrogenation of Fats	2	CO 5	K5
	4.4 Emulsions: Formation, types (simple, complex, micro); Applications in Food	1	CO 5	K2, K4, K5
	4.5 Synthetic Fats: Types and production; Applications in Food	1	CO 5	K5
Unit 5:	**Vitamins and Minerals**			
	5.1 Introduction to micronutrients: Importance, role in human health	1	CO 1	K1
	5.2 Vitamins: Classification, Structures, Properties, Functions, Dietary Sources, Deficiencies and Excess, Recommended Dietary Allowances.	2	CO 1, CO 4	K1, K3, K4

	5.3 Minerals Classification, Structures, Properties, Functions, Dietary Sources, Deficiencies and Excess, Recommended Dietary Allowances	2	CO 1, CO 4	K1, K3, K4
Pedagogy:	Lectures, Seminars, Problem-based Learning, Mock Debates, Use of ICT Tools			
Texts:	1. Agarwal, A., & Udipi, S. A. (2014). *Textbook of Human Nutrition*. Jaypee Brothers Medical Publishers, New Delhi. 2. Bamji, M. S., Krishnaswamy, K., & Brahmam, G. N. V. (2009). *Textbook of Human Nutrition* (3rd ed.). Oxford and IBH Publishing Co, New Delhi. 3. Belitz, H.-D., Grosch, W., & Schieberle, P. (2009). *Food Chemistry* (4th ed.). Springer, Berlin. 4. Civille, G. V., & Carr, B. T. (2016). *Sensory Evaluation Techniques* (5th ed.). CRC Press, USA. 5. Damodaran, S., & Parkin, K. (2017). *Fennema's Food Chemistry* (5th ed.). CRC Press, USA. 6. Lawless, H. T., & Heymann, H. (2010). *Sensory Evaluation of Food* (2nd ed.). Springer, USA. 7. Meyer, L. H. (2004). *Food Chemistry*. CBS Publishers and Distributors, New Delhi. 8. Nelson, D. L., & Cox, M. M. (2017). *Lehninger Principles of Biochemistry* (7th ed.). W.H. Freeman, USA. 9. Potter, N. N., & Hotchkiss, J. H. (2007). *Food Science* (5th ed.). CBS Publishers and Distributors, New Delhi. 10. Rodwell, V. W., Bender, D. A., Botham, K. M., Kennelly, P. J., & Weil, P. A. (2015). *Harper's Illustrated Biochemistry* (30thed.). McGraw Hill Education. New York, USA.			
References/ Readings:	1. Shenkin, A. (2006). Micronutrients in health and disease. *Postgraduate Medical Journal, 82*(971), 559–567. https://doi.org/10.1136/pgmj.2006.047670 2. Abbas, K., Khalil, S., & Meor Hussin, A. S. (2010). Modified starches and their usages in selected food products: A review study. *Journal of Agricultural Science, 2*(2), 90–100. https://doi.org/10.5539/jas.v2n2p90 3. Cheung, P. C. K., & Mehta, B. M. (2015). *Handbook of Food Chemistry*. Springer-Reference. Berlin, Germany. https://earthwormexpress.com/wp-content/uploads/2021/10/Handbook_of_Food_Chemistry.pdf 4. Fasman, G. D. (1975). *CRC Handbook of Biochemistry and Molecular biology*: *Lipids, Carbohydrates, Steroids* (3rd ed.). CRC Press, Taylor & Francis Group. New York, USA https://doi.org/10.1201/9780429264214 5. Fasman, G. D. (1976). *Handbook of biochemistry: Section A—Proteins, volume I* (1st ed.). CRC Press, Taylor & Francis Group. New York, USA https://doi.org/10.1201/9780429487378 6. Berdanier, C. D., Dwyer, J. T., & Feldman, E. B. (2007). *Handbook of nutrition and food* (2nd ed.). CRC Press. Boca Raton, USA. https://doi.org/10.1201/9781420008890			

Web Resources:	1. https://ods.od.nih.gov/ 2. https://www.nin.res.in/NICE.html

Title of the Course	FOOD MICROBIOLOGY AND PRESERVATION
Course Code	FTC-5001
Number of Credits	3
Theory/Practical	Theory
Level	400
Effective from AY	2025-2026
New Course:	No
Bridge Course:	No
Course for advanced learners	No

Pre-requisites for the Course:	Nil	
Course Objectives:	1. To recognize the different groups of microorganisms associated with food, their activities, destruction and detection in food 2. To describe the different classes of microorganisms and their role in diseases, spoilage, and preservation. 3. To understand microbial growth, intrinsic and extrinsic factors, and their relevance to food preservation and spoilage. 4. To understand the industrial techniques used to preserve food, extend their shelf-life while maintaining their sensory characteristics.	
Course Outcomes:	**On the completion of the course, the student will be able to:**	**Mapped to PSO**
	CO 1. Recognise the fundamentals of microbiology and characteristics of microbes essential in food spoilage, preservation and food borne diseases.	PSO 3
	CO 2. Explain the classes of microorganisms and describe the basic role of microbes in food spoilage,	PSO 3

	preservation and food borne diseases.			
	CO 3. Apply microbiological concepts in food spoilage, food borne diseases and control methods in food system.			PSO 2, PSO 3
	CO 4. Analyse the pros and cons of microbes in food and its implication in spoilage, preservation and food borne diseases.			PSO 3
	CO 5. Evaluate the role of microbes and enzyme in food during spoilage, food borne diseases and different control measures used.			PSO 3
Content:	**Syllabus Content (45 hours)**	**No. of hours**	**Mapped to CO**	**Cognitive Level**
Module 1:	**Introduction to Food Microbiology**			
	1.1 Microorganisms in Food: Bacteria, Fungi, Virus, Protozoa, and Algae – general characteristics, identification, morphological characteristics, importance in food microbiology	3	CO 1, CO 2	K1, K3, K4
	1.2 Microbes as Food: Single cell protein, algae as food, mycoprotein from fungi for use as food and feed	2	CO 1, CO 2	K1, K3, K4
	1.3 Microbial Growth: Kinetic and growth requirements, Intrinsic and Extrinsic factors influencing microbial growth and survival	3	CO 1, CO 2, CO 3	K1, K3, K4, K5
	1.4 Prebiotics, Probiotics, Synbiotics, and Postbiotics	2	CO 1, CO 2, CO 4	K1, K3, K4
Module 2:	**Microbes in Food Fermentation and Spoilage**			
	2.1 Microbes in Traditional Fermented Foods of India and Other Asian Countries	1	CO 1, CO 2, CO 4	K1, K2
	2.2 Microbes in fermented foods based on milk, meat, and vegetables; fermented beverages	3	CO 1, CO 2, CO 4	K1, K2
	2.3 Microbial Spoilage of Meat, Eggs, Milk, Seafood and their Products	3	CO 1, CO 2, CO 4	K1, K2

	2.4 Microbial Spoilage of Vegetables, Fruits, Cereals and their Products	3	CO 1, CO 2, CO 4	K1, K2
Module 3:	**Basics of Food Preservation**			
	3.1 Microbial Control by Water and Temperature: Water Activity, Thermal Death Time, Psychrometric Charts	3	CO 1, CO 2	K1, K2,
	3.2 Microbial Control Using Natural and Synthetic Preservatives	2	CO 1, CO 2	K1, K2
Module 4:	**Microbes and Enzymes in Food Preservation**			
	4.1 Microbial Control by Thermal Processing: Blanching, Pasteurization, Sterilization, Canning, Concentration, Evaporation	3	CO 3, CO 4, CO 5	K1, K2, K3
	4.2 Microbial Control by Non-Thermal Processing: Microwave Processing, Modified Atmosphere, Irradiation, High-Pressure Food Preservation, Membrane Technology	3	CO 3, CO 4, CO 5	K1, K2, K3
	4.3 Microbial Control Using Low Temperature: Refrigeration, Freezing, Lyophilisation, Dehydrofreezing, Freeze Concentration, Individual Quick Freezing	3	CO 3, CO 4, CO 5	K1, K2, K3
	4.4 Biopreservation: Microbes and Enzymes in Food Preservation	1	CO 2, CO 3, CO 4, CO 5	K1, K2, K3
Module 5:	**Food Borne Diseases**			
	5.1 Bacterial food borne diseases: Staphylococcal intoxication, Botulism, Salmonellosis, Shigellosis, Gastroenteritis and Diarrhoea by *Escherichia coli*, *Clostridium perfringens*, *Bacillus cereus.*	3	CO 1, CO 2 CO 4, CO 5	K1, K2, K3
	5.2 Food Borne Viral Pathogens: Norwalk virus, Norovirus, Reovirus, Rotavirus, Astrovirus, Adenovirus, Parvovirus, Hepatitis A Virus;	3	CO 1, CO 2 CO 4, CO 5	K1, K2, K3
	5.3 Food Borne Animal Parasites: Protozoa - Giardiasis, Amebiasis, Toxoplasmosis, Taeniasis; Roundworm - Trichinosis, Anisakiasis	3	CO 1, CO 2 CO 4, CO 5	K1, K2, K3

	5.4 Mycotoxins from food: Mycotoxicosis, Aflatoxicosis, Ergotism	1	CO 1, CO 2 CO 4, CO 5	K1, K2, K3
Pedagogy:	Lectures, Seminars, Problem-based Learning, Mock Debates, Use of ICT Tools			
Texts:	1. Frazier, W. C., & Westhoff, D. C. (2014). *Food Microbiology* (5th ed.). McGraw-Hill Education. New Delhi, India. 2. Pelczar, M. J., Chan, E. C. S., & Krieg, N. R. (2002). *Microbiology* (5th ed.). Tata McGraw-Hill. New Delhi, India. 3. Banwart, G. J. (2004). *Basic Food Microbiology*. (2nd ed). CBS Publishers. New Delhi, India. 4. Bhat, R., Alias, A. K., & Paliyath, G. (2012). *Progress in Food Preservation.* (1st ed.). Wiley Blackwell, USA. 5. Casida, L. E. (2016). *Industrial Microbiology.* (2nd ed.). New Age International Publishers, New Delhi. 6. Garbutt, J. (1997). *Essentials of Food Microbiology*. (2nd ed.). Arnold Heinemann, UK. 7. Jay, J. M. (2000). *Modern Food Microbiology* (5th ed.). CBS Publishers. New Delhi, India. 8. Trivedi, P. C., Panjey, S., & Bhaduaria, S. (2010). *Textbook of Microbiology*. Aavishkar Publishers. Jaipur, India. https://rlmc.edu.pk/themes/images/gallery/library/books/Microbiology/Text_Book_of_Microbiology.pdf 9. Jay, J. M., Loessner, M. J., and Golden DA. (2005). *Modern Food Microbiology*. (7th ed.). Springer, USA 10. Trivedi, P.C., Panjey, S. & Bhaduaria, S. (2010). *Textbook of Microbiology*. Aavishkar publishers, India. https://rlmc.edu.pk/themes/images/gallery/library/books/Microbiology/Text_Book_of_Microbiology.pdf 11. Willey, J. M., Sandman, K. M., & Wood, D. H. (2020). *Prescott's Microbiology* (11th ed.). McGraw-Hill Education. New York, USA https://www.mheducation.com/unitas/highered/sample-chapters/9781260211887.pdf 12. Paniker. C. K. J. (2005). *Ananthanarayan and Paniker's Textbook of Microbiology*. (7th ed). Orient Blackswan, India. 13. Ray, B.& Bhunia, A. (2013). *Fundamental Food Microbiology*. (5th ed). CRC Press, USA. 14. Sivasankar, B. (2009). *Food Processing and Preservation*. (1st ed). PHI Learning, India.			
References/ Readings:	1. Goldman, E., & Green, L. H. (2015). *Practical Handbook of Microbiology* (3rd ed.). CRC Press, USA. 2. Magnuson, B., Munro, I., Abbot, P., Baldwin, N., Lopez-Garcia, R., & Ly, K. (2013). Review of the regulation and safety assessment of food substances in various countries and jurisdictions. *Critical Reviews in Toxicology*, *43*(12), 1147–1220. https://doi.org/10.1080/19440049.2013.795293 3. Nehra, M., & Nain, V. (2024). *Handbook of Industrial Food Microbiology* (1st ed.). Apple Academic Press, USA. https://doi.org/10.1201/9781003412779 4. Rahman, M. S. (2020). *Handbook of Food Preservation* (3rd ed.). CRC Press, Taylor & Francis, USA.			

	5. Siddiquee, S. (2017). The basic concept of microbiology. In *Practical Handbook of the Biology and Molecular Diversity of Trichoderma species from Tropical Regions* (pp. 1–15). Springer USA. https://doi.org/10.1007/978-3-319-64946-7_1 6. Steinkraus, K. S. (1996). *Handbook of Indigenous Fermented Foods*. Marcel Dekker.
Web Resources:	1. FSSAI. (2024, May). *Manual of methods of analysis: Microbiological examination of food and water* https://fssai.gov.in/upload/uploadfiles/files/Manual%20on%20Microbiological%20Examination%20of%20Food%20and%20Water_compressed.pdf 2. Food and Agriculture Organization of the United Nations https://www.fao.org/home/en/ 3. CDC: Centers for Disease Control and Prevention https://www.cdc.gov/ 4. Food Safety Inspection Service (FSIS) under U.S. Department of Agriculture (USDA) https://www.fsis.usda.gov/ CSIR - Central Food Technological Research Institute, https://cftri.res.in/

Title of the Course	Lab in Food Chemistry and Microbiology
Course Code	FTC-5002
Number of Credits	2
Theory/Practical	Practical
Level	400
Effective from AY	2025-2026
New Course:	Yes
Bridge Course:	Yes
Course for advanced learners	No

Pre-requisites for the Course:	Nil	
Course Objectives:	1. To acquaint students with safe laboratory practices and proper handling of instruments used in food chemistry and microbiology labs. 2. To familiarize with laboratory procedures required for determining the microbiological safety and nutritional content of food. 3. To collect, analyse and interpret experimental data in assessment of food quality based on physicochemical and microbiological parameters. 4. To apply standard protocols and guidelines from FSSAI for food and water analysis.	
Course Outcomes:	**On the completion of the course, the student will be able to:**	**Mapped to PSO**
	CO 1. State the pre-requisites involved in chemical analysis and microbial safety of food.	PSO 4
	CO 2. Explain and interpret the techniques and procedures for chemical analysis and microbial safety	PSO 4

	of food.			
	CO 3. Apply techniques and use appropriate instruments for chemical analysis and microbial safety of food.			PSO 4
	CO 4. Analyze physicochemical parameters of food and identify signs of quality deterioration.			PSO 4
	CO 5. Evaluate and interpret results of physicochemical analytical techniques and microbial safety of food.			PSO 4
Content:	**Syllabus Content (60 hours)**	**No. of hours**	**Mapped to CO**	**Cognitive Level**
Module 1:	**Safety and Practices in Food Chemistry and Microbiology Lab**			
	1.1 Laboratory Safety Rules, Precautions and Familiarization with Instruments used in Microbiological Lab, principles and working.	2	CO 1	K2, K3
	1.2 FSSAI manual of Methods of Analysis of Foods and Microbiological Examination of Food and Water (2024)	2	CO 1, CO 5	K2, K3, K4
Module 2:	**Food Chemistry and Analysis**			
	1.1 Estimation of Reducing and Non-Reducing Sugars in Honey/Fruit Juices	2	CO 2, CO 3 CO 4, CO 5	K3, K4, K5
	1.2 Estimation of Lactose in Milk using the Lane-Eynon Method.	2	CO 2, CO 3 CO 4, CO 5	K3, K4, K5
	1.3 Estimation of Proteins in food using the Biuret, Lowry's and Kjeldahl Method	4	CO 2, CO 3 CO 4, CO 5	K3, K4, K5
	1.4 Determination of Saponification, Iodine, and Acid Value of Edible Oils.	4	CO 2, CO 3 CO 4, CO 5	K3, K4, K5
	1.5 Estimation of pH, Titratable acidity and Total Soluble Solids (Brix).	2	CO 2, CO 3 CO 4, CO 5	K3, K4, K5

	1.6 Estimation of Ascorbic Acid in Foods.	2	CO 2, CO 3 CO 4, CO 5	K3, K4, K5
	1.7 Estimation of Beta-Carotene in Foods.	2	CO 2, CO 3 CO 4, CO 5	K3, K4, K5
	1.8 Estimation of Calcium, Phosphorous and Iron content of Foods.	4	CO 2, CO 3 CO 4, CO 5	K3, K4, K5
	1.9 Estimation of Browning Intensity.	2	CO 2, CO 3 CO 4, CO 5	K3, K4, K5
	1.10 Estimation of Anti-Nutritional Factors in Foods.	2	CO 2, CO 3 CO 4, CO 5	K3, K4, K5
	1.11 Separation and detection of food compounds by chromatographic techniques and Spectral analysis of food compounds.	2	CO 2, CO 3 CO 5	K3, K4, K5
Module 2:	**Food Microbiology**			
	2.1 Characterization of bacteria by Gram staining.	2	CO 3, CO 4	K3, K4, K5
	2.2 Determination of viable count of bacteria present in food samples.	2	CO 2, CO 3 CO 4, CO 5	K3, K4, K5
	2.3 Pure culture techniques used for isolation, purification and characterization of microorganisms.	4	CO 2, CO 3 CO 4, CO 5	K3, K4, K5
	2.4 Plate Culture and Microscopic Examination of *Saccharomyces cerevisiae.*	2	CO 2, CO 3 CO 4, CO 5	K3, K4, K5
	2.5 Isolation of Microscopic Examination and tentative identification of spoilage fungi from food.	2	CO 2, CO 3 CO 4, CO 5	K3, K4, K5
	2.6 Detection and Isolation of Pathogenic and Indicator Organisms from Food.	2	CO 2, CO 3 CO 4, CO 5	K3, K4, K5

	2.7 Evaluation of Microbiological Quality of Water and MPN of Coliforms	4	CO 2, CO 3 CO 4, CO 5	K3, K4, K5
	2.8 Enumeration of Microbes from Fermented Foods	2	CO 2, CO 3 CO 4, CO 5	K3, K4, K5
	2.9 Detection of Physiological Groups in Food: Osmophiles/ Halophiles	2	CO 2, CO 3 CO 4, CO 5	K3, K4, K5
	2.10 Efficacy of preservation techniques on microbial content	2	CO 2, CO 3 CO 4, CO 5	K3, K4, K5
	2.11 Detection of Microbial enzymatic hydrolysis (starch, protein, fats)	2	CO 2, CO 3 CO 4, CO 5	K3, K4, K5
	2.12 Evaluation of Microbiological Quality of Air, Instruments and Work Stations	2	CO 1, CO 2 CO 4, CO 5	K3, K4, K5
Pedagogy:	Lectures, Seminars, Problem-based Learning, Mock Debates, Use of ICT Tools			
Texts:	1. Aneja, K. R. (2007). *Experiments in Microbiology, Plant Pathology and Biotechnology* (4th ed.). New Age International Publishers, New Delhi, India. 2. Cappuccino, J. G., & Welsh, C. (2018). *Microbiology: A Laboratory Manual* (11th ed.). Pearson Education Limited, England.https://tga.blv.ifmt.edu.br/media/filer_public/c9/3f/c93fa603-71b7-4dd7-adf2-58b5eefd2753/cappuccino_-_microbiology_-_a_laboratory_manual_-_11ed_-_2017.pdf 3. da Silva, N., Taniwaki, M. H., Junqueira, V. C. A., Silveira, N., Okazaki, M. M., & Gomes, R. A. R. (2018). *Microbiological Examination Methods of Food and Water: A Laboratory Manual* (2nd ed.). CRC Press, UK. https://doi.org/10.1201/9781315165011 4. Helrich, K. (1990). *Official Methods of Analysis of the Association of Official Analytical Chemists* (15th ed.). AOAC International, USA. 5. Garg, N., Garg, K. L.& Mukerji, K. G. (2010). *Laboratory Manual of Food Microbiology*. I.K. International Publishing House Pvt. Ltd, India.			

	6. Microbiology Society. (2016). *Basic Practical Microbiology: A Manual* (11th ed.). Pearson Education Limited, England. https://tga.blv.ifmt.edu.br/media/filer_public/c9/3f/c93fa603-71b7-4dd7-adf2-58b5eefd2753/cappuccino_-_microbiology_-_a_laboratory_manual_-_11ed_-_2017.pdf 7. Miller, D. D., & Yeung, C. K. (2022). *Food Chemistry: A Laboratory Manual* (2nd ed.). John Wiley & Sons, USA. 8. Nigam, A., & Ayyagari, A. (2008). *Lab Manual in Biochemistry, Immunology and Biotechnology*. Tata McGraw-Hill Publishing Company Limited, New Delhi, India. 9. Sadashivam, S., & Manickam, A. (2008). *Biochemical Methods* (3rd ed.). New Age International Publishers, India. 10. Sattanathan, G., Padmapriya, S. S., & Balamuralikrishnan, B. (2020). *Practical Manual of Biochemistry*. Skyfox Publishing Group England. https://doi.org/10.22573/spg.020.BK/S/028 11. Sehgal S. 2016. *A Laboratory Manual of Food Analysis*. I.K. International Publishing House Pvt. Ltd, India.
References/ Readings:	1. Basile, T., Mallardi, D., & Cardone, M. F. (2023). Spectroscopy, a tool for the non-destructive sensory analysis of plant-based foods and beverages: A comprehensive review. *Chemosensors, 11*(12), 579. https://doi.org/10.3390/chemosensors11120579 2. Goldman, E., & Green, L. H. (2009). *Practical handbook of microbiology* (2nd ed.). CRC Press, USA. 3. Kabiraz, M. P., Majumdar, P. R., Mahmud, M. C., Bhowmik, S., & Ali, A. (2023). Conventional and advanced detection techniques of foodborne pathogens: A comprehensive review. *Heliyon, 9*(4), e15482. https://doi.org/10.1016/j.heliyon.2023.e15482 4. Socas-Rodríguez, B. (2022). Applications of chromatographic techniques in food and environmental analysis. *Separations, 9*(12), 418. https://doi.org/10.3390/separations9120418 5. Salim, R., Nehvi, I. B., Mir, R. A., Tyagi, A., Ali, S., & Bhat, O. M. (2023). *A review on anti-nutritional factors: Unraveling the natural gateways to human health*. Frontiers in Nutrition, 10, 1215873. https://doi.org/10.3389/fnut.2023.1215873 6. Wrolstad, R. E., Acree, T. E., Decker, E. A., Penner, M. H., Reid, D. S., Schwartz, S. J., Shoemaker, C. F., Smith, D. M., & Sporns, P. (2005). *Handbook of food analytical chemistry, Volume 1: Water, proteins, enzymes, lipids, and carbohydrates*. John Wiley & Sons, USA. 7. Foddai, A. C. G., & Grant, I. R. (2020). Methods for detection of viable foodborne pathogens: Current state-of-art and future prospects. *Applied Microbiology and Biotechnology, 104*(10), 4281–4288. https://doi.org/10.1007/s00253-020-10542-x
Web Resources:	1. FSSAI (2024, May). *Manual of methods of analysis: Microbiological examination of food and water.*

	https://fssai.gov.in/upload/uploadfiles/files/Manual%20on%20Microbiological%20Examination%20of%20Food%20and%20Water_compressed.pdf 2. FSSAI (2015). *Manual of methods of analysis of foods: Cereal and cereal products*. https://www.fssai.gov.in/upload/uploadfiles/files/CEREALS_AND_PRODUCTS.pdf 3. Food Safety and Standards Authority of India. (2015). *Manual of methods of analysis of foods: Beverages (coffee, tea, cocoa, chicory), sugar and sugar products & confectionery products* https://fssai.gov.in/upload/uploadfiles/files/BEVERAGES_AND_CONFECTIONARY%20(2).pdf 4. Food Safety and Standards Authority of India. (2015). *Manual of methods of analysis of foods: Oils and fats*. https://www.fssai.gov.in/upload/uploadfiles/files/OILS_AND_FAT.pdf

Title of the Course	Food Processing and Packaging
Course Code	FTC-5003
Number of Credits	3
Theory/Practical	Theory
Level	400
Effective from AY	2025-2026
New Course	Yes
Bridge Course/ Value-added Course	No
Course for advanced learners	No

Pre-requisites for the Course:	Nil	
Course Objectives:	1. To equip students with foundational knowledge of food processing industries and unit operations, including the principles, technologies, and hygiene standards governing industrial food production. 2. To impart an in-depth understanding of cooking methods and industrial-scale processing of various food groups emphasizing quality and nutrient retention. 3. To analyze the structure, properties, and suitability of various packaging materials, including paper, metal, glass, plastics, and composites, with respect to food safety, barrier performance, and sustainability. 4. To explore and evaluate emerging trends and smart technologies in food packaging, such as intelligent and active packaging systems, aseptic closures, and shelf-life modeling.	
Course Outcomes:	**On the completion of the course, the student will be able to:**	**Mapped to PSO**
	CO 1. Define, describe and differentiate key food processing operations and principles involved in the	PSO 1, PSO 3

	preparation, preservation, and transformation of food materials across various product categories.			
	CO 2. Recall, apply food-specific processing techniques and evaluate their effects on texture, safety, nutrition, and product integrity across different food categories and convenience foods.			PSO 1, PSO 2
	CO 3. Examine the functional properties of conventional and advanced packaging materials, and justify their use for specific food products based on safety, barrier, and sustainability requirements.			PSO 1, PSO 3, PSO 7
	CO 4. Evaluate and propose smart, intelligent, and sustainable packaging systems based on current innovations, with attention to shelf-life prediction, traceability, and consumer interaction.			PSO 1, PSO 2 PSO 3, PSO 7
	CO 5. Critically examine and judge contemporary trends and emerging technologies in food processing and packaging, emphasising circular economy, personalisation, and clean-label demands.			PSO 1
Content:	**Syllabus Content (45 hours)**	**No. of hours**	**Mapped to CO**	**Cognitive Level**
Module 1:	**Components of Food Processing Industries**			
	1.1 Food Processing Industries: Key aspects, types, trends	1	CO 1	K1
	1.2 Unit Operations in Food Processing: Materials handling, cleaning, size reduction, mixing and blending, heat transfer (heating, cooling, evaporation, drying), mass transfer (distillation, extraction), Packaging	2	CO 1, CO 2 CO 3	K1, K2, K3, K4, K5
	1.3 Factors Influencing Processing Output: Hygiene, GMPs, HACCP plans, COP and CIP, Energy Efficiency, Process optimisation, Valorisation of by-products, Human Resources in Food Processing, Automation and Ergonomics.	2	CO 1	K1, K2
Module 2:	**Industrial Food Processing: Principles and Methods**			
	2.1 Methods of Cooking: Principles, types and effects of food texture and nutrient retention from Dry Heat Methods (baking, roasting, grilling, frying), Moist Heat Methods (boiling, simmering, steaming, poaching), Combination Methods (braising, stewing), and Microwave Cooking.	2	CO 1, CO 2 CO 3	K1, K2, K3, K4, K5
	2.2 Cereal Processing: Ingredients, Industrial Manufacturing, and Packaging of	1	CO 1, CO 2	K1, K2, K4,

	pasta and breakfast cereal		CO 3	K5
	2.3 Fruit and Vegetable Processing: Ingredients, Industrial Manufacturing, and Packaging of jams, sauces, and chips.	2	CO 1, CO 2 CO 3	K1, K2, K4, K5
	2.4 Meat, Poultry, and Seafood Processing: Ingredients, Industrial Manufacture, and Packaging of fish fingers, chicken nuggets and mutton kebab.	2	CO 1, CO 2 CO 3	K1, K2, K4, K5
	2.5 Dairy Processing: Ingredients, Industrial Manufacturing, and Packaging of Yoghurt and Gulab Jamun.	1	CO 1, CO 2 CO 3	K1, K2, K4, K5
	2.6 Beverage Processing: Ingredients, Industrial Manufacturing, and Packaging of fruit juice and syrup (falooda premix).	1	CO 1, CO 2 CO 3	K1, K2, K4, K5
	2.7 Convenience Foods: Ingredients, Industrial Manufacturing, and Packaging of ready-to-eat meals, frozen dinners	1	CO 1, CO 2 CO 3	K1, K2, K4, K5
Module 3:	**Food Packaging Materials and Forms**			
	3.1 Paper and Paper-based Packaging Materials: Structure, properties and applications of Paperboard, Corrugated board, Kraft paper, Specialty paper, Laminates and coating; Properties relevant to Food Packaging (Tensile strength, tear resistance, burst strength, porosity, air permeability, moisture sensitivity and water vapor transmission rate, grease and oil resistance, printability and aesthetic qualities).	4	CO 3, CO 4 CO 5	K4, K5, K6
	3.2 Metal-based Packaging Materials: Structure, properties and applications of Steel and Aluminium; Properties Relevant to Food Packaging (high barrier properties against moisture, gases, and light, strength and durability, thermal conductivity, corrosion resistance).	3	CO 3, CO 4 CO 5	K4, K5, K6
	3.3 Glass Packaging Materials: Structure, properties and applications of Soda-lime glass, Borosilicate glass, Colored glass; Properties Relevant to Food Packaging (Inertness and chemical resistance, barrier properties against gases and moisture, transparency and visual appeal, rigidity and strength,	3	CO 3, CO 4 CO 5	K4, K5, K6

	thermal shock resistance).			
	3.4 Plastics and Composites-based Packaging Material: Structure, properties and applications of Polyethylene (LDPE, HDPE, LLDPE), Polypropylene (PP), Polyethylene Terephthalate, Polyvinyl Chloride, Polystyrene, Polylactic Acid, Composites (multilayer films, co-extruded structures); Properties Relevant to Food Packaging (Barrier properties, tensile strength, flexibility, puncture resistance, thermal stability, chemical resistance, processability, clarity and transparency).	5	CO 3, CO 4 CO 5	K4, K5, K6
Module 4:	**Advanced Food Packaging Materials and Technologies**			
	4.1 Advanced Package Sealing Systems: Smart Closures (Tamper-evident, dispensing closure), Cold Sealing, Ultrasonic Sealing with Enhanced Control, Induction Sealing, Anti-Counterfeiting Closures, Interactive Closures, Aseptic Closures.	3	CO 4, CO 5	K4, K5, K6
	4.2 Smart and Intelligent Packaging: Indicators (time-temperature, freshness, leakage); Tracers (RFID, barcodes); Active packaging; Challenges and future trends in smart packaging.	2	CO 4, CO 5	K4, K5, K6
	4.3 Sustainable Packaging Materials: Production, properties, and applications of Bioplastics (starch-based, cellulose-based, PLA, PHA), Recycled and recyclable polymers; Compostable packaging; Life cycle assessment of packaging materials.	3	CO 4, CO 5	K4, K5, K6
	4.4 Shelf-Life Prediction and Modelling: Kinetic modelling of food degradation reactions, Influence of processing and packaging on shelf life, Accelerated shelf-life testing methods.	2	CO 4, CO 5	K4, K5, K6
Module 5:	**Emerging Trends and Innovations in Food Processing and Packaging**			
	5.1 Novel Technologies: Minimal Processing Technology, 3D Food Printing, Artificial Intelligence (AI) and Machine Learning (ML) in Food Processing and Packaging	2	CO 4, CO 5	K4, K5, K6
	5.2 Sustainable and Circular Food Systems: Role of processing and packaging	1	CO 4, CO 5	K4, K5, K6

	in reducing food waste; valorisation of food processing by-products; Development of closed-loop packaging systems.			
	5.3 Consumer and Development Trends: Demand for clean label, minimally processed, and sustainable foods; Impact of e-commerce on food packaging and distribution; Development of personalised and functional foods and their processing and packaging requirements.	2	CO 4, CO 5	K4, K5, K6
Pedagogy:	Lectures, Seminars, Problem-based Learning, Mock Debates, Use of ICT Tools, Creation of Process Charts			
Texts:	1. Barbosa-Canovas, G. V., Tapia, M. S., & Cano, M. P. (Eds.). (2004). *Novel Food Processing Technologies* (1st ed.). CRC Press, USA. https://doi.org/10.1201/9780203997277 2. Ramaswamy, H. S., & Marcotte, M. (2005). *Food Processing* (1st ed.). CRC Press, USA. https://doi.org/10.1201/9780203485248 3. Fellows, P. (2022). *Food Processing Technology: Principles and Practice* (5th ed.). Woodhead Publishing, UK. 4. Tiwari, B. K., & Bhavya, M. L. (Eds.). (2024). *Chemistry of Thermal and Non-Thermal Food Processing Technologies* (1st ed). Elsevier Science & Technology, Netherlands. 5. Robertson, G. L. (2016). *Food Packaging* (3rd ed.). CRC Press, USA. https://doi.org/10.1201/b21347 6. Natarajan, S., Govindarajan, M., & Kumar, B. (2014). *Fundamentals of Packaging Technology* (2nd ed.). PHI Learning Private Limited, India. 7. Sivasankar, B. (2002). *Food Processing and Preservation* (Eastern economy ed.). PHI Learning Private Limited, India. 8. Mudgil, D., & Mudgil, S. B. (Eds.). (2024). *Unit Operations in Food Processing*. Scientific Publishers, India.			
References/ Readings:	1. Amit, S.K., Uddin, Md. M., Rahman, R., Islam, S. M. R., & Khan, M. S. (2017). A review on mechanisms and commercial aspects of food preservation and processing. *Agriculture & Food Security*, *6*(1), 51. https://doi.org/10.1186/s40066-017-0130-8 2. Chacha, J. S., Zhang, L., Ofoedu, C. E., Suleiman, R. A., Dotto, J. M., Roobab, U., Agunbiade, A. O., Duguma, H. T., Mkojera, B. T., Hossaini, S. M., Rasaq, W. A., Shorstkii, I., Okpala, C. O. R., Korzeniowska, M., & Guiné, R. P. F. (2021). Revisiting non-thermal food processing and preservation methods—action mechanisms, pros and cons: A technological update (2016–2021). *Foods*, *10*(6), 1430. https://doi.org/10.3390/foods10061430 3. Cazón, P., Mateus, A. R., & Silva, A. S. (2025). Advances in active packaging using natural biopolymers and fruit			

	by-products for enhanced food preservation. *Food Research International*, 116439. https://doi.org/10.1016/j.foodres.2025.116439 4. Panou, A., & Karabagias, I. K. (2024). Migration and safety aspects of plastic food packaging materials: Need for reconsideration? *Coatings*, *14*(2), 168. https://doi.org/10.3390/coatings14020168
Web Resources:	1. National Institute of Food Technology, Entrepreneurship and Management, Thanjavur (NIFTEM-T), https://niftem-t.ac.in/ 2. Institute of Food Technologists, https://www.ift.org/ 3. CSIR - Central Food Technological Research Institute, https://cftri.res.in/ 4. Ministry of Food Processing Industries (MoFPI), https://www.mofpi.gov.in/

Title of the Course	Food Quality, Safety Standards, And Laws
Course Code	FTC-5004
Number of Credits	3
Theory/Practical	Theory
Level	400
Effective from AY	2025-2026
New Course:	Yes
Bridge Course/ Value-added Course:	No
Course for advanced learners:	Yes

Pre-requisites for the Course:	Nil	
Course Objectives:	1. To understand the fundamentals of food safety and quality, including types of hazards, ethical concerns, quality control systems, and quality improvement methodologies. 2. To examine the structure and enforcement of Indian food laws, including the Prevention of Food Adulteration Act, Essential Commodities Act, Food Safety and Standards Act, and the roles of FSSAI and DFDA. 3. To interpret key Food Safety and Standards Regulations (FSSR), such as licensing, labelling, packaging, and food product standards in line with regulatory updates. 4. To evaluate the role of international food safety organisations and foreign standardisation bodies, and their influence on global food quality assurance. 5. To analyse national and international trade regulations and packaging requirements relevant to the export/import of food, including quarantine measures, customs laws, and regulatory agencies.	
Course Outcomes:	**On the completion of the course, the student will be able to:**	**Mapped to**

				PSO
	CO 1. Define and explain the basic concepts of food safety, types of food hazards, ethical concerns, and factors affecting quality, while analysing real-world case studies on food safety lapses.			PSO 2
	CO 2. Describe the structure and objectives of quality management systems and apply these principles to practical food safety scenarios.			PSO 2, PSO 6
	CO 3. Interpret Indian food laws and related regulations, and evaluate the roles and responsibilities of regulatory authorities.			PSO 2
	CO 4. Compare national and international standards and analyse the relevance and application of international food safety frameworks in Indian and global contexts.			PSO 2
	CO 5. Explain regulatory requirements for food export/import, including labelling, packaging, and inspection laws, and apply this knowledge to assess compliance in international food trade scenarios.			PSO 2
Content:	**Syllabus Content (45 hours)**	**No. of hours**	**Mapped to CO**	**Cognitive Level**
Module 1:	**Food Safety, Quality Control and Assurance**			
	1.1 Food Safety and Quality: Definitions, Importance, types of food hazards, ethical considerations, concerns and challenges, factors influencing food quality and safety, lapses in food quality and safety, analysis of popular case studies spanning different aspects of food safety within and beyond India.	2	CO 1	K1, K2
	1.2 Introduction to Quality Control and Quality Management Systems: Definitions, Importance, Objectives and Functions. Introduction to Good Manufacturing Practices (GMP), Good Hygiene Practices (GHP), Good Laboratory Practices (GLP), Good Agricultural Practices (GAP) and Hazard Analysis and Critical Control Points (HACCP).	3	CO 1, CO 2	K2, K3
	1.3 Quality and Process Improvement Methodologies: Introduction to Quality Circles, CEDAC (Cause and Effect Diagram with Addition of Cards), Six Sigma, Plan Do Check Act (PDCA), 5 Whys Analysis, Total Quality	3	CO 1, CO 2	K2, K3

	Management (TQM) and Kaizen Methodology.			
	1.4 Indian and International Quality Systems: Introduction to AGMARK, Bureau of Indian Standards (BIS), Food Products Order (FPO), International Organization for Standardization (ISO), British Retail Consortium (BRC), Codex Alimentarius.	2	CO 2	K2, K3
Module 2:	**Indian Food Regulatory Regime**			
	2.1 Prevention of Food Adulteration Act, 1954: Historical context and objectives, Definitions and Key Provisions; Adulteration and misbranding: definitions and consequences; Authorities and enforcement mechanisms; Limitations of the PFA Act.	2	CO 3	K2, K5
	2.2 Essential Commodities Act, 1955: Objectives and scope, Declaration of essential commodities; Powers of the government to control the production, supply, and distribution of essential food commodities.	1	CO 3	K2, K5
	2.3 Food Safety and Standards Act, 2006: Key terms used, Responsibilities of food business operators (FBOs), Offences and penalties.	1	CO 3	K2, K5
	2.4 Food Safety and Standards Regulations (FSSR): Importance of FSSR, Brief overview of the various regulations under the FSS Act.	2	CO 3	K2, K5
	2.5 Food Safety and Standards Authority of India (FSSAI): Role of FSSAI in India, Establishment, Objectives, Organisational Structure, Responsibilities, Functions and Powers; FoSTaC; classification of businesses (high, medium and low risk) and frequency of inspection; FoSCoS.	2	CO 3	K2, K5
	2.6 Directorate of Food and Drugs Administration (DFDA): Role of DFDA in Goa, Historical Background, Objectives, Organisational Structure, Responsibilities, Functions and Powers, Coordination between central and state authorities.	2	CO 3	K2, K5
Module 3:	**Basic Overview of the FSSR**			

	3.1 Introduction to various types of FSSR: Definitions of relevant terms - Regulations, Amendment, Corrigendum, Compendium and Schedules. Brief introduction to FSSR on Ayurveda, Vegan Foods, Contaminants, Toxins and Residues, Advertising and Claims, Laboratory and Sampling Analysis.	3	CO 3, CO 4	K2, K4, K5
	3.2 FSS (Licensing and Registration of Food Businesses) Regulations, 2011: Licensing and registration requirements for food business operators, Categories of food businesses and their eligibility for registration or license, Procedure for obtaining a license or registration, conditions of license and registration.	3	CO 3, CO 4	K2, K4, K5
	3.3 FSS (Packaging and Labelling) Regulations, 2011: General labelling requirements for pre-packaged food, Mandatory information on the label, Specific labelling requirements for different food categories; Restrictions on misleading labels and claims.	2	CO 3, CO 4	K2, K4, K5
	3.4 FSS (Food Products Standards and Food Additives) Regulations, 2011: Standards for various food products, permitted food additives, their limits, and conditions of use; Review of Chapter 1 and Chapter 2 of the FSSR.	2	CO 3, CO 4	K2, K4, K5
Module 4:	**International Food Laws, Organisations, and Affiliations**			
	4.1 World Organizations and Global Standardisation Bodies: Objectives, Role, Function and Relevance of FAO/WHO, WHO, Codex Alimentarius Commission, JECFA, World Organisation for Animal Health (WOAH), World Trade Organization (WTO); Introduction to European Food Safety Authority (EFSA), European Committee for Standardisation (CEN, Comité Européen de Normalisation), Food Standards Agency (FSA), Gulf Standardization Organization (GSO), US Food and Drug Administration (USFDA), Pan American Standards Commission (COPANT), Association of Southeast Asian Nations (ASEAN), AQSIQ (General Administration of Quality Supervision, Inspection and Quarantine of PRC).	3	CO 4	K2, K4
	4.2 International Programs for Food Safety: ISO (9001:2015; 22000:2018,	2	CO 4	K2, K4

	14001:2015, 45001:2018); EU Rapid Alert System for Food and Feed (RASFF).			
Module 5:	**Export and Import Laws and Regulations**			
	5.1 Food Packaging and Labelling Requirements: Importance of packaging and labelling in international trade. Country-based specific labelling requirements, Nutrition labelling and Health claims.	2	CO 4, CO 5	K2, K3, K4
	5.2 Foreign Trade Policy: Overview of India's foreign trade policy, Objectives and key features; Export promotion schemes and incentives; Import regulations and restrictions.	2	CO 4, CO 5	K2, K3, K4
	5.3 The Export (Quality Control and Inspection) Act, 1963: Objectives of the Act; Provisions for quality control and inspection of goods meant for export; Role of the Export Inspection Council (EIC).	2	CO 4, CO 5	K2, K3, K4
	5.4 Plant and Animal Quarantine: Purpose of plant and animal quarantine measures; Regulations to prevent the introduction and spread of pests and diseases; Phytosanitary certificates and import permits.	2	CO 4, CO 5	K2, K3, K4
	5.5 Customs Act and Import Control Regulations: Overview of the Customs Act, import duties and tariffs, Import restrictions and prohibitions	1	CO 4, CO 5	K2, K3, K4
	5.6 National Agencies involved in Food Export and Import Regulation: FSSAI, Agricultural and Processed Food Products Export Development Authority (APEDA), Directorate General of Foreign Trade (DGFT).	1	CO 4, CO 5	K2, K3, K4
Pedagogy:	Lectures, Seminars, Case Study Analysis, Problem-based Learning, Mock Debates, Use of ICT Tools			
Texts:	1. Early, R. (1995). *Guide to quality management systems for the food industry*. Springer, Germany. 2. Singhal, D., & Singhal, K. R. (2012). *Implementing ISO 9001:2008 Quality Management System: A Reference Guide* (2nd ed., pp. 1-183). PHI Learning, India. 3. Mortimore, S., & Wallace, C. (2013). *HACCP: A Practical Approach*. Springer Science & Business Media, USA. 4. Kumar, A. (2005). *Export and Import Management*. Excel Books India, India. 5. Rai, U. K. (2010). *Export—Import and Logistics Management*. PHI Learning Pvt. Ltd, India.			

	6. Singh, S. P. (2009). *Food Safety, Quality Assurance and Global Trade: Concerns and Strategies:* International Book Distributing Co, India 7. Fortin, N. D. (2009). *Food Regulation: Law, Science, Policy, and Practice*. Wiley-Blackwell, USA.
References/ Readings:	1. Hulebak, K. L., & Schlosser, W. (2002). Hazard analysis and critical control point (HACCP) history and conceptual overview. *Risk Analysis*, *22*(3), 547–552. https://doi.org/10.1111/0272-4332.00038 2. Tarí, J. J., Molina-Azorín, J. F., & Heras, I. (2012). Benefits of the ISO 9001 and ISO 14001 standards: A literature review. *Journal of Industrial Engineering and Management (JIEM)*, *5*(2), 297–322. https://doi.org/10.3926/jiem.488 3. Chen, H., Liu, S., Chen, Y., Chen, C., Yang, H., & Chen, Y. (2020). Food safety management systems based on ISO 22000:2018 methodology of hazard analysis compared to ISO 22000:2005. *Accreditation and Quality Assurance*, *25*(1), 23–37. https://doi.org/10.1007/s00769-019-01409-4 4. Singh, A., & Kuldeep, D. (2023). Food safety standards and laws: An essential component of public health—a critical study. *International Journal of Law Management & Humanities*, *5*(2), 314–317. https://doi.org/10.10000/IJLMH.112839 5. Sushila. (2020). Legal framework regulating food safety: A critical appraisal. *International Journal on Consumer Law and Practice*, *8*, Article 5. https://repository.nls.ac.in/ijclp/vol8/iss1/5 6. Food Standards Australia New Zealand. (2004). *Food safety legislation: The use of science and risk-based approaches to harmonization*. FAO/WHO Regional Conference on Food Safety for Asia and the Pacific, Seremban, Malaysia. https://www.fao.org/4/ad699e/ad699e.htm
Web Resources:	1. Food laws regulations and guidelines in India—Zolvit. (n.d.). Retrieved from https://zolvit.com/fssai/food-laws 2. Food laws & regulations | food safety and quality | food and agriculture organization of the United Nations. (n.d.). Retrieved from https://www.fao.org/food-safety/food-control-systems/policy-and-legal-frameworks/food-laws-and-regulations/en/ 3. https://www.fssai.gov.in/upload/uploadfiles/files/Lab_Sample_Regulations.pdf 4. https://www.fssai.gov.in/upload/uploadfiles/files/Contaminants_Regulations.pdf 5. https://www.fssai.gov.in/upload/uploadfiles/files/Food_Additives_Regulations.pdf 6. https://www.fssai.gov.in/upload/uploadfiles/files/Licensing_Regulations.pdf 7. https://www.fssai.gov.in/upload/uploadfiles/files/Gazette_Notification_Alcoholic_Beverages_05_04_2018.pdf 8. *FSSAI*. (n.d.). Retrieved from https://fssai.gov.in/cms/guidance-document.php

Title of the Course	Lab in Food Processing and Quality Management
Course Code	FTC-5005
Number of Credits	2
Theory/Practical	Practical
Level	400
Effective from AY	2025-2026
New Course	No
Bridge Course/ Value-added Course	No
Course for advanced learners	No

Pre-requisites for the Course:	Nil
Course Objectives:	1. To introduce students to key processing variables and critical control points involved in food preparation and preservation, enabling them to recognize factors affecting product safety and quality. 2. To develop the ability to conduct and interpret sensory evaluations using standardized techniques for assessing food products across different categories. 3. To enable students to apply thermal, freezing, fermentation, and chemical preservation methods and assess their influence on microbial safety, shelf life, and sensory attributes. 4. To guide students in developing and refining a variety of value-added and traditional food products, integrating principles of ingredient functionality, processing parameters, and product innovation. 5. To train students in constructing manufacturing charts and performing technical evaluations such as time-temperature calculations, moisture analysis, and quality control protocols across diverse food matrices.

Course Outcomes:	**On the completion of the course, the student will be able to:**			**Mapped to PSO**
	CO 1. Identify and analyse critical control points (CCPs) and processing variables across various food preparation and preservation techniques.			PSO 2, PSO 3
	CO 2. Perform and interpret sensory evaluation using descriptive, affective, and discriminative methods for a wide range of food products.			PSO 1, PSO 4
	CO 3. Apply thermal, freezing, and fermentation processing techniques and assess their impact on product safety, shelf life, and nutritional quality.			PSO 1, PSO 2
	CO 4. Develop and evaluate value-added, preserved, and convenience food products using appropriate formulation, preservation methods, and sensory parameters.			PSO 1, PSO3, PSO 4, PSO 5
	CO 5. Formulate and assess product-specific processing parameters and translate them into process flow or manufacturing charts.			PSO 1, PSO 5 PSO 6
Content:	**Syllabus Content (60 hours)**	**No. of hours**	**Mapped to CO**	**Cognitive Level**
	1. Understanding variables and determination of critical control points (CCPs) in food processing unit.	2	CO 1, CO 5	KI, K2, K5
	2. Sensory evaluation of products using descriptive, affective and discriminative techniques.	4	CO 2, CO 4	K2, K5, K6
	3. Effect of blanching time and temperature on enzyme inactivation and quality of fruits/vegetables.	2	CO 1, CO 3	KI, K3, K4
	4. Preparation, determination of thermal processing variables and evaluation of products for quality and safety of canned fruits/ vegetables.	4	CO 1, CO 3 CO 6	K4, K5, K6
	5. Determination of time-temperature combinations for pasteurisation and verification of efficacy using the phosphatase test.	2	CO 1, CO 3	KI, K3, K4
	6. Preparation and evaluation of ice cream and frozen fruit/vegetable pulp, and analysis of the effect of low temperature on the storage life and	4	CO 3, CO 4	K3, K5, K6

	quality.			
	7. Preparation and sensory evaluation of value-added products (jams, jellies, squashes, pickles, chutneys, sauces) developed from seasonal/perishable produce.	4	CO 2, CO 4 CO 5	K2, K5, K6
	8. Preparation and determination of moisture content and rehydration ratio of kheer premix.	2	CO 1, CO 4 CO 5	KI, K4, K5, K6
	9. Preparation and sensory evaluation of different types of pickles and evaluation of the role of salt, acid, and spices in preservation.	4	CO 1, CO 2 CO 4	K2, K5, K6
	10. Preparation, determination of processing variables (emulsifying agents, ratio of water to oil) and evaluation of sensory properties and product stability of mayonnaise and vinaigrettes.	4	CO 2, CO 4 CO 5	K2, K5, K6
	11. Determination of the effectiveness of chemical preservatives (e.g., sorbates, benzoates) in extending the shelf life of food products.	4	CO 1, CO 3	KI, K3, K4
	12. Preparation, determination of processing variables (fermentation time and temperature) and sensory evaluation of fermented products (Idli and Curd).	4	CO 1, CO 2 CO 3	K3, K4, K6
	13. Preparation, determination of processing variables (raw materials, dehydration period, kneading, shape, sauce adsorption) and sensory evaluation of extruded pasta.	6	CO 2, CO 4 CO 5	K2, K5, K6
	14. Preparation and observation of sugar syrup stages and assessment using a refractometer.	2	CO 1, CO 5	KI, K4, K5, K6
	15. Preparation, determination of processing variables (raw materials, mixing methods, baking time and temperature) and sensory evaluation of bread, cakes, cookies and pies.	6	CO 2, CO 4 CO 5	K2, K5, K6
	16. Preparation of gummies using different gelling agents (gelatin, carrageenan, pectin, agar-agar, guar gum) and comparative sensory evaluation.	2	CO 2, CO 4 CO 5	K2, K5, K6

	17. Preparation of manufacturing charts for selected products and assessment of critical control points (CCPs).	4	CO 1, CO 5	KI, K4, K5, K6
Pedagogy:	Experiential Learning (Hands-on-experimentation), Problem-based Learning, Group Projects, Demonstration			
Texts:	1. Mortimore, S., & Wallace, C. (2013). *HACCP: A Practical Approach* (3rd Ed.). Springer US. https://doi.org/10.1007/978-1-4614-5028-3 2. Lawless, H. T., & Heymann, H. (2010). Preference testing. In H. T. Lawless & H. Heymann (Eds.), *Sensory Evaluation of Food: Principles and Practices* (pp. 303–324). Springer. https://doi.org/10.1007/978-1-4419-6488-5_13 3. Enachescu Dauthy, M. (1995). *Fruit and Vegetable Processing* (FAO Agricultural Services Bulletin No. 119). Food and Agriculture Organization of the United Nations. https://www.fao.org/4/V5030E/V5030E00.htm 4. Brennan, J. G. (Ed.). (2006). *Food Processing Handbook*. Wiley-VCH Verlag GmbH & Co. KGaA, Germany. 5. Fellows, P. J. (2000). *Food Processing Technology: Principles and Practice* (2nd ed.). Woodhead Publishing Limited, England 6. Ramaswamy, H. S., & Marcotte, M. (2005). *Food Processing: Principles and Applications*. CRC Press, USA 7. Shapton, D. A., & Shapton, N. F. (1998). *Principles and Practices for the Safe Processing of Foods*. Butterworth-Heinemann, UK			
References/ Readings:	1. Mihafu, F. D., Issa, J. Y., & Kamiyango, M. W. (2020). Implication of sensory evaluation and quality assessment in food product development: A review. *Current Research in Nutrition and Food Science Journal, 8*(3), 690–702. https://doi.org/https://dx.doi.org/10.12944/CRNFSJ.8.3.03 2. Jenkins, H. (1926). Experiments on the pasteurisation of milk, with reference to the efficiency of commercial pasteurisation. *Journal of Hygiene, 25*(3), 273–284. https://doi.org/10.1017/S002217240001740X 3. Tireki, S., Sumnu, G., & Sahin, S. (2021). Correlation between physical and sensorial properties of gummy confections with different formulations during storage. *Journal of Food Science and Technology, 58*(9), 3397–3408. https://doi.org/10.1007/s13197-020-04923-3 4. Shittu, T. A., Raji, A. O., & Sanni, L. O. (2007). Bread from composite cassava-wheat flour: I. Effect of baking time and temperature on some physical properties of bread loaf. *Food Research International, 40*(2), 280–290. https://doi.org/10.1016/j.foodres.2006.10.012 5. Akinola, S. A., Samson Akinmadeyemi, A., Ajatta, M. A., & Aworh, C. O. (2018). Influence of chemical			

	preservatives on quality attributes of orange juice. *Croatian Journal of Food Science and Technology*, *10*(1), 8–15. https://doi.org/10.17508/CJFST.2018.10.1.02 6. Garg, M., Ali, M., Batra, V., Sadhu, S. D., Sharma, S., Basak, S., & Sablania, V. (2023). Quality evaluation of nutri-premix prepared by using millets and seeds of fruits and vegetables. *Journal of Food Science and Technology*, *60*(11), 2782–2791. https://doi.org/10.1007/s13197-023-05796-y
Web Resources:	1. Institute of Food Technologists (IFT). (2025, May 2). https://www.ift.org 2. U.S. Food and Drug Administration. (1997, August 14). *HACCP principles & application guidelines*. U.S. Department of Health and Human Services. https://www.fda.gov/food/hazard-analysis-critical-control-point-haccp/haccp-principles-application-guidelines

Discipline Specific Elective Courses

Title of the Course	Food Industry Waste Management
Course Code	FTC-5201
Number of Credits	3
Theory/Practical	Theory
Level	400
Effective from AY	2025-2026
New Course:	No
Bridge Course/ Value-added Course:	No
Course for advanced learners:	No

Pre-requisites for the Course:	Nil	
Course Objectives:	1. To understand the characteristics of food industry waste and their environmental implications 2. To explain the conventional and advanced waste treatment technologies used in the food industry that comply with Indian Standards 3. To apply scientific and regulatory knowledge in waste generation and waste utilization 4. To familiarize with waste generated from food industries and methods of byproduct utilization	
Course Outcomes:	**On the completion of the course, the student will be able to:**	**Mapped to PSO**
	CO 1. Recognise the type and characteristics of the waste generated by food industries and its treatment methods.	PSO 7

	CO 2. Describe the waste generated, its characteristics and explain the treatment methods.			PSO 7
	CO 3. Use appropriate treatment methods based on the type and characteristics of the waste generated by food industry.			PSO 7
	CO 4. Analyse waste generated by food industries, its characteristics and effect of the treatment methods.			PSO 7
	CO 5. Evaluate the effectiveness of the treatment methods for the waste generated by different food industries.			PSO 7
Content:	**Syllabus Content (45 hours)**	**No. of hours**	**Mapped to CO**	**Cognitive Level**
Module 1:	**Industrial Food Waste**			
	1.1 Waste generated, disposal and by-products in Cereal, legumes and oilseed processing industry.	2	CO 1, CO 2	K1, K2, K3
	1.2 Waste generated, disposal and by-products in Fruits and Vegetable sector.	2	CO 1, CO 2	K1, K2, K3
	1.3 Waste generated, disposal and by-products in Confectionaries, Sugar Factories and Bakery Industries.	2	CO 1, CO 2	K1, K2, K3
	1.4 Waste generated, disposal and by-products in Breweries, Distilleries and beverage industries.	2	CO 1, CO 2	K1, K2, K3
	1.5 Waste generated, disposal and by-products in Dairy Industry	2	CO 1, CO 2	K1, K2, K3
	1.6 Waste generated, disposal and by-products in Flesh Food Processing Units	3	CO 1, CO 2	K1, K2, K3
	1.7 Waste generated, disposal and by-products in Convenience food industry	2	CO 1, CO 2	K1, K2, K3
Module 2:	**Food Waste Effluents and Waste Utilisation**			
	2.1 Characterization of food industry effluents: Physical and chemical parameters, Oxygen demands (BOD & COD) and their interrelationships	3	CO 1, CO 2	K1, K2, K3, K4

	2.2 Waste Components and their Toxicity: Residues (solids), Fats, Oils and grease; Forms of Nitrogen, Sulphur and Phosphorus, surfactants and other ingredients	3	CO 1, CO 2	K1, K2, K3, K4
	2.3 Environmental consequences of effluents and waste disposal methods	3	CO 1, CO 2	K1, K2, K3
	2.4 New and Renewable Energy Sources for Waste Utilization	1	CO 1, CO 2	K1, K2, K3
Module 3:	**Food Waste Treatment Methods**			
	3.1 Treatment methods for waste from food industry: Design and working of Activated Sludge Process & Handling of sludge, Bioremediation, Microbial Fuel Cells trickling filters	3	CO 1, CO 2 CO 3	K1, K2, K3, K4
	3.2 Waste Water Management: Quality, Treatment, Recycle, Reuse, Role of Macrophytes and Microphytes	2	CO 3, CO 4	K1, K2, K3, K4
	3.3 Treatment by Biological Methods: Biogas, Plant-derived Fuels, Landfill Gas, Biomethanation and Biocomposting Technology for Organic Waste	2	CO 1, CO 2 CO 3	K1, K2, K3, K4
	3.4 Methods of Solid Waste Management: Incineration, Combustion, etc.	2	CO 1, CO 2 CO 3	K1, K2, K3, K4
	3.5 Advanced Wastewater Treatment Systems: Physical separations, Micro-strainers and other Filters, Ultra filtration and reverse osmosis	3	CO 1, CO 2 CO 3	K1, K2, K3, K4
	3.6 Physicochemical Separations: Activated Carbon Adsorption, Ion Exchange, Electrodialysis and Magnetic Separation; Chemical Oxidation and Treatment - Coagulation and Flocculation	3	CO 1, CO 2 CO 3	K1, K2, K3, K4
Module s4:	**Law and Regulation**			
	4.1 Effluent treatment plants as per Indian Standard Guidelines	3	CO 1, CO 2	K2, K3, K4 K5
	4.2 Environmental performance of food industry to comply with ISO-14001 and IS 2296-1982 standards.	2	CO 1, CO 2	K3, K4, K5
Pedagogy:	Lectures, Seminars, Case Study Analysis, Problem-based Learning, Mock Debates, Use of ICT Tools			

Texts:	1. Arvanitoyannis, I. S. (2008). *Waste Management for the Food Industries* (2nd ed.). Elsevier Academic Press, UK. 2. Barbera, M., & Gurnari, G. (2018). *Wastewater Treatment and Reuse in the Food Industry*. Springer Briefs in Molecular Science: Chemistry of Foods. Springer, Switzerland. 3. Green, J. H., & Kramer, A. (Eds.). (1979). *Food Processing Waste Management*. AVI Publishing Company, USA. 4. Kazmi, A., & Shuttleworth, P. (2013). *The Economic Utilization of Food Co-products*. Royal Society of Chemistry Publishing, UK. 5. Kosseva, M. R., & Webb, C. (2013). *Food Industry Wastes*. Academic Press, USA. 6. Oreopoulou, V., & Russ, W. (2007). *Utilization of by-products and Treatment of Waste in the Food Industry*. Springer, UK. 7. Russell, D. L. (2006). *Practical Wastewater Treatment*. John Wiley & Sons, Inc, USA. 8. Wun Jern, N. G. (2006). *Industrial Wastewater Treatment*. Imperial College Press, UK.
References/ Readings:	1. Cheremisinoff, N. P. (2002). *Handbook of Water and Wastewater Treatment Technologies*. Butterworth-Heinemann, UK. 2. Waldron, K. (2007). *Handbook of Waste Management and Co-product Recovery in Food Processing* (Vol. 1). CRC Press, Woodhead Publishing Limited, England. 3. Westport, A. K. (2017). *Food Processing by-products and their Utilization* (IFST Advances in Food Science). Wiley-Blackwell, UK. 4. TERI. (2014). *Waste to Resources: A Waste Management Handbook*. TERI Press, New Delhi, India. 5. Katsuyama, A. M. (Ed.). (1979). *A Guide for Waste Management in the Food Processing Industry*. Food Processors Institute USA. 6. Gunjal, A. B., Waghmode, M. S., Patil, N. N., & Bhatt, P. (Eds.). (2019). *Global Initiatives for Waste Reduction and Cutting Food Loss*. IGI Global. https://doi.org/10.4018/978-1-5225-7706-5 7. Mohanty, A., Mankoti, M., Rout, P. R., Meena, S. S., Dewan, S., Kalia, B., Varjani, S., Wong, J. W. C., & Banu, J. R. (2022). Sustainable utilization of food waste for bioenergy production: A step towards circular bioeconomy. *International Journal of Food Microbiology*, *365*, 109538. https://doi.org/10.1016/j.ijfoodmicro.2022.109538 8. Samudro, G., & Mangkoedihardjo, S. (2010). Review on BOD, COD and BOD/COD ratio: A triangle zone for toxic, biodegradable and stable levels. *International Journal of Academic Research, 2*(4), 235–239. https://doi.org/10.7813/2075-4124.2010/2-4/B.35
Web Resources:	1. Food Safety and Standards Authority of India. (2022). *Regulatory – FSSAI (Part 1)* https://www.fssai.gov.in/upload/advisories/2022/12/638ede8932f0cDirection_Licensing_28_11_2022_.pdf

	2. Food Safety and Standards Authority of India. (2018). *Guidance document: Food safety management systems – Food industry guide to implement GMP/GHP requirements and risk assessment* (Based on Part II of Schedule 4 of Food Safety & Standards [Licensing & Registration of Food Businesses] Regulation, 2011). https://www.fssai.gov.in/upload/uploadfiles/files/Guidance_Document_Nutraceutical_18_05_2018.pdf 3. Central Pollution Control Board. (n.d.). *General standards for effluent discharge: Schedule and annexures.* The Environment (Protection) Rules, 1986 https://www.cpcb.nic.in/GeneralStandards.pdf 4. Central Pollution Control Board. (2021). *Pollution Control Law Series: PCLS/02/2021-2022. Pollution control acts, rules & notifications issued thereunder*. Ministry of Environment, Forest & Climate Change, Government of India, https://goaspcb.gov.in/Media/Default/Rules/7thEditionPollutionControlLawSeries2021.pdf

Title of the Course	Lab in Food Industry Waste Management
Course Code	FTC-5202
Number of Credits	1
Theory/Practical	Practical
Level	400
Effective from AY	2025-2026
New Course:	No
Bridge Course/ Value-added Course	No
Course for advanced learners	No

Pre-requisites for the Course:	Nil	
Course Objectives:	1. To enable experimentation and observation of the outcomes of environmental waste utilisation techniques. 2. To provide students a practical understanding of industrial food waste management processes. 3. To analyse physicochemical parameters and bioremediation potential of wastewater from food industries. 4. To extract and recover valuable compounds from food and agricultural waste.	
Course Outcomes:	**On the completion of the course, the student will be able to:**	**Mapped to PSO**
	CO 1. State the procedures involved in physicochemical analysis, bioremediation potential and recover valuable compounds of waste from food industries.	PSO 7
	CO 2. Explain the techniques and procedures physicochemical analysis, bioremediation potential and recover valuable compounds of waste from food industries.	PSO 4, PSO 7

	CO 3. Apply appropriate techniques for food waste analysis and waste utilization.			PSO 4, PSO 7
	CO 4. Analyze physicochemical parameters, bioremediation potential of food waste and methods for its management and utilization.			PSO 4, PSO 7
	CO 5. Evaluate techniques and interpret results of physicochemical analysis, bioremediation potential and recover valuable compounds of waste from food industries.			PSO 4, PSO 7
Content:	**Syllabus Content (30 hours)**	**No. of hours**	**Mapped to CO**	**Cognitive Level**
Module 1:	**Industrial Waste Water Analysis**			
	1.1 Determination of TS, TSS and TDS in Water Samples	2	CO 2, CO 3, CO 4, CO 5	K3, K4
	1.2 Determination of Dissolved Oxygen (DO), Biological Oxygen Demand (BOD), and Chemical Oxygen Demand (COD) of Wastewater.	4	CO 1, CO 2, CO 4, CO 5	K3, K4
	1.3 Determination of pH and Alkalinity of Wastewater	2	CO 1, CO 2, CO 3, CO 5	K3, K4
	1.4 Qualitative and Quantitative Determination of Faecal Contamination of Water	2	CO 1, CO 2, CO 3, CO 5	K3, K4, K5
	1.5 Determination of Statistical Process Control (SPC) of different wastes, and Compliance with regulatory guidelines in Laboratory techniques	2	CO 1, CO 2	K2, K3
	1.6 Assessment of Bioremediation/Biodegradation Potential of Isolated Soil or Wastewater	2	CO 1, CO 2, CO 4, CO 5	K4, K5
Module 2:	**Industrial Food Waste Management**			
	2.1 Juice Production from banana pseudostem	2	CO 1, CO 2, CO 3	K3, K4
	2.2 Extraction of Cellulose from Crop Residue	2	CO 1, CO 2,	K3, K4

			CO 3, CO 5	
	2.3 Extraction of Oil from Food Waste (fruit and vegetable peels, flesh food waste)	2	CO 1, CO 2, CO 3, CO 5	K3, K4
	2.4 Extraction of Pectin from Food Waste	2	CO 1, CO 2, CO 3, CO 5	K3, K4
	2.5 Extraction of Gelatine from Food Waste	2	CO 1, CO 2, CO 3, CO 5	K3, K4
	2.6 Extraction of Chitin from Food Waste	2	CO 1, CO 2, CO 3, CO 5	K3, K4
	2.7 Extraction of Biogas from Organic Waste	2	CO 1, CO 2, CO 3	K3, K4
	2.8 Assessment of microbial degradation of Waste (preparation of lab-scale compost)	2	CO 1, CO 2, CO 4, CO 5	K3, K4, K5
Pedagogy:	Experiments in the Laboratory			
Texts:	1. Aneja, K. R. (2007). *Experiments in microbiology, plant pathology and biotechnology* (4th ed.). New Age International Publishers. 2. Helrich, K. (Ed.). (1990). *Official methods of analysis of the Association of Official Analytical Chemists* (15th ed.). AOAC International. 3. Chaurasia, S., & Gupta, A. D. (2014). *Handbook of water, air and soil analysis: A lab manual*. International E-Publication. 4. Nigam, A., & Ayyagari, A. (2008). *Lab manual in biochemistry, immunology and biotechnology*. Tata McGraw-Hill Publishing Company Limited. 5. Martin, A. M. (2012). *Bioconversion of waste materials to industrial products*. Springer Science & Business Media.			
References/ Readings:	1. Isniah, S., & Purba, H. H. (2021). The application of using Statistical Process Control (SPC) method: Literature review and research issues. *Spektrum Industri, 19*(2), 125–133. https://doi.org/10.12928/si.v19i2.19035			

	2. Muzaffar, K., Sofi, S. A., & Mir, S. A. (2023). *Handbook of fruit wastes and by-products: Chemistry, processing technology, and utilization*. CRC Press, Taylor & Francis Group. 3. Manivasakam, N. (2011). *Industrial water analysis handbook*. Chemical Publishing Company. 4. Liu, Z., de Souza, T. S. P., Holland, B., Dunshea, F., Barrow, C., & Suleria, H. A. R. (2023). Valorization of food waste to produce value-added products based on its bioactive compounds. *Processes, 11*(3), 840. https://doi.org/10.3390/pr11030840 5. Ranganathan, S., Dutta, S., Moses, J. A., & Anandharamakrishnan, C. (2020). Utilization of food waste streams for the production of biopolymers. *Heliyon, 6*, e04891. https://doi.org/10.1016/j.heliyon.2020.e04891
Web Resources:	1. Central Pollution Control Board. (n.d.). *Guide manual: Water and wastewater analysis*. Ministry of Environment & Forests, Government of India. https://cpcb.nic.in/openpdffile.php?id=TGF0ZXN0RmlsZS9MYXRlc3RfNjdfZ3VpZGVtYW51YWx3Jnd3YW5hbHlzaXMucGRm 2. Central Pollution Control Board. (n.d.). *General standards for effluent discharge: Schedule and Annexure.* The Environment (Protection) Rules, 1986 https://www.cpcb.nic.in/GeneralStandards.pdf

Title of the Course	Food Additives, Adulteration, and Toxicology
Course Code	FTC-5203
Number of Credits	3
Theory/Practical	Theory
Level	400
Effective from AY	2025-2026
New Course:	No
Bridge Course/ Value-added Course:	No
Course for advanced learners:	No

Pre-requisites for the Course:	Nil	
Course Objectives:	1. To provide students with a comprehensive understanding of the principles and regulations governing food additives, adulteration, and toxicology within the Indian context. 2. To equip students with the knowledge and skills necessary to identify, classify, and evaluate the safety and potential health impacts of various substances encountered in the food supply chain. 3. To foster critical thinking about the complexities of ensuring food quality and safety, including the methods used for detection, analysis, and risk assessment of food-related hazards. 4. To cultivate an awareness of the legal and ethical responsibilities associated with food production and distribution in India, particularly concerning the use of additives, the prevention of adulteration, and the management of toxicological risks.	
Course Outcomes:	**On the completion of the course, the student will be able to:**	**Mapped to PSO**

	CO 1. Recall and interpret the regulatory frameworks governing food safety in India across the spectrum of food additives, adulterants, and toxicants to propose informed solutions for ensuring food quality and public health.			PSO 2, PSO 4
	CO 2. Describe the classification and approval processes for food additives and compare and contrast analytical detection methods for both additives and adulterants.			PSO 4
	CO 3. Analyse the public health impact of food adulteration in light of the potential toxicological effects of common adulterants and contaminants.			PSO 4
	CO 4. Comprehend the fundamental principles of toxicology and analyse the regulatory limits and assess the permissible levels of both food additives and certain contaminants in ensuring consumer safety.			PSO 2, PSO 4
	CO 5. Investigate qualitative and quantitative detection methods for food adulterants and toxicants, and assess their effectiveness in ensuring food safety.			PSO 2, PSO 4
Content:	**Syllabus Content (45 hours)**	**No. of hours**	**Mapped to CO**	**Cognitive Level**
Module 1:	**Additives in Food**			
	1.1 Food Additives: Definition, Importance, Relevance in Food, FSSR Specifications.	1	CO 1	K1, K2
	1.2 Class I and II Preservatives: Definition, examples, technological purposes.	2	CO 1, CO 2	K1, K2
	1.3 Classification of Food Additives: Class Names and International Numbering System (INS) for Food Additives given in CAC/GL 36-1988 Amendment 2015; functional classes, definition and technological purpose.	2	CO 1, CO 2	K1, K2, K4
	1.4 Food colours, flavourings and sweetening agents: Natural, and synthetic colours; synthetic colours permitted in India, permissible limits, non-permitted colours in India; natural flavours, nature-identical flavouring substances and artificial flavouring substances; flavourings prohibited in India; Applications, Calorific, low-calorie and no-calorie sweeteners,	7	CO 1, CO 2 CO 3	K1, K2, K4

	permitted sweeteners and food products, permissible limits.			
	1.5 Regulation of Food Additives: Role of Codex Alimentarius Commission, JECFA, Approval Process in India (Working groups, Harmonisation); FSSAI Panel for food additives.	3	CO 1, CO 2	K1, K2, K4
Module 2:	**Adulteration of Food**			
	2.1 Food Adulteration: Definition, causes and Types (intentional, incidental, metallic); FSSA (2006) definition of unsafe food.	2	CO 1, CO 3	KI, K2, K4
	2.2 Impact on public health: Common food adulterants in Indian foods (milk and milk products, edible oils, food grains, spices, tea and coffee); impact on human health; review of relevant case studies.	3	CO 3, CO 5	K4, K5
	2.3 Qualitative detection methods: FSSAI DART Manuals, Home test methods.	2	CO 3, CO 5	K4, K5
	2.4 Analytical detection methods: Physical, chemical/ biochemical and molecular techniques; Applications of chromatography (GC, LC, TLC, HPLC), Spectroscopy (FTIR, SERS), Electronic nose, Immunology-based (ELISA) in detection of adulterants.	3	CO 3, CO 5	K4, K5
	2.5 Offences and Penalties as per Chapter IX and XI of the FSSA (2006); COPRA 2019.	2	CO 1, CO 3	K1, K2, K4
Module 3:	**Basics of Toxicology**			
	3.1 Food Toxicology: Introduction, history, relevant terminology, important case studies.	1	CO 3, CO 4	K2, K4, K5
	3.2 Principles of toxicology: Processing and accumulation of toxins in the human body; elimination and detoxification mechanisms; toxicokinetics and toxicodynamics.	2	CO 3, CO 4	K2, K4, K5
	3.3 Toxicant Chemistry: Differences between toxicants and toxins, classification of toxicants and toxins; manifestation of toxic effects; Factors affecting toxicity of compounds; Introduction to toxicological dose descriptors (LD50,	2	CO 3, CO 4	K2, K4, K5

	LC50, EC50, NOAEL, NOAEC, LOAEL, DNEL, PNEC).		CO 5	
	3.4 Bacterial toxins: *Bacillus Species*, *Campylobacter*, *Clostridium botulinum*, *Clostridium perfringens*, *Listeria*, *Mycobacterium*, *Pseudomonas aeruginosa*, *Salmonella*, *Shigella*, *Staphylococcus aureus*, *Streptococci*, Verocytotoxin-Producing *Escherichia*, *Vibrio cholerae*, *Vibrio parahaemolyticus*, and *Yersinia enterocolitica*.	3	CO 3, CO 4 CO 5	K2, K4, K5
	3.5 Mycotoxins: Aflatoxins, Cyclopiazonic Acid, Deoxynivalenol, Ergot, Fumonisins, Ochratoxins, Patulin and Sterigmatocystin.	1	CO 3, CO 4 CO 5	K2, K4, K5
	3.6 Phytotoxins: Cucurbitacins, Cyanogenic Glycosides, Furocoumarins, Glycoalkaloids, Grayanotoxin and Lectins.	1	CO 3, CO 4 CO 5	K2, K4, K5
	3.7 Aquatic biotoxins: Amnesic Shellfish Poisoning, Azaspiracid Shellfish Poisoning, Ciguatera Fish Poisoning, Diarrhoeic Shellfish Poisoning, Neurologic Shellfish Poisoning, Paralytic Shellfish Poisoning, Tetrodotoxin.	2	CO 4, CO 5	K2, K4, K5
	3.8 Biological amines: Biogenic amines (excluding histamine), Scombrotoxin	1	CO 4, CO 5	K2, K4, K5
	3.9 Contaminants produced during processing: Acrylamide, Benzene, Chloropropanols, Furans, Polycyclic Aromatic Hydrocarbons.	1	CO 4, CO 5	K2, K4, K5
	3.10 Contaminants from Food-Contact Materials: Bisphenol A, Phthalates and Semicarbazide.	1	CO 4, CO 5	K2, K4, K5
	3.11 Environmental Contaminants: Dioxins and PCBs, Heavy Metals, Perchlorate; Veterinary Residues (Antibiotics and Hormones)	1	CO 4, CO 5	K2, K4, K5
	3.12 Methods used in Safety Evaluation: Toxicity analysis, animal models, clinical trials, and In vitro models and studies.	2	CO 5	K4, K5
Pedagogy:	Lectures, Seminars, Case Study Analysis, Problem-based Learning, Mock Debates, Use of ICT Tools			
Texts:	1. Lawley, R., Curtis, L., & Davis, J. (with Royal Society of Chemistry (Great Britain)). (2008). *The Food Safety*			

	Hazard Guidebook. RSC Publishing, UK. 2. El-Samragy, Y. (Ed.). (2012). *Food Additive*. IntechOpen, Croatia. 3. Msagati, T. A. M. (2012). *Chemistry of Food Additives and Preservatives* (1st ed.). Wiley, USA. https://doi.org/10.1002/9781118274132 4. Smith, J. (Ed.). (1991). Food additive user's handbook. Springer US. https://doi.org/10.1007/978-1-4615-3916-2 5. Morya, Sonia & Sharma, Ankit. (2019). Food Additives and Preservatives. In S. K. Singh & S. Kaur, *Advances in Horticultural Crop Management and Value Addition* (1st ed.), Laxmi Publications Pvt Ltd, India. 6. Shibamoto, T., & Bjeldanes, L. F. (2009). *Introduction to Food Toxicology*. Academic Press, USA. 7. Omaye, S. T. (2004). *Food and Nutritional Toxicology*. CRC Press, USA. https://doi.org/10.1201/9780203485309
References/ Readings:	1. Habza-Kowalska, E., Grela, M., Gryzińska, M., & Listos, P. (2020). Molecular techniques for detecting food adulteration. *Medycyna Weterynaryjna, 75*(05), 6260–2020. https://doi.org/10.21521/mw.6261 2. Anagaw, Y. K., Ayenew, W., Limenh, L. W., Geremew, D. T., Worku, M. C., Tessema, T. A., Simegn, W., & Mitku, M. L. (2024). Food adulteration: Causes, risks, and detection techniques—review. *SAGE Open Medicine, 12*, 20503121241250184. https://doi.org/10.1177/20503121241250184 3. Kobylewski, S., & Jacobson, M. F. (2012). Toxicology of food dyes. *International Journal of Occupational and Environmental Health, 18*(3), 220–246. https://doi.org/10.1179/1077352512Z.00000000034 4. Yeung, A. W. K., Tzvetkov, N. T., Jóźwik, A., Horbanczuk, O. K., Polgar, T., Pieczynska, M. D., Sampino, S., Nicoletti, F., Berindan-Neagoe, I., Battino, M., & Atanasov, A. G. (2020). Food toxicology: Quantitative analysis of the research field literature. *International Journal of Food Sciences and Nutrition, 71*(1), 13–21. https://doi.org/10.1080/09637486.2019.1620184 5. Bansal, S., Singh, A., Mangal, M., Mangal, A. K., & Kumar, S. (2017). Food adulteration: Sources, health risks, and detection methods. *Critical Reviews in Food Science and Nutrition, 57*(6), 1174–1189. https://doi.org/10.1080/10408398.2014.967834
Web Resources:	1. https://www.fao.org/input/download/standards/13341/CXG_036e_2015.pdf 2. https://eatrightindia.gov.in/dart/ 3. https://www.fssai.gov.in/upload/uploadfiles/files/Chapter1.pdf 4. https://fssai.gov.in/upload/uploadfiles/files/Chapter11.pdf

	5. https://www.fssai.gov.in/cms/checkadulteration.php 6. https://www.fda.gov/files/food/published/Toxicological-Principles-for-the-Safety-Assessment-of-Food-Ingredients.pdf

Title of the Course	Lab in Food Additives, Adulteration, and Toxicology
Course Code	FTC-5204
Number of Credits	1
Theory/Practical	Practical
Level	400
Effective from AY	2025-2026
New Course:	No
Bridge Course/ Value-added Course	No
Course for advanced learners	No

Pre-requisites for the Course:	Nil	
Course Objectives:	1. To develop proficiency in applying fundamental analytical techniques for the qualitative and quantitative determination of food additives and adulterants in various food matrices. 2. To enable students to critically evaluate the principles behind different methods used for the detection of food contaminants, including pesticide residues, antibiotics, hormones, veterinary drugs, and heavy metals. 3. To provide practical experience in assessing the impact of food additives and preservatives on microbial growth and cellular systems using microbiological and spectrophotometric techniques. 4. To cultivate the ability to utilise online databases and regulatory resources for information on food additives, contaminants, and risk assessment methodologies.	
Course Outcomes:	**On the completion of the course, the student will be able to:**	**Mapped to PSO**

	CO 1. Identify and classify various food additives, adulterants, and toxicants based on their chemical nature, functional properties, and regulatory status according to Indian and international standards.			PSO 2, PSO 4
	CO 2. Analyse the methods used for the detection and quantification of food additives and adulterants in food matrices, and interpret the results in the context of food safety regulations.			PSO 2, PSO 4
	CO 3. Evaluate the potential health risks associated with different foodborne toxicants and contaminants by applying principles of toxicology and considering factors influencing their toxicity.			PSO 2, PSO 4
	CO 4. Design and conduct basic laboratory experiments related to the analysis of food additives and adulterants, and interpret the experimental data to conclude on food quality and safety.			PSO 2, PSO 4
	CO 5. Critique current food safety regulations and risk assessment methodologies in India, and propose potential improvements based on scientific literature and case studies.			PSO 2, PSO 4
Content:	**Syllabus Content (30 hours)**	**No. of hours**	**Mapped to CO**	**Cognitive Level**
	1. Survey of Additives Used in Popular Commercial Food Products.	2	CO 1	K2, K3
	2. Estimation of Water-soluble and Oil-soluble Colours in Foods.	2	CO 2, CO 4	K2, K3, K5
	3. Qualitative Analysis of Adulterants in food samples using the DART manual.	4	CO 2, CO 4	K2, K3, K5
	4. Comparison of food preservatives on susceptibility of Gram-negative bacteria.	4	CO 3	K5
	5. Spectrophotometric estimation of benzoic acid.	2	CO 2, CO 4	K2, K3, K5
	6. TLC estimation of Asparatame.	2	CO 2, CO 4	K2, K3, K5
	7. Detection of Pesticide/ Antibiotic Residues/ Hormones/ Veterinary Drugs, and Heavy Metals in Foods	2	CO 2, CO 3	K2, K4, K5
	8. Effect of food additives on suppression of the growth of *S. cerevisiae* via spectrophotometry and hemocytometry.	4	CO 3, CO 4	K3, K5

	9. Impact of food additives on mitotic chromosomes of *Allium cepa* L.	2	CO 3	K5
	10. Exploration of the Data in the Codex General Standard for Food Additives (GSFA) Online Database.	2	CO 1	K2, K3, K4
	11. Exploration of the resources available in *EFSA OpenFoodTox* and *USFDA NCTR.*	2	CO 1	K2, K3, K4
	12. Mock Risk Assessment and Risk Characterisation.	2	CO 5	K4, K5, K6
Pedagogy:	Wet lab and Dry lab experimentation, Use of ICT Tools			
Texts:	1. Belitz, H.-D., Grosch, W., & Schieberle, P. (2009). *Food Chemistry* (4th ed.). Springer, Germany 2. de Vries, J. W. (2007). *Principles of Food Toxicology.* Springer, USA. 3. Lang, T., & Millstone, E. (2019). *Food Safety: A Very Short Introduction*. Oxford University Press, UK. 4. Mayo, D., Boerio-Martin, E., & Prats-Vives, G. (2017). *Food Safety Management: A practical guide for the Food Industry*. Wiley-Blackwell, USA. 5. Motarjemi, Y. (Ed.). (2014). *Encyclopedia of Food Safety* (Vols. 1-5). Academic Press, Netherlands. 6. Rechcigl, M. J. (Ed.). (1983). *Handbook of Naturally Occurring Food Toxicants*. CRC Press, USA 7. Kramer, A., & Twigg, B. A. (1973). *Quality Control for the Food Industry* (Vols. 1–2). AVI Publishing Company, USA. 8. Vasconcellos, J. A. (2003). *Quality Assurance for the Food Industry: A Practical Approach*. CRC Press, USA.			
References/ Readings:	1. Zhou, X., Qiao, K., Wu, H., & Zhang, Y. (2023). The impact of food additives on the abundance and composition of gut microbiota. Molecules, 28(2), 631. https://doi.org/10.3390/molecules28020631 2. Haji, A., Desalegn, K., & Hassen, H. (2023). Selected food items adulteration, their impacts on public health, and detection methods: A review. *Food Science & Nutrition*, *11*(12), 7534–7545. https://doi.org/10.1002/fsn3.3732 3. Peycheva, E., Alexandrova, R., & Miloshev, G. (2014). Application of the yeast comet assay in testing of food additives for genotoxicity. *LWT - Food Science and Technology*, *59*(1), 510–517. https://doi.org/10.1016/j.lwt.2014.04.023 4. Onyemaobi, O. I., Williams, G. O. & Adekoya, K. O. (2012) Cytogenetic Effects of Two Food Preservatives, Sodium Metabisulphite and Sodium Benzoate on The Root Tips of *Allium Cepa* Linn. *IFE Journal of Science, 14*(1): 155.			

	5. Neelam, M., & Mishra, S. (2018). Effects of food additives and preservatives on processed food. *Asian Journal of Science and Applied Technology*, *7*(2), 30–32. https://doi.org/10.51983/ajsat-2018.7.2.1031 6. Thakur, K., Singh, D., & Rajput, R. (2022). Effects of food additives and preservatives and shelf life of the processed foods. *Journal of Current Research in Food Science*, *3*(2), 11–22. https://www.foodresearchjournal.com/archives/2022.v3.i2.A.67
Web Resources:	1. FSSAI DART Manual. https://fssai.gov.in/upload/knowledge_hub/1878035b34b558a3b48DART%20Book.pdf

SEMESTER II

Discipline Specific Core Courses

Title of the Course	Food Biotechnology
Course Code	FTC-5006
Number of Credits	3
Theory/Practical	Theory
Level	500
Effective from AY	2025-2026
New Course:	No
Bridge Course/ Value-added Course:	No
Course for advanced learners:	No

Pre-requisites for the Course:	Nil	
Course Objectives:	1. To acquaint with the concepts and techniques of biotechnology applied in food industry 2. To familiarize with methods to obtain genetically modified organism and food 3. To understand biotechnological processes involved in developing products with industrial application. 4. To provide knowledge of ethical, regulatory, and social aspects of biotechnology in the food industry, including intellectual property rights and food security	
Course Outcomes:	**On the completion of the course, the student will be able to:**	**Mapped to PSO**

	CO 1. Recall the concept of molecular biology, food biotechnology, techniques used and application in the industry			PSO 1
	CO 2. Explain the concept and describe techniques of food biotechnology and its application in the industry			PSO 4
	CO 3. Apply the concept of food biotechnology and techniques used within the industry			PSO 1
	CO 4. Analyse the outcome of applying food biotechnological concepts and techniques			PSO 1
	CO 5. Evaluate the concepts, effectiveness and outcome of food biotechnological techniques within the industry			PSO 1
Content:	**Syllabus Content (45 hours)**	**No. of hours**	**Mapped to CO**	**Cognitive Level**
Module 1:	**Fundamentals of Biotechnology**			
	1.1 Definition, Scope, and Application of Biotechnology - application in food industries, pharmaceuticals, agriculture, and waste utilization	1	CO 1, CO 2	K2, K3
	1.2 Fundamentals of Molecular Biology: Chemistry and Biology of DNA; Types of DNA; DNA Mutations and the Role of Mutagenic Agents, Bacterial DNA replication, Bacterial transcription, Bacterial Translation, RNA synthesis, types of RNA, genetic code; Regulation of Gene Expression in Prokaryotes;	3	CO 1, CO 2	K2, K3
	1.3 Recombinant DNA Technology: Restriction enzymes, cloning vectors, steps involved in gene cloning. PCR, DNA sequencing	3	CO 1, CO 2	K2, K3, K4
	1.4 Genetic recombination mechanisms: transformation, transduction, conjugation	1	CO 1, CO 2	K2, K3, K4
	1.5 Cell and tissue cultivation: Principles and Applications of Animal cultures and Plant Tissue Cultures and Micropropagation. Case studies of lab grown meat.	2	CO 1, CO 2	K2, K3, K4
Module 2:	**Genetic Modification**			
	2.1 Genetically Modified Organisms (GMOs) in industrial Fermentation	3	CO 3,	K3, K4, K5

	Processes and Techniques for improvement in Microbial Strains		CO 4, CO 5	
	2.2 Improvement of Crops by Genetic Engineering – drought resistant, insect resistant and herbicide tolerant crops	3	CO 3, CO 4, CO 5	K3, K4, K5
	2.3 Genetically Modified Plants (Golden rice, Flavr savr tomato) and Animals (AquAdvantage Salmon, Transgenic Cows). Pros and Cons of Genetically Modified Foods	4	CO 3, CO 4, CO 5	K3, K4, K5
Module 3:	**Bioprocess Technology**			
	3.1 Principal Components of Fermentation Technology, Growth Kinetics (batch, fed-batch, continuous), submerged and solid-state fermentation	2	CO 1, CO 2	K1, K2, K3
	3.2 Bioreactor: Sterilization of media & fermentor; types, configuration and functions; parts and working of fermentor.	2	CO 1, CO 2	K1, K2, K3
	3.3 Principles of Upstream & Downstream Processing, Bioprocess Measurement and Control System	2	CO 1, CO 2	K1, K2, K3, K4
	3.4 Techniques Involved in Product Recovery and Purification – foam separation, precipitation, filtration, centrifugation, cell disruption, liquid-liquid extraction, chromatography, membrane processes, drying, crystallization, whole broth processing.	2	CO 1, CO 2	K1, K2, K3, K4
	3.5 Immobilization of enzymes and microbes – types of methods and application in the food industry, Biosensors.	2	CO 1, CO 2, CO 3	K1, K2, K3, K4
Module 4:	**Industrial Biotechnology**			
	4.1 Therapeutic Proteins produced by Biotechnological Processes	2	CO 3	K1, K2, K3
	4.2 Industrial Production of Enzymes (Amylases, Proteases, Lipases) and Chemicals (Alcohols, Acids and Solvents)	2	CO 3	K1, K2, K3

	4.3 Use of Microorganisms in Mineral Beneficiation and Recovery; Biomass Production using Microorganisms	1	CO 3, CO 4	K1, K2, K3
	4.4 Role of Plants for Production of Nutraceuticals and Bioremediation	1	CO 3, CO 4	K1, K2, K3
	4.5 Manufacture of Beer, Wine, Vinegar, Cheese, and Mould-Modified Foods	2	CO 3	K1, K2, K3
	4.6 Manufacture of Food Ingredients: Biogums, xanthan gum, fat substitutes, bio-colours, organic acids and sweeteners	2	CO 3	K1, K2, K3
Module 5:	**Bioinformatics and Biotechnology for Food Security**	**(5)**		
	5.1 Bioinformatics: History, Scope and Importance; Application in Food Technology; Sequence Information Sources (Protein & Nucleotide databases Entrez, PDB), Pairwise Alignments, Introduction to BLAST, Sequence Similarity Searches (BLAST, FASTA)	2	CO 1, CO 2, CO 3	K1, K2, K3
	5.2 Trade-related, Regulatory and Social aspects of Food Biotechnology: Ethical issues and guidelines concerning Genetically Modified foods. Intellectual Property Rights (IPR), Bioprospecting and Biopiracy	2	CO 1, CO 2	K1, K2, K3, K4
	5.3 Biotechnology for Food Security: Effect of Biotech Foods on food business of Developing and Developed Countries	1	CO 1, CO 2, CO 3, CO 5	K1, K2, K4, K5
Pedagogy:	Lectures, Seminars, Case Study Analysis, Problem-based Learning, Mock Debates, Use of ICT Tools			
Texts:	1. Barbosa-Cánovas, G. V., & Fontana, A. J. (2003). *Food Science and Food Biotechnology*. CRC Press USA. 2. Bielecki, S., Tramper, J., & Polak, J. (2000). *Food Biotechnology*. Elsevier Netherlands. 3. Chawla, H. S. (2000). *Introduction to Plant Biotechnology*. Oxford & IBH Publishing Co India. 4. Crueger, W., & Crueger, A. (2000). *Biotechnology: A textbook of Industrial Microbiology* (2nd ed.). Panima Publishing Co India. 5. El-Mansi, E. M. T., Bryce, C. F. A., Demain, A. L., & Allman, A. R. (2012). *Fermentation Microbiology and Biotechnology* (3rd ed.). CRC Press USA. 6. Gutiérrez, G. F., & Barbosa-Cánovas, G. V. (2003). *Food Science and Food Biotechnology*. CRC Press USA.			

	7. Joshi, V. K., & Pandey, A. (1999). *Biotechnology – Food Fermentation: Microbiology, Biochemistry and Technology*. EPD India. 8. Kuddus, M. (Ed.). (2018). *Enzymes in Food Biotechnology: Production, Applications, and Future Prospects*. Academic Press UK. 9. Lawrence, G., Lyons, K., & Wallington, T. (2010). *Food Security, Nutrition and Sustainability*. Earthscan USA. 10. Norer, R. (2016). Genetic technology and food safety. In *International Congress of Comparative Law*. Springer Switzerland. 11. Saha, B. C. (2003). *Fermentation Biotechnology*. American Chemical Society USA. 12. Singh, B. D. (2014). *Biotechnology: Expanding Horizons*. Kalyani Publishers India. 13. Stahl, U., Donalies, U. E. B., Nevoigt, E., & Archer, D. B. (2008). *Food Biotechnology*. Springer Germany. 14. Stanbury, P. F., Whitaker, A., & Hall, S. J. (2006). *Principles of Fermentation Technology* (2nd ed.). Elsevier Science Ltd. 15. Watson, J. D. (2013). *Molecular Biology of the Gene* (7th ed.). Benjamin Cummings USA. 16. Watson, R. R., & Preedy, V. R. (2015). *Genetically Modified Organisms in Food: Production, Safety, Regulation and Public Health*. Academic Press USA.
References/ Readings:	1. Bateman, R. (2017). Bioinformatics and Biotechnology: Tools for Food Security. *Journal of Agricultural Biotechnology*, 22(2), 199-215. 2. Brookes, G., & Barfoot, P. (2018). GM Crops: The Global Economic and Environmental Impact - The First 21 Years. *GM Crops and Food*, 9(4), 169-180. 3. Carter, C. A., Moschini, G., & Sheldon, I. M. (2011). *Genetically Modified Food and Global Welfare*. Emerald UK. doi:10.1108/S1574-8715(2011)0000010005 4. FAO/WHO. (2014). Food Safety and GMOs: The Role of Biotechnology in Ensuring Global Food Security. *Food and Agriculture Organization*. 5. Qaim, M. (2016). *Genetically Modified Crops and Agricultural Development*. Palgrave Macmillan US. doi: 10.1057/9781137405722 6. James, C. (2019). Global Status of Commercialized Biotech/GM Crops: 2019. *ISAAA Brief No. 55*. 7. Nielsen, J., Tillegreen, C. B., & Petranovic, D. (2022). Innovation Trends in Industrial biotechnology. *Trends in Biotechnology, 40*(10), 1160–1172. https://doi.org/10.1016/j.tibtech.2022.03.007 8. Stanke, M., & Hitzmann, B. (2013). Bioprocess control: Current progress and future perspectives. *Advances in Biochemical Engineering/Biotechnology, 132*, 35–63. https://doi.org/10.1007/10_2012_167
Web Resources:	1. European Molecular Biology Laboratory. (n.d.). *EMBL homepage*. https://www.embl.org/

	2. Innovative Genomic Institute https://innovativegenomics.org/about-us/ 3. National Center for Biotechnology Information. *NCBI homepage*. U.S. National Library of Medicine. https://www.ncbi.nlm.nih.gov/ 4. National Center for Biotechnology Information. *Entrez*. https://www.ncbi.nlm.nih.gov/Entrez/ 5. National Center for Biotechnology Information. *GenBank homepage*. https://www.ncbi.nlm.nih.gov/genbank/ 6. National Center for Biotechnology Information. *Nucleotide BLAST*. https://www.ncbi.nlm.nih.gov/ 7. RCSB Protein Data Bank. *PDB homepage*. https://www.rcsb.org/ 8. UniProt Consortium. *UniProt homepage*. https://www.uniprot.org/

Title of the Course	Lab in Food Biotechnology
Course Code	FTC-5007
Number of Credits	2
Theory/Practical	Practical
Level	500
Effective from	2025-2026
New Course:	No
Bridge Course/ Value-added Course:	No
Course for advanced learners:	No

Pre-requisites for the Course:	Nil	
Course Objectives:	1. To enable students to experiment with and observe the outcomes of biotechnological techniques propagated in food industries. 2. To provide students a practical application and biotechnological concepts with its industrial application. 3. To have practical understanding of molecular biology and its application. 4. To get an overview of proteomics/genomics including use of various databases.	
Course Outcomes:	**On the completion of the course, the student will be able to:**	**Mapped to PSO**
	CO 1. Recall the procedures of biotechnological techniques used.	PSO 4
	CO 2. Explain the biotechnological techniques used and application in the industry.	PSO 4

	CO 3. Demonstrate the application of the biotechnological techniques used in food industry.			PSO4
	CO 4. Analyse and examine the application of biotechnological techniques used in the food industry.			PSO1, PSO 4
	CO 5. Evaluate and justify the results and effectiveness of the biotechnological techniques applied.			PSO 4
Content:	**Syllabus Content (60 hours)**	**No. of hours**	**Mapped to CO**	**Cognitive Level**
Module 1:	**Industrial Biotechnology**			
	1.1 Assessment of Bacterial Growth Kinetics by batch and Fed-Batch Fermentation	4	CO 3, CO 4	K3, K4
	1.2 Submerged and Solid-state fermentation in biomass or product formation	4	CO 4, CO 5	K3, K4
	1.3 Production and Estimation of Amylase	4	CO 3, CO 4 CO 5	K3, K4
	1.4 Immobilization by entrapment and assessment of efficiency	4	CO 3, CO 4 CO 5	K3, K4, K5
	1.5 Production of Oyster Mushroom using different substrate.	4	CO 3, CO 4 CO 5	K3, K4, K5
	1.6 Plant tissue culture - media preparation, Callus culture and Artificial seeds.	8	CO 1, CO 2	K2, K3, K4, K5
	1.7 Micropropagation through Tissue Culture	2	CO 1, CO 2 CO 3	K3, K4
Module 2:	**Molecular Biology**			
	2.1 Improvement of lactose utilisation efficiency of microbe (strain improvement) using UV light induced mutagenesis.	4	CO 3, CO 4 CO 5	K3, K4, K5, K6
	2.2 Improvement of lactose utilisation efficiency of microbe (strain improvement) using chemical induced mutagenesis.	4	CO 3, CO 4 CO 5	K3, K4, K5, K6

	2.3 Isolation of Bacterial Genomic DNA and Analysis by Agarose Gel Electrophoresis	4	CO 1, CO 2	K3, K4
	2.4 Isolation of Plant Genomic DNA and Analysis by Agarose Gel Electrophoresis	4	CO 1, CO 2	K3, K4
	2.5 Isolation of Bacterial Plasmid DNA and Analysis by Agarose Gel Electrophoresis.	4	CO 1, CO 2	K3, K4
	2.6 Analysis of protein using SDS-PAGE.	4	CO 1, CO 2	K3, K4
	2.7 Bacterial Degradation of Pesticides.	4	CO 4, CO 5	K3, K4, K5
	2.8 Exploring Bioinformatic Web Tools and Resources: EMBL, Genbank, Entrez, BLAST	2	CO 1, CO 2	K2, K3, K4
Pedagogy:	Wet and dry lab experiments, Hands-on-experiments. Use of ICT tools			
Texts:	1. Aneja, K. R. (2007). *Experiments in microbiology, plant pathology and biotechnology* (4th ed.). New Age International Publishers India. 2. Reddy, H. P., & Govil, L. (2018). *Life sciences protocol manual*. Department of Biotechnology, Ministry of Science & Technology, Government of India. 3. Doyle, A., & Griffiths, J. B. (1998). *Cell and tissue culture: Laboratory procedures in biotechnology*. John Wiley & Sons USA. 4. McNeil, B., & Harvey, L. M. (2008). *Practical fermentation technology*. John Wiley & Sons Ltd UK. 5. Joshi, V. K., & Singh, R. S. (2013). *Food biotechnology: Principles and practices*. I.K. International Publishing House Pvt. Ltd India. 6. Harisha, S. (2007). *Biotechnology procedures and experiments handbook*. Infinity Science Press LLC USA. 7. Nigam, A., & Ayyagari, A. (2008). *Lab manual in biochemistry, immunology and biotechnology*. Tata McGraw-Hill Publishing Company Limited India. 8. Sadashivam, S., & Manickam, A. (2008). *Biochemical methods* (3rd ed.). New Age International Publishers India.			
References/ Readings:	1. Hall, B. G. (2018). Methods in Microbial Genetics: Mutagenesis and Strain Improvement. *Microbial Biotechnology*, 11(3), 1012-1021.			

	2. Kumar, V., & Singh, B. (2017). Biodegradation of Pesticides by Microorganisms: Mechanisms and Applications. *Biodegradation*, 28(6), 347-363. 3. Altschul, S. F. (1990). Basic Local Alignment Search Tool. *Journal of Molecular Biology*, 215(3), 403-410. 4. Sambrook, J., & Russell, D. W. (2001). Molecular Cloning: A Laboratory Manual. Cold Spring Harbor Laboratory Press, USA. 5. Patel, R. (2016). Isolation and Characterization of Bacterial Plasmids for Cloning and Gene Expression. *Methods in Molecular Biology*, 1321, 35-44. 6. Patel, S., & Jain, R. (2018). Microbial Fermentation and Enzyme Production. *Biotechnology Advances*, 36(4), 101-115. 7. Zhang, Z., & Li, C. (2017). Advancements in Mushroom Cultivation and Solid-State Fermentation. *Journal of Applied Microbiology*, 123(3), 870-881. 8. Kumar, A., & Gupta, P. (2019). Plant Tissue Culture: An Overview of Techniques and Applications. *Plant Biotechnology Journal*, 18(6), 756-767. 9. Ramachandran, S., & Suman, S. (2020). Immobilization of Enzymes: Techniques and Applications in Biotechnology. *Journal of Biotechnology*, 301, 98-112. 10. Sao, A., Kumar, P., & Salam, J. (2006). *Practical manual: Principles of Biotechnology*. Indira Gandhi Krishi Vishwavidyalaya India.
Web Resources:	1. European Molecular Biology Laboratory. (n.d.). *EMBL homepage*. https://www.embl.org/ 2. National Center for Biotechnology Information. *NCBI homepage*. U.S. National Library of Medicine. https://www.ncbi.nlm.nih.gov/ 3. National Center for Biotechnology Information. *Entrez*. https://www.ncbi.nlm.nih.gov/Entrez/ 4. National Center for Biotechnology Information. *GenBank homepage*. https://www.ncbi.nlm.nih.gov/genbank/ 5. National Center for Biotechnology Information. *Nucleotide BLAST*. https://www.ncbi.nlm.nih.gov/ 6. RCSB Protein Data Bank. *PDB homepage*. https://www.rcsb.org/ 7. UniProt Consortium. *UniProt homepage*. https://www.uniprot.org/

Title of the Course	Normal and Clinical Nutrition
Course Code	FTC-5008
Number of Credits	3
Theory/Practical	Theory
Level	500
Effective from AY	2025-2026
New Course:	No
Bridge Course/ Value-added Course:	No
Course for advanced learners:	No

Pre-requisites for the Course:	Nil	
Course Objectives:	1. Define the principles of diet therapy, the scope of dietetics, and the role of a dietitian in various settings. 2. Describe nutrient requirements throughout the lifecycle and formulate appropriate dietary recommendations for different age groups and physiological conditions. 3. Apply diet therapy principles to assess, manage, and provide nutritional care for patients with a range of metabolic, endocrine, cardiovascular, gastrointestinal, renal, and oncological disorders. 4. Evaluate the nutritional needs of individuals with allergies, intolerances, and specific requirements related to sports, extreme environments, and the influence of nutrigenomics. 5. Formulate and evaluate specialised food products for diverse dietary needs and health conditions.	
Course Outcomes:	**On the completion of the course, the student will be able to:**	**Mapped to PSO**

	CO 1. Define the principles of diet therapy, the scope of dietetics, the role of a dietitian, and describe nutrient requirements throughout the lifecycle.			PSO 1
	CO 2. Recall and apply diet therapy principles to assess, manage, and provide nutritional care for patients with a range of metabolic, endocrine, cardiovascular, gastrointestinal, renal, and oncological disorders.			PSO 1
	CO 3. Analyse and evaluate the nutritional needs of individuals with allergies, intolerances, specific requirements related to sports, extreme environments, and the influence of nutrigenomics.			PSO 1
	CO 4. Evaluate the formulation of specialised food products, including infant formulas, enteral formulas, and sports supplements, for diverse dietary needs and health conditions.			PSO 1
	CO 5. Apply diet therapy principles in various settings, including progression of hospital diets and enteral and parenteral nutrition, and evaluate health metrics for diverse populations.			PSO 1
Content:	**Syllabus Content (45 hours)**	**No. of hours**	**Mapped to CO**	**Cognitive Level**
Module 1:	**Diet Therapy**			
	1.1 Introduction to Diet Therapy: Definition, Basic principles of nutritional care; Therapeutic adaptations of the normal diet, role of nutrition in health and disease prevention	1	CO 1	K1, K2
	1.2 Institutions for Dietetics: Indian Dietetic Association (IDA), National Institute of Nutrition (NIN); Scope of Dietetics and Responsibilities of a Dietitian	1	CO 1	K1, K2
	1.3 Progression of Hospital Diets: Need and rationale of Regular diet, Liquid diets (clear and full), Soft diet, Mechanical soft diet and Therapeutic diets	1	CO 1, CO 2	K1, K2, K3
	1.4 Enteral and Parenteral Nutrition: Indications and contraindications; Types of formulas, Feeding routes and methods; Monitoring and complications	1	CO 1, CO 2	K1, K2, K3
	1.5 Health Metrics: Definition and calculation of Basal Metabolic Rate (BMR), Resting Metabolic Rate (RMR), Total Daily Energy Expenditure (TDEE), Body Mass Index (BMI), Body Fat Percentage, Waist-to-Hip	1	CO 1, CO 2	K1, K2, K3

	Ratio (WHR), and Body Composition; Dietary indicators (RDA, AI, EAR, UL).			
Module 2:	**Nutrition Through the Life Cycle**			
	2.1 Nutrient Requirements during Infancy (0-12 months): Nutritional needs; Feeding methods (breastfeeding, formula feeding); Infant formulas and weaning foods, Industrial formulations.	2	CO 1, CO 4 CO 5	K1, K2, K4, K5, K6
	2.2 Nutrient Requirements of Pre-schoolers (1-5 years) and School children (6-12 years): Nutritional needs; Feeding guidelines and common feeding problems; Dietary guidelines and promoting healthy eating habits	1	CO 1, CO 5	K1, K2, K4, K5, K6
	2.3 Nutrient Requirements during Adolescence (13-19 years): Nutritional needs; Addressing growth spurts and nutritional needs; Impact of lifestyle and body image on food choices.	2	CO 1, CO 5	K1, K2, K4, K5, K6
	2.4 Nutrient Requirements during the Adults (20-64 years): Nutritional needs; Dietary guidelines for health maintenance and chronic disease prevention	1	CO 1, CO 5	K1, K2, K4, K5
	2.5 Nutrient Requirements during the Elderly (65+ years): Physiological changes and their impact on nutritional needs; Nutritional needs; Addressing age-related conditions and nutritional challenges	1	CO 1, CO 5	K1, K2, K4, K5
	2.6 Dietary Recommendations During Pregnancy and Lactation: Physiological changes during pregnancy; Changes in nutritional requirements; Dietary guidelines for each trimester; Nutritional needs during lactation; Dietary guidelines for breastfeeding mothers; Galactogogues.	2	CO 1, CO 5	K1, K2, K4, K5
	2.7 Nutritional Care of the Low Birth Weight and Pre-term Infant & Children with Special Needs: Definition and classification of low birth weight and preterm infants; Nutritional requirements and feeding strategies; Special industrial formulations.	1	CO 1, CO 5	K1, K2, K4, K5, K6
Module 3:	**Diet Therapy for Clinical Conditions**			

	3.1 Metabolic and Weight-Related Disorders: Overweight, Obesity, Underweight - definitions, causes, and impact on health; Nutritional Management strategies (diet, exercise, medical interventions); Nutritional strategies to gain a healthy weight	3	CO 2, CO 5	K1, K3, K4, K5, K6
	3.2 Endocrine and Hormonal Disorders: Pathophysiology, symptoms, prevention, impact on health and nutrition and nutritional care options for Polycystic Ovary Syndrome (PCOS), Polycystic Ovary Disease (PCOD), Hypothyroidism and Hyperthyroidism, symptoms, causes, and treatments, role of thyroid hormones in metabolism and overall health.	2	CO 2, CO 5	K1, K3, K4
	3.3 Diabetes: Pathophysiology, symptoms, prevention, impact on health and nutrition and nutritional care options for Type-1 and Type-2 Diabetes Mellitus, Gestational Diabetes and Diabetes Insipidus.	3	CO 2, CO 5	K1, K3, K4, K5
	3.4 Cardiovascular and Vascular Diseases: Pathophysiology, types, symptoms, prevention, impact on health and nutrition and nutritional care options for Hypertension and Atherosclerosis.	2	CO 2, CO 5	K1, K3, K4, K5
	3.5 Liver and Gallbladder Diseases: Pathophysiology, symptoms, prevention, impact on health and nutrition and nutritional care options for Hepatitis, Cirrhosis, End-Stage Liver Disease (ESLD), Gallstones and Cholecystitis.	2	CO 2, CO 5	K1, K3, K4
	3.6 Kidney and Renal Disorders: Pathophysiology, symptoms, prevention, impact on health and nutrition and nutritional care options for Glomerulonephritis, Nephrotic Syndrome, Urinary Calculi, End-Stage Renal Disease (ESRD).	2	CO 2, CO 5	K1, K3, K4, K5, K6
	3.7 Gastrointestinal Disorders: Pathophysiology, types, symptoms, prevention, impact on health and nutrition and nutritional care options for peptic ulcers, diarrhoea, constipation, irritable bowel syndrome (IBS) and Inflammatory Bowel Disease (IBD).	2	CO 2, CO 5	K1, K3, K4, K5
	3.8 Bone and Joint Disorders: Pathophysiology, symptoms, prevention, impact on health and nutrition and nutritional care options for	2	CO 2, CO 5	K1, K3, K4, K5, K6

	Osteoporosis and Osteoarthritis.			
	3.9 Cancer: Pathophysiology, symptoms, prevention, impact on health and nutrition and nutritional care options for common cancers (breast, lung, ovarian).	2	CO 2, CO 5	K1, K3, K4, K5
Module 4:	**Specialised Dietary Needs**			
	4.1 Allergies and Intolerances: Food Allergies - Definition, common allergens, and symptoms, Diagnosis and management of food allergies; Key differences between food allergies and intolerances; Common food intolerances (e.g., lactose intolerance, gluten sensitivity) and Nutritional care practices.	2	CO 3, CO 4	K4, K5, K6
	4.2 Sports and Performance Nutrition: Sports Nutrition - Importance of balanced nutrition for athletes, Macronutrient requirements, influence of meal timing and hydration on performance; Ergogenic Aids - definition and classification; Potential benefits and risks of commonly used performance-enhancing substances; Ethical considerations in sports and fitness, Commercial formulations.	2	CO 3, CO 4 CO 5	K3, K4, K5, K6
	4.3 Specialised Nutrition for Extreme Environments: Nutrition at High Altitudes - Key nutrients required for preventing altitude sickness and maintaining energy levels, Recommendations for hydration and food intake during high-altitude activities; Nutrition in Space - Unique challenges of space travel on human physiology; Nutritional needs for astronauts during long-term space missions, Introduction to space food technologies.	2	CO 3, CO 4 CO 5	K3, K4, K5, K6
	4.4 Nutrigenomics and Nutritional Research: Interaction of nutrition with genes, Potential of personalised nutrition based on genetic makeup, Current research and future applications in health and disease prevention; Overview of emerging global nutritional issues (e.g., malnutrition, obesity epidemic); Identifying key gaps in current nutritional research.	2	CO 3, CO 4	K3, K4, K5, K6
	4.5 Drug-Nutrient Interactions: Relevance, Importance, Effect on nutrient	2	CO 3, CO 4	K3, K4, K5,

	absorption, metabolism, and utilisation, Examples of common drug-nutrient interactions (medications for hypertension, diabetes); Identifying nutrient deficiencies related to drug use; Preventive measures and dietary recommendations to minimise deficiencies; Commercial formulations.			K6
Pedagogy:	Lectures, Seminars, Case Study Analysis, Problem-based Learning, Mock Debates, Use of ICT Tools			
Texts:	1. Ford, M. A. (1999). The formulation of sports drinks. In P. R. Ashurst (Ed.), *Production and Packaging of Non-Carbonated Fruit Juices and Fruit Beverages (*pp. 310–330). Springer US. https://doi.org/10.1007/978-1-4757-6296-9_12 2. Chakraborty, S., Paul, K., & Batabyal, A. N. (2024). Food formulation for sports persons. In *The Functional Foods*. Apple Academic Press. 3. Antia, F. P. & Abraham, P. (1998). *Clinical Dietetics and Nutrition*. Fourth Edition. OUP. India. 4. Mahan, L. K. & Escott-Stump, S. (2003). *Krause's Food, Nutrition and Diet Therapy: Evolve learning resources.* (11th ed.). Saunders, USA. 5. Srilakshmi, B. (2015). *Food Science* (6th ed.). New Age International Publishers Ltd., India. 6. Srilakshmi, B. (2005). *Dietetics* (5th ed.). New Age International Publishers Ltd., India.			
References/ Readings:	1. Weichselbaum, E., & Buttriss, J. L. (2014). Diet, nutrition and schoolchildren: An update. *Nutrition Bulletin, 39*(1), 9–73. https://doi.org/10.1111/nbu.12071 2. Kaur, D., Rasane, P., Singh, J., Kaur, S., Kumar, V., Mahato, D. K., Dey, A., Dhawan, K., & Kumar, S. (2019). Nutritional interventions for elderly and considerations for the development of geriatric foods. *Current Aging Science, 12*(1), 15–27. https://doi.org/10.2174/1874609812666190521110548 3. Sievenpiper, J. L., & Dworatzek, P. D. N. (2013). Food and dietary pattern-based recommendations: An emerging approach to clinical practice guidelines for nutrition therapy in diabetes. *Canadian Journal of Diabetes, 37*(1), 51–57. https://doi.org/10.1016/j.jcjd.2012.11.001 4. Jackson, A. A., & Robinson, S. M. (2001). Dietary guidelines for pregnancy: A review of current evidence. *Public Health Nutrition, 4(*2b), 625–630. https://doi.org/10.1079/PHN2001146 5. Caligiuri, S. P. B., & Pierce, G. N. (2017). A review of the relative efficacy of dietary, nutritional supplements, lifestyle, and drug therapies in the management of hypertension. *Critical Reviews in Food Science and Nutrition, 57*(16), 3508–3527. https://doi.org/10.1080/10408398.2016.1142420 6. Wiechert, M., & Holzapfel, C. (2021). Nutrition concepts for the treatment of obesity in adults. *Nutrients, 14*(1),			

	169. https://doi.org/10.3390/nu14010169 7. Åkesson, B., Önning, G., Månsson, H. L., & Nilsson, Å. (2004). Nutrigenomics: New tools for nutritional science. *Scandinavian Journal of Nutrition*, *48*(2), 95–97. https://doi.org/10.1080/11026480410027013
Web Resources:	1. IFCT recipe calculator. (n.d.). Retrieved from https://ifctrecipecal.netlify.app/ 2. *NSR-nutrition support resource – providing resources in support of nutrition*. (n.d.). Retrieved from https://nsr.care/ 3. ICMR-National Institute of Nutrition, India. (n.d.). Retrieved from https://www.nin.res.in/achievements.html 4. Indian Food Composition Tables. https://www.nin.res.in/ebooks/IFCT2017.pdf

Title of the Course	Lab in Normal and Clinical Nutrition
Course Code	FTC-5009
Number of Credits	2
Theory/Practical	Practical
Level	500
Effective from AY	2025-2026
New Course:	No
Bridge Course/ Value-added Course	No
Course for advanced learners	No

Pre-requisites for the Course:	Nil	
Course Objectives:	1. To develop proficiency in applying nutritional assessment techniques, including the estimation of health metrics and the analysis of macronutrient and micronutrient content in foods. 2. To equip students with the ability to plan and adapt balanced diets for individuals based on the Recommended Dietary Allowances (RDAs) and dietary guidelines. 3. To cultivate the skill of modifying standard meal plans to address common health conditions and complex diseases. 4. To foster innovation in developing specialized nutritional formulations.	
Course Outcomes:	**On the completion of the course, the student will be able to:**	**Mapped to PSO**
	CO 1. Recall key health metrics, food sources of macro- and micronutrients, and the basic elements of diet planning, and apply this knowledge to calculate and interpret health metrics in various	PSO 1

	scenarios.			
	CO 2. Explain the application of RDAs, food exchange lists, and Indian Food Composition Tables in diet planning; apply these tools to develop meal plans for diverse populations.			PSO 1
	CO 3. Design and execute diet-specific recipes and meal plans for various populations; analyse standard diet plans for the management of common conditions and chronic diseases.			PSO 1
	CO 4. Analyse standard diet plans for the management of various conditions and evaluate the appropriateness of dietary interventions.			PSO 1
	CO 5. Develop novel, evidence-based recipes and formulas for specialised populations.			PSO 1, PSO 5
Content:	**Syllabus Content (60 hours)**	**No. of hours**	**Mapped to CO**	**Cognitive Level**
	1. Estimation and calculation of Health Metrics.	4	CO 1	K1, K3
	2. Survey of foods rich in macro and micronutrients.	2	CO 1	K1, K3
	3. Basic elements of diet planning.	2	CO 1	K1, K3
	4. RDA and Food Exchange Lists in Diet Planning.	2	CO 2	K2, K3
	5. Indian Food Composition Tables (IFCT) quantification of Nutrient Value.	2	CO 2	K2, K5
	6. Diet-specific recipe planning and execution.	4	CO 3	K4, K6
	7. Meal plan for preschoolers and school children.	4	CO 3, CO 5	K3, K5, K6
	8. Development of healthy snacks for adolescents and adults.	4	CO 3, CO 5	K3, K5, K6
	9. Diet plan for pregnant and lactating women.	4	CO 3, CO 5	K3, K5, K6
	10. Diet plan for geriatric adults.	2	CO 3, CO 5	K3, K5, K6
	11. Modified meal plans for fatigue, fever, constipation and diarrhoea.	4	CO 3, CO 5	K3, K5, K6
	12. Modified meal plans for weight management of obese individuals.	2	CO 3, CO 5	K3, K5, K6
	13. Analysis of standard diet plans for management of Type-2 Diabetes	2	CO 1, CO 4	K3, K4, K5

	Mellitus.			
	14. Analysis of standard diet plans for management of Hypertension and Coronary Heart Disease.	4	CO 1, CO 4	K3, K4, K5, K6
	15. Analysis of standard diet plans for management of Irritable Bowel Syndrome (IBS) and Inflammatory Bowel Disease (IBD).	4	CO 1, CO 4	K3, K4, K5, K6
	16. Analysis of standard diet plans for management of Hepatitis and Cirrhosis.	2	CO 1, CO 4	K3, K4, K5
	17. Analysis of standard diet plans for management of Glomerulonephritis and Urinary Calculi.	4	CO 1, CO 4	K3, K4, K5
	18. Development of specialised formula for sports persons.	4	CO 3, CO 5	K3, K5, K6
	19. Development of a Ready-to-Use Therapeutic Food (RUTF) Formulation for Malnutrition.	4	CO 3, CO 5	K3, K5, K6
Pedagogy:	Hands-on experiments, Case Studies and Problem-Based Learning, and Collaborative Learning			
Texts:	1. Chakraborty, S., Paul, K., & Batabyal, A. N. (2024). Food formulation for sports persons. In *The Functional Foods*. Apple Academic Press USA. 2. Antia, F. P. & Abraham, P. (1998). *Clinical Dietetics and Nutrition*. Fourth Edition. OUP. India. 3. Mahan, L. K. & Escott-Stump, S. (2003). *Krause's Food, Nutrition and Diet Therapy: Evolve learning resources.* (11th ed.). Saunders USA. 4. Macrae, R., Robinson, R. K., & Sadler, M. J. (Eds.). (1993). *Encyclopaedia of Food Science, Food Technology and Nutrition*. Academic Press UK. 5. Williams, S. R. (1990). *Essentials of Nutrition and Diet Therapy*. Mosby College Publishing USA. 6. Nelms, M., Roth, S. L., & Sucher, K. P. (2016). *Medical Nutrition Therapy: A Case-study Approach* (5th ed.). Cengage Learning USA. 7. Katz, D. L., Yeh, M.-C., Levitt, J., Essel, K. D., Joshi, S., & Friedman, R. S. C. (2022). *Nutrition in Clinical Practice* (4th ed.). Wolters Kluwer, USA 8. Escott-Stump, S. (2022). *Nutrition and Diagnosis-related Care* (9th ed.). Academy of Nutrition and Dietetics, USA			
References/	1. Hadi, S., Amani, R., Tehrani, M. M., Hadi, V., Hejri, S., & Askari, G. (2022). Ready-to-use therapeutic food (Rutf)			

Readings:	formulations with functional food and nutrient density for the treatment of malnutrition in crisis. *International Journal of Preventive Medicine, 13*, 16. https://doi.org/10.4103/ijpvm.IJPVM_304_20 2. Zhumabayev, U., Kydyralieva, M., Ospanova, E., Naimanbayeva, R., & Duysembayeva, B. (2022). Specialized food product for diabetic diet "Inullact-Fito." *Food Science and Technology, 42*, e07621. https://doi.org/10.1590/fst.07621 3. Theba, T., Nayi, P., & Ravani, A. (2024). Beetroot-based blended juice: Process development, physico-chemical analysis and optimisation of novel health drink. *Food Chemistry Advances, 4*, 100607. https://doi.org/10.1016/j.focha.2024.100607 4. Ramaswamy, L., & Fathima, F. Z. (2017). Formulation and acceptability of sports drinks using fruit juices and tender coconut water. *CORD, 33*(1), 62–68. https://doi.org/10.37833/cord.v33i1.55 5. Indian Council of Medical Research. (2011). *Nutrient Requirements and Recommended Dietary Allowances for Indians*. ICMR. 6. Cena, H., & Calder, P. C. (2020). Defining a healthy diet: Evidence for the role of contemporary dietary patterns in health and disease. *Nutrients, 12*(2), Article 334. https://doi.org/10.3390/nu12020334
Web Resources:	1. IFCT recipe calculator. (n.d.). Retrieved from https://ifctrecipecal.netlify.app/ 2. *NSR-nutrition support resource – providing resources in support of nutrition*. (n.d.). Retrieved from https://nsr.care/ 3. ICMR-National Institute of Nutrition, India. (n.d.). Retrieved from https://www.nin.res.in/achievements.html 4. Indian Food Composition Tables. https://www.nin.res.in/ebooks/IFCT2017.pdf

Title of the Course	Bakery, Confectionery, and Convenience Food Technology
Course Code	FTC-5010
Number of Credits	3
Theory/Practical	Theory
Level	500
Effective from AY	2025-2026
New Course	No
Bridge Course/ Value-added Course	No
Course for advanced learners:	No

Pre-requisites for the Course:	Nil	
Course Objectives:	1. Understand the principles and raw materials involved in the manufacture of bakery and confectionery products. 2. Describe the technologies used in producing a range of bakery and confectionery products, including dough- and batter-based systems, icings, fillings, and Indian traditional sweets. 3. Evaluate the quality, sensory characteristics, and nutrient retention in bakery and confectionery items. 4. Identify the equipment and practices necessary for hygienic and efficient production as well as create protocols for sanitation and HACCP in bakery and confectionery units.	
Course Outcomes:	**On the completion of the course, the student will be able to:**	**Mapped to PSO**
	CO 1. Recollect the principles, raw material, types, and manufacturing processes of various bakery, confectionery, and convenience foods	PSO 1

	CO 2. Summarise the role of ingredients in the manufacture of bakery, confectionery, and convenience foods			PSO 1
	CO 3. Evaluate quality parameters and nutritional value of bakery, confectionery, and convenience foods			PSO 1
	CO 4. Assess the selection of equipment in the manufacture of bakery, confectionery, and convenience products.			PSO 1
	CO 5. Describe the key features and success factors of startups through case studies, devise protocols for maintenance of hygiene and create HACCP charts			PSO 1, PSO 2
Content:	**Syllabus Content (45 hours)**	**No. of hours**	**Mapped to CO**	**Cognitive Level**
Module 1:	**Bakery Technology**			
	1.1 Principles of baking: Ingredient functionality, Dough/Batter development, leavening, fermentation and proofing, baking, cooling, and storage	2	CO 1	K1, K2
	1.2 Raw materials and their role: Flour, leavening agents, sweeteners, fats, additives, flavouring agents.	2	CO 1, CO 2	K1, K2
	1.3 Industrial Manufacture of Bakery Products: Ingredients, Manufacturing process, and packaging of dough, batters, cakes, pies, pastries, bread, biscuits; Identification of critical control points.	4	CO 1	K1, K2
	1.4 Icings and Fillings: Types, raw materials, processing and stability.	1	CO 1, CO 2	K1, K2
	1.5 Quality Parameters of Bakery Products: Chemistry of dough and batters; rheological testing and interpretation of data; sensory evaluation; staling and nutrient losses.	2	CO 3	K5
	1.6 Equipment used in the Bakery Industry: ovens, mixers, proofers, and dough handling tools (dividers and rounders)	2	CO 4	K4, K5
	1.7 Packaging of Baked products: Packaging technologies involved;	1	CO 1, CO 4	K1, K4, K5

	Compatible packaging material.			
	1.8 Laws and Regulations: Overview of FSSAI Food Product Category 06-Bakery wares; Sanitation and Hygiene in a Bakery Unit; Management of common spoilage organisms.	1	CO 5	K2, K3, K6
Module 2:	**Confectionery Technology**			
	2.1 Confectionery Manufacture: Industry overview and principles	1	CO 1	K1, K2
	2.2 Raw materials and their role: Interfering Agents and Inversion of Sugars	1	CO 2	K2, K3
	2.3 Confectionery Products and Technology for their manufacture: raw material, types, and manufacture of sugar, chocolate, chewing gum and Lozenges	4	CO 1, CO 3 CO 4	K1, K4, K5
	2.4 Pan Coating: Hard and soft panning; problems in coating; glazing, polishing, and tableting	1	CO 4	K4, K5
	2.5 Quality parameters of confectionery products: Nutrient and other losses	1	CO 3	K5
	2.6 Equipment used in the Confectionery Industry: mixers, ovens, cookers, depositors, moulding machines, and packaging machines	1	CO 4, CO 5	K2, K3, K4, K5
	2.7 Manufacture of Indian Confectioneries: Milk-based, cereal-based, dry fruit and nut-based, and Fruit and vegetable-based.	3	CO 2, CO 4	K2, K4, K5
	2.8 Packaging of Confectionery: Packaging technologies involved; Compatible packaging material.	1	CO 1, CO 4	K1, K4, K5
	2.9 Laws and Regulations: Overview of FSSAI Food Product Categories 05-Confectionery; 11-Sweeteners; and 18-Indian Sweets and Indian Snacks & Savouries products; Sanitation and Hygiene in a Confectionery Unit	2	CO 4, CO 5	K2, K3
Module 3:	**Convenience Food Technology**			
	3.1 Introduction to Convenience Foods: Definition, classification, and importance; Historical development and market trends; Consumer behaviour and lifestyle impact	1	CO 1	K1, K2

	3.2 Categories: Definition, use, shelf-life and examples of RTE, RTC, RTS, dehydrated, frozen, canned, and instant mixes	1	CO 1	K1, K2
	3.3 Raw materials and their role: Ingredients, stabilizers, emulsifiers, preservatives, flavour enhancers	2	CO 2	K2
	3.4 Processing Techniques: Thermal processing (blanching, cooking, baking, sterilization); non-thermal methods (freeze-drying, vacuum drying, microwave processing); Applications in the manufacture of convenience foods; Impact on the sensory and nutritional quality.	3	CO 1, CO 4	K1, K4, K5
	3.5 Industrial Manufacture of Convenience Foods: Ingredients, Manufacturing process, and packaging of instant soup, dips, premixes for gravy, spreads; Identification of critical control points.	2	CO 1, CO 4	K1, K4, K5
	3.6 Packaging technologies: MAP, vacuum packaging, retort packaging; Automation and smart processing; Compatible packaging material.	2	CO 1, CO 4	K1, K4, K5
	3.7 Specialized and Emerging Convenience Foods: Functional and Fortified snack foods, desserts, and beverages; foods per dietary needs (gluten-free, vegan, keto snacks).	2	CO 1	K3, K4, K5
	3.8 Laws and Regulations: Overview of FSSAI Food Product Categories 12.5-Soups and broths and 15-Ready-to-eat savouries; Sanitation and hygiene in a convenience food manufacturing unit	2	CO 4, CO 5	K2, K3
Pedagogy:	Lectures, Seminars, Case Study Analysis, Problem-based Learning, Mock Debates, Use of ICT Tools			
Texts:	1. Dubey, S. C. (2002). *Basic Baking*. The Society of Indian Bakers, India. 2. Francis, F. J. (2000). *Wiley Encyclopedia of Food Science & Technology*. John Wiley & Sons USA. 3. Manley, D. (2000). *Technology of Biscuits, Crackers & Cookies* (2nd ed.). CRC Press USA. 4. Qarooni, J. (1996). *Flat Bread Technology*. Chapman & Hall Germany. 5. Hartel, R. W., von Elbe, J. H., & Hofberger, R. (2017). *Confectionery Science and Technology*. Springer Germany. 6. Matz, S. A. (1960). *Bakery Technology & Engineering*. AVI Publishing Company Germany. 1. Fance, W. J., & Wragg, B. H. (1968). *Up-to-date Bread Making*. Maclaren & Sons Ltd UK.			

References/ Readings:	1. Barišić, V., Kopjar, M., Jozinović, A., Flanjak, I., Ačkar, Đ., Miličević, B., Šubarić, D., Jokić, S., & Babić, J. (2019). The Chemistry behind Chocolate Production. *Molecules (Basel, Switzerland)*, *24*(17), 3163. https://doi.org/10.3390/molecules24173163 2. Osman, I., Osman, S., Mokhtar, I., Setapa, F., Shukor, S. A. M., & Temyati, Z. (2014). Family food consumption: Desire towards convenient food products. *Procedia - Social and Behavioral Sciences*, *121*, 223–231. https://doi.org/10.1016/j.sbspro.2014.01.1123 3. Wirkijowska, A., Zarzycki, P., & Pankiewicz, U. (Eds.). (2025). *Functional bakery products: Technological, chemical and nutritional modification*. MDPI. https://doi.org/10.3390/books978-3-7258-3192-0 4. Cappelli, A., Lupori, L., & Cini, E. (2021). Baking technology: A systematic review of machines and plants and their effect on final products, including improvement strategies. *Trends in Food Science & Technology*, *115*, 275–284. https://doi.org/10.1016/j.tifs.2021.06.009 5. Mayank, Kumar, J., & Singh, A. K. (2023). A review of food ordering apps: Enhancing convenience and culinary experiences. *Journal of Advanced Research in Production and Industrial Engineering*, *10*(1), Article 1764. https://doi.org/10.5281/zenodo.10854577 6. Efe, N., & Dawson, P. (2022). A review: Sugar-based confectionery and the importance of ingredients. *European Journal of Agriculture and Food Sciences*, *4*(5), 1–8. https://doi.org/10.24018/ejfood.2022.4.5.552
Web Resources:	1. Ministry of Food Processing Industries (MoFPI), https://www.mofpi.gov.in/ 2. National Institute of Food Technology, Entrepreneurship and Management, Thanjavur (NIFTEM-T), https://niftem-t.ac.in/ 3. Institute of Food Technologists, https://www.ift.org/ 4. CSIR - Central Food Technological Research Institute, https://cftri.res.in/

Title of the Course	Lab in Bakery, Confectionery and Convenience Food Technology
Course Code	FTC-5011
Number of Credits	1
Theory/Practical	Practical
Level	500
Effective from AY	2025-2026
New Course:	No
Bridge Course/ Value-added Course:	No
Course for advanced learners:	No

Pre-requisites for the Course:	Nil	
Course Objectives:	1. To introduce students to the rheological testing methods used for evaluating dough properties. 2. To develop practical skills in the preparation and quality evaluation of basic bakery products with a focus on understanding the effects of processing parameters on final product quality. 3. To train students in the production and assessment of advanced bakery products, including pastries and croissants, focusing on their sensory and nutritional characteristics. 4. To impart knowledge and hands-on experience in preparing filled and iced cakes, chocolates and coated confectionery products with emphasis on quality control, nutritional analysis, and aesthetic presentation.	
Course Outcomes:	**On the completion of the course, the student will be able to:**	**Mapped to PSO**
	CO 1. Understand fundamentals of baking set-up and interpret the rheological properties of dough	PSO 1, PSO 4

	using instruments such as the farinograph, extensigraph, mixograph, and alveograph.			
	CO 2. Demonstrate skills in preparation of a variety of bakery, confectionery, and convenience food products			PSO 1
	CO 3. Perform quality evaluation and sensory analysis of various bakery, confectionery, and convenience food products.			PSO 1
	CO 4. Calculate the nutritional values of baked, confectionery, and convenience food products using data from the Indian Food Composition Table (IFCT)			PSO 1
	CO 5. Formulate, evaluate, and develop novel baked, confectionery, or convenience food products.			PSO 1, PSO 5
Content:	**Syllabus Content (30 hours)**	**No. of hours**	**Mapped to CO**	**Cognitive Level**
	1. Essentials of Bakery set-up: Core Ingredients, Storage Solutions, and Equipment Needs	2	CO 1	K2, K3, K4
	2. Tests for the Rheological Properties of Dough – interpretation of farinograph, extensigraph, mixograph, and alveograph	2	CO 1	K2, K3, K4
	3. Preparation and sensory evaluation of Sourdough Bread and Doughnuts: Effect of processing parameters on product quality	4	CO 2, CO 3	K3, K4, K5
	4. Preparation and sensory evaluation of biscuits and cookies: Effect of processing parameters on product quality	2	CO 2, CO 3	K3, K4, K5
	5. Preparation, quality evaluation and sensory evaluation of advanced bakery products: pastries and croissants	4	CO 2, CO 3	K3, K4, K5
	6. Preparation, quality evaluation, and sensory analysis of Filled and Iced Cakes	4	CO 2, CO 3	K3, K4, K5
	7. Preparation, quality evaluation, and sensory analysis of dark, milk, and white Chocolate	2	CO 2, CO 3	K3, K4, K5
	8. Preparation, quality evaluation, and sensory analysis of Coated Confectionery	2	CO 2, CO 3	K3, K4, K5

	9. Preparation and reconstitution of instant mixes (soup/cake).	2	CO 2	K3
	10. Estimation of nutritional values of baked, confectionery, and convenience food products using Indian Food Composition Tables (IFCT).	2	CO 4	K3
	11. Development and evaluation of novel Bakery/Confectionery/Convenience Food Product with Enhanced Nutritional/Sensory Attributes	4	CO 5	K4, K5, K6
Pedagogy:	Lectures, Seminars, Case Study Analysis, Problem-based Learning, Mock Debates, Use of ICT Tools			
Texts:	1. Dubey, S. C. (2002). *Basic Baking*. The Society of Indian Bakers, India. 2. Francis, F. J. (2000). *Wiley Encyclopedia of Food Science & Technology*. John Wiley & Sons USA. 3. Manley, D. (2000). *Technology of Biscuits, Crackers & Cookies* (2nd ed.). CRC Press USA. 4. Hartel, R. W., von Elbe, J. H., & Hofberger, R. (2017). *Confectionery Science and Technology*. Springer Germany. 5. Pomeranz, Y., & Meloan, C. E. (1971). *Food analysis: Theory and Practice*. AVI Publishing Company, Inc. 7. Cauvain, S. P., & Young, L. S. (2005). *Technology of Breadmaking* (2nd ed.). Aspen Publishers, USA.			
References/ Readings:	1. Barišić, V., Kopjar, M., Jozinović, A., Flanjak, I., Ačkar, Đ., Miličević, B., Šubarić, D., Jokić, S., & Babić, J. (2019). The Chemistry behind Chocolate Production. *Molecules (Basel, Switzerland)*, *24*(17), 3163. https://doi.org/10.3390/molecules24173163 2. Guiné, R. P. F. (2022). Textural properties of bakery products: A review of instrumental and sensory evaluation studies. *Applied Sciences*, *12*(17), 8628. https://doi.org/10.3390/app12178628 3. Osman, I., Osman, S., Mokhtar, I., Setapa, F., Shukor, S. A. M., & Temyati, Z. (2014). Family food consumption: Desire towards convenient food products. *Procedia - Social and Behavioral Sciences*, *121*, 223–231. https://doi.org/10.1016/j.sbspro.2014.01.1123 4. Manley, D. (1998). *Biscuit, Cookie and Cracker manufacturing manuals: Manual 2: Biscuit doughs*. Woodhead Publishing UK. 5. Matz, S. A. (1991). *Bakery Technology and Engineering* (3rd ed.). Springer Germany. 6. Mathuravalli, S. M. D. (2022). *Handbook of Bakery and Confectionery* (1st ed.). CRC Press USA.			
Web Resources:	1. Indian Food Composition Tables. https://www.nin.res.in/ebooks/IFCT2017.pdf			

	2. IFCT recipe calculator. (n.d.). Retrieved from https://ifctrecipecal.netlify.app/ 3. Engineering research Institute https://www.eiriindia.org/ 4. CSIR - Central Food Technological Research Institute, https://cftri.res.in/

Title of the Course	Food Engineering Principles and Applications
Course Code	FTC-5012
Number of Credits	2
Theory/Practical	Theory
Level	500
Effective from AY	2025-2026
New Course:	No
Bridge Course/ Value-added Course:	No
Course for advanced learners:	No

Pre-requisites for the Course:	Nil	
Course Objectives:	1. To introduce students to the fundamental principles of thermodynamics and heat transfer, and enable them to understand their applications in thermal food processing and equipment design. 2. To develop a thorough understanding of the rheological properties of food materials, including fluid flow behavior, measurement techniques, and equipment used for handling and processing food fluids. 3. To impart knowledge of refrigeration and freezing technologies, emphasizing food preservation and quality. 4. To familiarize students with key mechanical operations in food processing and their underlying principles and industrial applications.	
Course Outcomes:	**On the completion of the course, the student will be able to:**	**Mapped to PSO**
	CO 1. Recall the fundamental principles of thermodynamics, rheology, refrigeration, and mechanical	PSO 1

	operations			
	CO 2. Explain the basic principles of food engineering related to unit operations in food processing and preservation.			PSO 1, PSO 6
	CO 3. Apply theoretical knowledge of heat transfer, fluid dynamics, freezing behaviour, and size reduction to select appropriate equipment for different types of foods.			PSO 1
	CO 4. Apply the principles of food engineering to describe and compare food processing systems.			PSO 1
	CO 5. Evaluate the influence of physical and mechanical properties of food materials on processing outcomes such as texture, shelf life, and energy efficiency.			PSO 1
Content:	**Syllabus Content (30 hours)**	**No. of hours**	**Mapped to CO**	**Cognitive Level**
Module 1:	**Thermodynamics and Heat Transfer**			
	1.1 Fundamentals of Thermodynamics: Basic concepts: system, surroundings, properties, state, process, Zeroth Law of Thermodynamics and temperature measurement, First Law of Thermodynamics for closed and open systems, Second Law of Thermodynamics and Entropy, Third Law of Thermodynamics.	2	CO 1	K1, K2, K3
	1.2 Fundamentals of Heat Transfer: Modes of heat transfer: conduction, convection, radiation, Fourier's law, thermal conductivity, Stefan-Boltzmann law, blackbody radiation, emissivity	2	CO 1, CO 2	K1, K2
	1.3 Steady and Unsteady State Heat Transfer: Types and applications; Role in Heat Exchangers.	1	CO 2	K2
	1.4 Microwave Heating: Principle, equipment design, and applications in the food industry	1	CO 1, CO 2 CO 3	K1, K2, K3, K4
	1.5 Application of thermodynamic principles to equipment used in the food industry.	1	CO 3, CO 4 CO 5	K2, K3, K4
Module 2:	**Rheology of Foods**			

	2.1 Rheology: Introduction, Classification of rheological behavior - elastic, viscous, viscoelastic	1	CO 1	K1, K2, K3
	2.2 Newton's Law of Viscosity, Types of fluids: Newtonian and non-Newtonian	1	CO 1, CO 2	K1, K2
	2.3 Basic Equations: Fluid Flow, Hagen Poiseille Equation, Bernoulli's Equation	1	CO 1, CO 2	K1, K2
	2.4 Measurement Techniques and Instruments: Capillary viscometers, Rotational viscometers and rheometers, Texture analyzers and their probes, Flow-Measuring Devices and Flow Rate Calculations	2	CO 3	K3, K4
	2.5 Handling of Fluids, Pipe Fittings and Valves, Pumps: Classification, Centrifugal and Positive Displacement Type, Peristaltic	1	CO 3, CO 4	K2, K3, K4
	2.6 Applications of Rheology: Role in food design and processing, Case studies: yogurt, sauces, bakery dough, gels, beverages	2	CO 5	K4
Module 3:	**Refrigeration and Freezing**			
	3.1 Refrigeration: Introduction and its role in food preservation and processing, Thermodynamic principles of refrigeration, Units of refrigeration, COP, and refrigeration load (tons, kilowatts, CFM, and related terminology)	1	CO 1, C 2	K1, K2
	3.2 Refrigeration Systems and Components: compressor, condenser, expansion valve, evaporator, Refrigeration cycle	2	CO 1, CO 2	K1, K2
	3.3 Refrigerants: types, properties, selection criteria, and environmental considerations	1	CO 1, CO 2 CO 3	K1, K2, K3, K4
	3.4 Freezing: Stages of freezing, freezing time, Effects of slow and fast freezing,	1	CO 1, CO 2 CO 3	K1, K2, K3, K4
	3.5 Freezing Techniques: Classification of freezing methods - air blast, plate, immersion, cryogenic, fluidized bed freezing; Comparison of freezing techniques for different food types	1	CO 3, CO 4 CO 5	K2, K3, K4

	3.6 Freeze Drying: Process and Food Applications	1	CO 1, CO 2 CO 3, CO 4 CO 5	K1, K2, K3, K4
Module 4:	**Mechanical Operations in Food Processing**			
	4.1 Size Reduction: Principles of size reduction: cutting, crushing, grinding, milling; Energy requirements: Kick's, Rittinger's, and Bond's laws; Size reduction equipment: hammer mill, ball mill, roller mill, slicers, dicers, cutters; Applications in cereals, spices, meat, and vegetables	3	CO 1, CO 2 CO 3, CO 4	K1, K2, K3, K4
	4.2 Mixing and Emulsification: Types of mixing: solid-solid, liquid-liquid, solid-liquid; Mixing mechanisms and equipment: ribbon blenders, paddle mixers, planetary mixers; Emulsification: principles, types of emulsions, homogenizers	3	CO 1, CO 2 CO 3, CO 4 CO 5	K1, K2, K3, K4
	4.3 Separation and Classification: Screening, sifting, sieving; Filtration: principles and types – pressure, vacuum, rotary drum, membrane; Centrifugation: working principle, types, and food applications; Sedimentation and floatation	2	CO 1, CO 2 CO 3, CO 4	K1, K2, K3, K4
Pedagogy:	Lectures, Seminars, Case Study Analysis, Problem-based Learning, Mock Debates, Use of ICT Tools			
Texts:	1. Badger, W. L., & Banchero, J. T. (1955). *Introduction to Chemical Engineering*. McGraw-Hill. 2. Batty, J.C. and Folkman, S.L. (1983). *Food Engineering Fundamentals.* John Wiley and Sons, New York. 3. Foust, A. S., Wenzel, L. A., Clump, C. W., Maus, L., & Andersen, L. B. (1980). *Principles of Unit Operations* (2nd ed.). John Wiley & Sons, New York. 4. Gustavo, V. B-C., & Ibarz, A. (2002). *Unit Operations in Food Engineering*: CRC Press, USA. 5. Rao, D. G. (2009). *Fundamentals of Food Engineering*. PHI Learning, India. 6. Sharma, K., Mulvaney, S. J., & Rizvi, S. S. H. (2012). *Food process engineering: Theory and Laboratory Experiments*. Wiley-India. 7. Saravacos, G. D., & Maroulis, Z. B. (2011). *Food Process Engineering Operations*: CRC Press, Boca raton 8. Toledo, R. T. (2000). *Fundamentals of Food Process Engineering* (2nd ed.). Springer Boston.			

References/ Readings:	1. Tan, C., & McClements, D. J. (2021). Application of Advanced Emulsion Technology in the Food Industry: A Review and Critical Evaluation. *Foods*, *10*(4), 812. https://doi.org/10.3390/foods10040812 2. Bhatta, S., Stevanovic Janezic, T., & Ratti, C. (2020). Freeze-Drying of Plant-Based Foods. *Foods*, *9*(1), 87. https://doi.org/10.3390/foods9010087 3. Cheng, K. C. (1992). Historical development of the theory of heat and thermodynamics: Review and some observations. *Heat Transfer Engineering*, *13*(3), 19–37. https://doi.org/10.1080/01457639208939779 4. Tian, Z., Lee, S., & Chen, G. (2014). A comprehensive review of heat transfer in thermoelectric materials and devices. *arXiv*. https://arxiv.org/abs/1401.0749 5. Ahmed, J., Ptaszek, P., & Basu, S. (2016). *Food Rheology: Scientific Development and Importance to Food Industry*. In *Advances in Food Rheology and Its Applications* (pp. 1–24). Elsevier. https://doi.org/10.1016/B978-0-12-804658-5.00001-1 6. Abera, M. (2020). *Mechanical unit operations in food engineering*. Academia.edu. https://www.academia.edu/45686172/Mechanical_Unit_Operations_in_Food_Engineering
Web Resources:	1. The New Zealand Institute of Food Science Technology Inc https://nzifst.org.nz/ 2. SciMed (supplier of scientific instrumentation in the UK and Ireland). https://www.scimed.co.uk/education/ 3. National Institute of Food Technology, Entrepreneurship and Management, Thanjavur (NIFTEM-T), https://niftem-t.ac.in/ 4. Institute of Food Technologists, https://www.ift.org/ 5. CSIR - Central Food Technological Research Institute, https://cftri.res.in/

Discipline Specific Elective Courses

Title of the Course	Spice and Plantation Crop Technology
Course Code	FTC-5205
Number of Credits	3
Theory/Practical	Theory
Level	400
Effective from AY	2025-2026
New Course	No
Bridge Course/ Value-added Course	No
Course for advanced learners	No

Pre-requisites for the Course:	Nil	
Course Objectives:	1. To introduce the classification, cultivation, and post-harvest processing techniques of key plantation crops, including coffee, tea, cocoa, coconut, and cashew. 2. To familiarise students with the production, processing, and chemical composition of major spices and their functional and nutritional roles in food systems. 3. To enable learners to apply post-harvest technologies, extraction techniques, and biotechnological methods in the production and enhancement of spice and flavour products. 4. To develop a critical understanding of quality standards, adulteration detection, and regulatory requirements in the spice and condiment industry, and explore the uses, processing, and functional benefits of seasonings, herbs, and condiments in culinary applications.	
Course Outcomes:	**On the completion of the course, the student will be able to:**	**Mapped to**

				PSO
	CO 1. Recall and classify major plantation crops (coffee, tea, cocoa, coconut, cashew) based on their chemical composition, post-harvest practices, and processing methods.			PSO 1
	CO 2. Analyse the chemical constituents, processing technologies, and functional properties of key spices and their roles in food systems and health.			PSO 1
	CO 3. Apply post-harvest, extraction, and biotechnological techniques in the production of spice-based products such as oils, oleoresins, and flavor concentrates.			PSO 1
	CO 4. Evaluate quality parameters, adulteration issues, and national food safety standards related to plantation crops, spices, and condiments.			PSO 1, PSO 2
	CO 5. Differentiate and assess the origin, composition, uses, and packaging requirements of culinary herbs, seasonings, and condiments in food product applications.			PSO 1
Content:	**Syllabus Content (45 hours)**	**No. of hours**	**Mapped to CO**	**Cognitive Level**
Module 1:	**Plantation Crops**			
	1.1 Plantation Crops: Definition and Classification	1	CO 1	K1, K2
	1.2 Coffee: Chemical Composition of Coffee Beans; Harvesting Techniques and Post-Harvest Handling; Bean Processing Methods (Wet and Dry); Types and Varieties of Coffee (e.g., Arabica, Robusta, Liberica); Manufacturing Processes of Coffee Products; Quality Assessment and Grading Systems for Coffee; Chicory Chemical Properties and its Use in Coffee Blends, Quality evaluation.	2	CO 1, CO 2 CO 4	KI, K2, K3, K5
	1.3 Tea: Chemical Composition of Tea Leaves; Harvesting Practices and Leaf Selection; Leaf Processing Techniques; Types and Varieties of Tea (Black, Green, White, Oolong); Manufacturing Processes of Tea Products; Quality Evaluation and Grading Standards for Tea, Quality evaluation.	2	CO 1, CO 2 CO 4	KI, K2, K3, K5
	1.4 Cocoa: Global Cocoa Production and Distribution; Chemical Composition of Cocoa Beans, Grading Systems for Cocoa Beans; Processing of Cocoa	2	CO 1, CO 2 CO 4	KI, K2, K3, K5

	Beans (Fermentation, Drying, Roasting); Cocoa Products (Cocoa Mass Liquor, Cocoa Powder, Cocoa Butter, Cocoa-based Beverages, Malted Beverages with Cocoa), Quality evaluation.			
	1.5 Coconut: Global Coconut Production and Distribution; Chemical Composition of Coconut; Grading of Coconuts; Post-Harvest Technology for Coconut Preservation, Processing and Products: Coconut Milk Production, Desiccated Coconut Production, Copra and Ball Copra, Quality evaluation.	2	CO 1, CO 2 CO 4	KI, K2, K3, K5
	1.6 Cashew (nut): Harvesting Methods for Cashew Nuts; Processing of Raw Cashew Nuts; Major Cashew Nut Products, Quality evaluation.	2	CO 1, CO 2 CO 4	KI, K2, K3, K5
	1.7 Jackfruit (fruit and nut): Production, Distribution and Grading; Chemical composition; Harvesting Methods; Processing and Products; Quality evaluation.	2	CO 1, CO 2 CO 4	KI, K2, K3, K5
	1.8 Kokum (fruit): Production and Distribution; Chemical composition; Harvesting Methods; Processing and Products; Quality evaluation.	2	CO 1, CO 2 CO 4	KI, K2, K3, K5
	1.9 Underutilized Seasonal fruits: Berries of Goan origin; Production and Distribution	1	CO 1, CO 2	KI, K2
Module 2:	**Spice Technology**			
	2.1 Spices: History, Classification, and Composition of Spices; Fumigation and Irradiation of Spices	2	CO 1	K1, K2
	2.2 Processing of Spices: Production, Key Chemical Constituents, Use in Food Systems, Functional and Health Benefits of Pepper (Black and White), Cardamom (Green and Black), Chilli (Red and Green), Cumin, Coriander (Seeds and Leaves), Cinnamon, Fenugreek, Nutmeg and Mace, Cloves and Turmeric.	4	CO 1, CO 2 CO 4	KI, K2, K3, K5
	2.3 Post-Harvest Technology and Spice Extracts: Production and Applications of Spice Oils; Manufacturing and Uses of Spice Powders;	3	CO 2, CO 4	K4, K5

	Extraction and Applications of Oleoresins; Isolation and Characterisation of Key Flavour Components; Production and Utilisation of Flavour Concentrates.			
	2.4 Biotechnology in Spice Production: Application of Plant Suspension Cultures for Spice Production and Enzymatic Synthesis of Flavour-Identical Compounds	2	CO 3	K3
	2.5 Spice Quality and Quality: Common Adulterants in Spices and Detection Methods; Quality Standards and FSSAI Specifications for Spices	2	CO 4, CO 5	K4, K5
	2.6 Essential Oil from Spices: Extraction of Spice essential oils, General methods of manufacture, Essential oil content of spices, Application of spice essential oils, Quality aspects	3	CO 4, CO 5	K4, K5
Module 3:	**Condiments, Flavourings and Herbs**			
	3.1 Introduction to Condiments: Historical Overview of Condiment Use; Role of Condiments in Food Systems	1	CO 1	K1, K2
	3.2 Seasonings & Culinary Herbs: Production Methods, Chemical Composition, Use in Food, Functional Benefits of Vinegar, Salt, Celery, Garlic, Ginger, Onion, Mint, Thyme, Basil, Mustard, Cilantro, Dill, Oregano, Parsley, Rosemary, Sage, Fennel, Paprika, Bay Leaf, Vanilla, Monosodium Glutamate	5	CO 1, CO 2 CO 4	KI, K2, K3, K5
	3.3 Post-Harvest Technology and Quality Standards	2	CO 4	K5
	3.4 Essential Oil from Herbs: Extraction of essential oils, General methods of manufacture, Content of spices, Application and Quality aspects	3	CO 3, CO 4 CO 5	K3, K4, K5
	3.5 Packaging of Condiments: Common Adulterants in condiments and Detection Methods; Quality Standards and FSSAI Specifications for condiments	2	CO 4, CO 5	K4, K5
Pedagogy:	Lectures, Seminars, Case Study Analysis, Problem-based Learning, Mock Debates, Use of ICT Tools			
Texts:	1. Pruthi, J. S. (1980). *Spices and Condiments: Chemistry, Microbiology, Technology*. Academic Press, USA.			

	2. Naik, B. (2023). *A Textbook of Plantation Crops*. NIPA, India. https://doi.org/10.59317/9789394490901 3. Clarke, R. J., & Macrae, R. (Eds.). (1987). *Coffee*. Springer, Netherlands. https://doi.org/10.1007/978-94-009-3417-7 4. Pandiselvam, R., & Ramesh, S. V. (Eds.). (2024). *Preservation and Authentication of Coconut Products: Recent Trends and Prospects*. Springer International Publishing, Switzerland. https://doi.org/10.1007/978-3-031-64653-9 5. Prakash, V. (1990). *Leafy Spices*. CRC Press USA. 6. Parry, J. W. (1969). *Spices: Morphology, Histology, and Chemistry* (2nd ed.). Chemical Publishing Company, New York.
References/ Readings:	1. Akpo-Djènontin, D. O. O., Anihouvi, V. B., Vissoh, V. P., Gbaguidi, F., & Soumanou, M. (2016). Processing, storage methods and quality attributes of spices and aromatic herbs in the local merchandising chain in Benin. *African Journal of Agricultural Research*, *11*(37), 3537–3547. https://doi.org/10.5897/AJAR2016.11262 2. Balasubramanian, S., Roselin, P., Singh, K. K., Zachariah, J., & Saxena, S. N. (2016). Postharvest processing and benefits of black pepper, coriander, cinnamon, fenugreek, and turmeric spices. *Critical Reviews in Food Science and Nutrition*, *56*(10), 1585–1607. https://doi.org/10.1080/10408398.2012.759901 3. Cantwell, M. I., & Reid, M. S. (1993). Postharvest physiology and handling of fresh culinary herbs. *Journal of Herbs, Spices & Medicinal Plants*, *1*(3), 93–127. https://doi.org/10.1300/J044v01n03_09 4. Nirmal Babu, K., Divakaran, M., Raj, R. P., Anupama, K., Peter, K. V., & Sarma, Y. R. (2015). Biotechnological approaches in improvement of spices: A review. In B. Bahadur, M. Venkat Rajam, L. Sahijram, & K. V. Krishnamurthy (Eds.), *Plant Biology and Biotechnology: Volume II: Plant Genomics and Biotechnology* (pp. 487–516). Springer India. https://doi.org/10.1007/978-81-322-2283-5_25 5. Ire, F., Eze, O., & Maduka, N. (2020). A influence of different wrapping materials on microbiological, physicochemical and sensory properties of condiment product 'ogiri-egusi.' *Journal of Life and Bio Sciences Research*, *1*(02), 34–43. https://doi.org/10.38094/jlbsr1213
Web Resources:	1. https://fssai.gov.in/upload/uploadfiles/files/SPICES_AND_CONDIMENTS.pdf 2. https://fssai.gov.in/upload/uploadfiles/files/Guidance_Note_Safe_Ground_Spices_30_07_2018(1).pdf 3. https://fssai.gov.in/upload/uploadfiles/files/Guidance_Document_Spices_23_10_2018.pdf

Title of the Course	Lab in Spice and Plantation Crop Technology
Course Code	FTC-5206
Number of Credits	1
Theory/Practical	Practical
Level	400
Effective from AY	2025-2026
New Course:	No
Bridge Course/ Value-added Course:	No
Course for advanced learners:	No

Pre-requisites for the Course:	Nil	
Course Objectives:	1. To enable students to gain insights into the cultivation, processing, and market trends of spices and plantation crops 2. To provide hands-on experience in processing techniques for plantation crops and spices 3. To provide skills to perform analyse and assess the quality of plantation crops and spices 4. To develop innovative products from plantation crops and spices, such as beverages, snacks, and functional foods, using modern processing and preservation techniques	
Course Outcomes:	**On the completion of the course, the student will be able to:**	**Mapped to PSO**
	CO 1. Identify and explain the importance, types, and market trends of plantation crops and spices.	PSO 1
	CO 2. Perform proximate analysis and quality assessment of plantation crops and spices	PSO 4

	CO 3. Demonstrate preparation techniques of different products using plantation crops and spices.			PSO 5
	CO 4. Analyse processing methods and assess the efficiency of processing methods in the plantation and spice industry			PSO 1, PSO 4
	CO 5. Evaluate bioactive components and detect adulteration and contaminants in spices			PSO 4
Content:	**Syllabus Content (30 hours)**	**No. of hours**	**Mapped to CO**	**Cognitive Level**
	1. Market Survey of Plantation Crops and their Products	2	CO 1	K3, K4
	2. Proximate analysis of different Goan plantation produce	2	CO 2	K2
	3. Preparation of Virgin Coconut Oil	2	CO 3	K3
	4. Preparation of dehydrated products at different techniques and determining the moisture content	2	CO 2, CO 3 CO 4	K3, K4
	5. Processing of Cashew Nuts through Steam Roasting	2	CO 2, CO 3	K2, K3
	6. Processing of Cashew Apple for Beverages	2	CO 3, CO 4	K3, K4
	7. Development of RTS Beverages using plantation crops	2	CO 3, CO 4 CO 5	K4, K5, K6
	8. Development of RTE products using plantation crops	2	CO 3, CO 4	K5, K6
	9. Market Survey of Spices, Condiments, Herbs, and their Products	2	CO 1	K3, K4
	10. Preparation of Spice Powders	2	CO 3	K3
	11. Detection of Adulteration in Spices	4	CO 3	K3
	12. Determination of Capsaicin Content of Chillies	2	CO 4	K4
	13. Estimation of Curcumin in Turmeric	2	CO 4, CO 5	K4, K5
	14. Drying of Spices using different techniques and determining moisture content	2	CO 4, CO 5	K4, K5

Pedagogy:	Lectures, Seminars, Case Study Analysis, Problem-based Learning, Mock Debates, Use of ICT Tools
Texts:	1. National Institute of Industrial Research (NIIR) Board. (2004). *Handbook on Spices*. Asia Pacific Business Press Inc. 2. Cauvain, S., & Young, L. S. (2007). *Technology of Bread Making*. Springer New York. https://doi.org/10.1007/978-0-387-38565-5 3. Gupta, S. (2016). *Handbook of Spices and Packaging with Formulae*. Engineers India Research Institute. 4. Khader, V. (2001). *Textbook of Food Science and Technology*. ICAA. 5. Parry, J. W. (1988.). *Spices: Morphology, History, Chemistry*. Chemical Publishing Co, USA. 6. Shanmugavelu, K. G. (1985). *Spices and Plantation Crops*. Oxford & IBH Publishing Co, India.
References/ Readings:	1. Kumar, G. V., Pandey, S. P., & Singh, A. B. (2022). Utilization of plantation crops and their by-products in the food processing industry and nutraceuticals. *Journal of Food Science and Technology, 59*(5), 1–12. https://doi.org/10.1007/s11483-022-01815-7 2. Bhandari, D. K. S., Patel, P. M. J., Reddy, V. S., & Singh, A. V. (2021). Plantation crops as functional ingredients in the food and nutraceutical industry: A review. *Comprehensive Reviews in Food Science and Food Safety, 20*(5), 4211–4230. https://doi.org/10.1111/1541-4337.12740 3. Wildman, R. E. C., & Bruno, R. S. (Eds.). (2019). *Handbook of Nutraceuticals and Functional Foods* (3rd ed.). CRC Press. https://doi.org/10.1201/9780429195594 4. Tyagi, S. K. (2015). *Spices, Plantation Crops, Medicinal and Aromatic Plants: A Handbook*. New India Publishing Agency. https://doi.org/10.1234/56789 5. Bharathi, S. K. V., Sukitha, A., Moses, J. A., & Anandharamakrishnan, C. (2019). Instrument-based detection methods for adulteration in spice and spice products – A review. *Journal of Spices and Aromatic Crops, 27*(2), 106–118. https://doi.org/10.25081/josac.2018.v27.i2.1099 6. Priya, R. B., Rashmitha, R., Preetham, G. S., Chandrasekar, V., Mohan, R. J., Sinija, V. R., & Pandiselvam, R. (2022). Detection of adulteration in coconut oil and virgin coconut oil using advanced analytical techniques: A review. *Food Analytical Methods, 15*(11), 2917–2930. https://doi.org/10.1007/s12161-022-02342-y
Web Resources:	1. Food Safety and Standards Authority of India. (2021). *Manual of methods of analysis of foods: Spices, herbs and condiments*. https://fssai.gov.in/upload/uploadfiles/files/Manual_Revised_Spices_Herbs_22_06_2021.pdf 2. Food Safety and Standards Authority of India. (2015). *Manual of methods of analysis of foods: Spices and condiments*. Ministry of Health and Family Welfare, Government of India.

Title of the Course	Nutraceuticals and Health Foods
Course Code	FTC-5207
Number of Credits	3
Theory/Practical	Theory
Level	400
Effective from AY	2025-2026
New Course:	No
Bridge Course/ Value-added Course:	No
Course for advanced learners:	No

Pre-requisites for the Course:	Nil	
Course Objectives:	1. To familiarize with the emerging trend of nutraceuticals with respect to the types, mechanisms of action, and manufacture of selected nutraceuticals. 2. To acquaint with nutraceutical product development, clinical testing and toxicity aspects. 3. To understand the regulatory requirements and issues associated with formulation of nutraceuticals and health foods. 4. To compare national and international standards associated with nutraceuticals and health foods.	
Course Outcomes:	**On the completion of the course, the student will be able to:**	**Mapped to PSO**
	CO 1. Define the terminology involved in understanding the concept and application of nutraceuticals and health foods.	PSO 1
	CO 2. Explain the concept and various aspects of nutraceuticals and health foods.	PSO 1

	CO 3. Apply the concept and various aspects of nutraceuticals and health food.			PSO 1
	CO 4. Analyse the application and various aspects of nutraceuticals and health food.			PSO 1
	CO 5. Evaluate the concepts and effectiveness of nutraceuticals and health foods, and formulate products by applying knowledge related to nutraceuticals and health foods.			PSO 1
Content:	**Syllabus Content (45 hours)**	**No. of hours**	**Mapped to CO**	**Cognitive Level**
Module 1:	**Introduction to Nutraceuticals and Health Foods**			
	1.1 Definition and Basis of Claims: nutraceuticals, supplements, health foods, functional foods (National and International)	3	CO 1, CO 2	K1, K2
	1.2 National and International Claims: Basis and types of claims, usage and comparison between India and other Countries	2	CO 1, CO 2	K1, K2
	1.3 National and International Regulations: Guidelines, Terminologies, Schedules and Issues related to Nutraceuticals and Health Foods, including Codex Alimentarius.	3	CO 1, CO 2	K1, K2
	1.4 Flora, Fauna, and Microbes as a Source for Nutraceuticals: Sources– cereals, pulses, millets, tubers, vegetables, fruits, dairy products, flesh foods, fermented products, nuts, mushrooms, algae, microbes: fungi and bacteria, edible insects and ferns.	6	CO 1, CO 2	K1, K2
	1.5 Present and Future Prospects: Recent development in areas of Nutraceuticals; Nutraceuticals as a bridge between foods and drugs	2	CO 1, CO 2	K1, K2
Module 2:	**Manufacture of Nutraceuticals**			
	2.1 Isolation of Nutraceuticals: Phytochemicals (Isoflavonoids, Phytosterols), Prebiotics and Probiotics, Glucosamine, Vitamins (carotenoids, tocopherols, folic acid, ascorbic acid), MUFA, PUFA, ω-3 Fatty Acids	4	CO 1, CO 2 CO 3, CO 4	K1, K2, K3, K4

	2.2 Formulation and Development: Functional Foods, Nutraceuticals and Supplements; Different forms of tablets, capsules and syrups; Production process; Issues related to stability, analysis and labelling	5	CO 1, CO 2 CO 3, CO 4 CO 5	K1, K2, K3, K4, K5
	2.3 Nutraceuticals from genetically modified foods: Plant, Golden Rice and Quality Protein Maize (QPM); Transgenic animals, Nutrigenetics and Nutrigenomics, importance of nutraceuticals	5	CO 3, CO 4	K2, K3, K4
	2.4 Testing and Therapeutics: Clinical Testing, Dosage, Contraindications, Side effects, Adverse effects, Efficacy and Toxicity of Nutraceuticals, Therapeutics and Bioavailability (ADME), Interactions between Nutraceuticals and Prescription Drugs	6	CO 1, CO 2 CO 3, CO 5	K1, K2, K3, K4, K5
Module 3:	**Role of Nutraceuticals**			
	3.1 Nutraceutical Use in Disease and Disorder: Need for and mechanism of action – cardiovascular disease, cancer, diabetes, obesity, anemia, immunity, bone and joint issues, macular degeneration, gastrointestinal disturbances, immunity, brain diseases, hepatic and renal disorders, hormonal problems, behavioural disorders	6	CO 1, CO 2 CO 3	K1, K2, K4, K5, K6
	3.2 Nutraceutical Use in Sports: Types, Formulation, Market Trends	3	CO 1, CO 2 CO 3, CO 5	K1, K2, K3, K4, K5, K6
Pedagogy:	Lectures, Seminars, Problem-based Learning, Mock Debates, Use of ICT Tools			
Texts:	1. Brigelius-Flohé, J., & Joost, H. G. (2006). *Nutritional Genomics: Impact on Health and Disease*. Wiley-VCH, Germany. 2. Cupp, J., & Tracy, T. S. (2003). *Dietary Supplements: Toxicology and Clinical Pharmacology*. Humana Press, USA. 3. Manson, P. (2001). *Dietary Supplements* (2nd ed.). Pharmaceutical Press, UK. 4. Robert, E. C. (Ed.). (2006). *Handbook of Nutraceuticals and Functional Foods* (2nd ed.). CRC Press, USA. 5. Rao, T. J. M., Kesharwani, R. K., Keservani, R. K., & Sharma, A. K. (Eds.). (2024). *Formulations, Regulations, and Challenges of Nutraceuticals*. Apple Academic Press, USA. 6. Sahidi, F., & Weerasinghe, D. K. (2015). *Nutraceutical Beverages: Chemistry, Nutrition, and Health Effects*. American Chemical Society, USA. 1. Webb, G. P. (2006). *Dietary Supplements and Functional Foods*. Blackwell Publishing, USA.			

References/ Readings:	1. Losso, J. N. (2007). *Anti-angiogenic Functional and Medicinal Foods*. CRC Press, USA. 2. Neeser, J. R., & German, B. J. (2004). *Bioprocesses and Biotechnology for Nutraceuticals*. Chapman & Hall. 3. Gupta, R. C., Lall, R., & Srivastava, A. (Eds.). (2021). *Nutraceuticals: Efficacy, safety and toxicity* (2nd ed.). Elsevier. https://doi.org/10.1016/B978-0-12-821038-3.00001-4 4. Malve, H., & Bhalerao, P. (2023). Past, present, and likely future of nutraceuticals in India: Evolving role of pharmaceutical physicians. *Journal of Pharmacy and Bioallied Sciences, 15*(2), 68–73. https://doi.org/10.4103/jpbs.jpbs_96_23 5. Sharma, M. K., Gupta, S. K., Yadav, S., Gupta, S. K., & Kumar, A. (2019). Nutraceuticals in the prevention and treatment of diseases: A review of their role in cardiovascular, metabolic, and other health disorders. *Nutrients, 11*(12), 2876. https://doi.org/10.3390/nu11122876 6. Shi, J. (Ed.). (2006). *Functional Food Ingredients and Nutraceuticals: Processing Technologies*. CRC Press, USA. 7. Wildman, R. E. C. (Ed.). (2019). *Handbook of Nutraceuticals and Functional Foods* (3rd ed.). CRC Press, USA 7. Puri, V., Nagpal, M., Singh, I., Singh, M., Arora Dhingra, G., Huanbutta, K., Dheer, D., Sharma, A., & Sangnim, T. (2022). A Comprehensive review on nutraceuticals: Therapy support and formulation challenges. *Frontiers in Nutrition, 14*, Article 4637. https://doi.org/10.3389/fnut.2021.804637
Web Resources:	1. Food Safety and Standards Authority of India. (2016). *Food Safety and Standards (Health Supplements, Nutraceuticals, Food for Special Dietary Use, Food for Special Medical Purpose, Functional Food and Novel Food) Regulations, 2016*. Ministry of Health and Family Welfare, Government of India. https://fssai.gov.in/upload/uploadfiles/files/Compendium_Nutra_29_09_2021.pdf 2. Food Safety and Standards Authority of India. (2016). *Notification on Nutraceutical Regulations*. Ministry of Health and Family Welfare, Government of India. https://fssai.gov.in/upload/uploadfiles/files/Nutraceuticals_Regulations.pdf 3. Food Safety and Standards Authority of India. (2022). *Food Safety and Standards (Health Supplements, Nutraceuticals, Food for Special Dietary Use, Food for Special Medical Purpose, and Prebiotic and Probiotic Food) Regulations, 2022*. Ministry of Health and Family Welfare, Government of India. https://www.fssai.gov.in/upload/advisories/2022/03/6243ef28079ceDirection_Nutra_30_03_2022.pdf

Title of the Course	Lab in Nutraceuticals and Health Foods
Course Code	FTC-5208
Number of Credits	1
Theory/Practical	Practical
Level	400
Effective from AY	2025-2026
New Course:	No
Bridge Course/ Value-added Course:	No
Course for advanced learners:	No

Pre-requisites for the Course:	Nil	
Course Objectives:	1. To acquaint students with extraction procedures and identification of nutrients and functional components from foods 2. To acknowledge the importance of food labelling and market research of developed products 3. To evaluate and interpret results applying knowledge of nutraceutical regulation 4. Design experiments and formulate products by applying knowledge related to nutraceuticals and health foods	
Course Outcomes:	**On the completion of the course, the student will be able to:**	**Mapped to PSO**
	CO 1. Recognise the procedure involved in the extraction and analysis of nutraceuticals and health food.	PSO 4
	CO 2. Explain the procedures in the extraction and analysis of nutraceuticals and health food.	PSO 4

	CO 3. Apply the appropriate procedures in extraction and analysis of nutraceuticals and health food.			PSO 4
	CO 4. Analyse the steps used in the extraction and analysis of nutraceuticals and health food.			PSO 4
	CO 5. Evaluate the method and Design experiments to develop products for nutraceuticals and health foods			PSO 5
Content:	**Syllabus Content (30 hours)**	**No. of hours**	**Mapped to CO**	**Cognitive Level**
Module 1:	**Nutraceutical Analysis**			
	1.1 Qualitative and quantitative analysis of amino acid content	2	CO 3, CO 4	K3, K4
	1.2 Extraction of Prebiotics like beta-glucan from different sources	2	CO 3, CO 4	K3, K4
	1.3 Isolation and culture of probiotics/Lactic acid bacteria (LAB)	2	CO 3, CO 4	K3, K4
	1.4 Biochemical tests for probiotic bacteria.	2	CO 3, CO 4	K3, K4
	1.5 Market Survey, Classification and Development of Labels for Health Foods and Nutraceuticals.	2	CO 3, CO 4, CO 5	K3, K4, K6
	1.6 Nutraceutical regulatory guidelines (FSSAI) in Laboratory techniques	2	CO 1, CO 2	K2, K4, K5
Module 2:	**Phytochemical sources of Nutraceuticals**			
	2.1 Extraction and Estimation of:	10	CO 3, CO 4	K3, K4
	A. Folic Acid from Vegetables			
	B. Lycopene from Tomatoes			
	C. Astaxanthin from Grapes			
	D. Curcumin Content from Turmeric			
	E. Capsaicin content from Chillies			
	F. Allicin content from Garlic and Onion			
	2.2 Determination of carotenoids and plant pigments	2	CO 3, CO 4	K3, K4

	2.3 Estimation of caffeine in different products	2	CO 3, CO 4	K3, K4
	2.4 Detection and Estimation of Phytochemicals like Polyphenols, Flavanoids, Tannins	2	CO 3, CO 4	K3, K4
	2.5 Estimate biological potential and claim of phytochemicals or nutraceutical like antimicrobial activity	2	CO 3, CO 4	K3, K4, K5
Pedagogy:	Experiments in the Laboratory			
Texts:	1. Aneja, K. R. (2007). *Experiments in Microbiology, Plant Pathology and Biotechnology* (4th ed.). New Age International Publishers, India. 2. Baltz, R. H., Davies, J. E., & Demain, A. L. (Eds.). (2010). *Manual of Industrial Microbiology and Biotechnology* (3rd ed.). ASM Press, USA. 3. Harborne, J. B. (1973). *Phytochemical methods: A Guide to Modern Techniques of Plant Analysis*. Chapman and Hall Ltd, UK 4. Helrich, K. (Ed.). (1990). *Official Methods of Analysis of the Association of Official Analytical Chemists* (15th ed.). AOAC International, USA. 5. Hui, Y. H. (Ed.). (1984). *Food Analysis: Principles and Techniques* (Vols. 1–4). CRC Press, USA Nigam, A., & Ayyagari, A. (2008). *Lab Manual in Biochemistry, Immunology and Biotechnology*. Tata McGraw-Hill Publishing Company Limited, India. 6. Sadashivam, S., & Manickam, A. (2008). *Biochemical Methods* (3rd ed.). New Age International Publishers, India. 7. Sattanathan, G., Padmapriya, S. S., & Balamuralikrishnan, B. (2020). *Practical Manual of Biochemistry*. Skyfox Publishing Group, India. https://doi.org/10.22573/spg.020.BK/S/028 8. Wagner, H., & Bladt, S. (2009). *Plant drug analysis: A thin layer chromatography atlas* (2nd ed.). Springer, Germany.			
References/ Readings:	1. Wildman, R. E. C. (Ed.). (2019). *Handbook of Nutraceuticals and Functional Foods* (3rd ed.). CRC Press, USA. 2. Nollet, L. M. L. (Ed.). (1996). *Handbook of Food Analysis* (Vols. 1–2). Marcel Dekker, USA. 3. Md Noh, M. F., Gunasegavan, R. D.-N., Khalid, N. M., Balasubramaniam, V., Mustar, S., & Abd Rashed, A. (2020). Recent techniques in nutrient analysis for food composition database. *Molecules, 25*(19), 4567. https://doi.org/10.3390/molecules25194567			

	4. Damián, M. R., Cortes-Perez, N. G., Quintana, E. T., Ortiz-Moreno, A., Garfias Noguez, C., Cruceño-Casarrubias, C. E., Sánchez Pardo, M. E., & Bermúdez-Humarán, L. G. (2022). Functional foods, nutraceuticals and probiotics: A focus on human health. *Microorganisms, 10*(5), Article 1065. https://doi.org/10.3390/microorganisms10051065 5. Dixit, V., Kamal, S. W. J., Chole, P. B., Dayal, D., Chaubey, K. K., Pal, A. K., Xavier, J., Manjunath, B. T., & Bachheti, R. K. (2023). Functional foods: Exploring the health benefits of bioactive compounds from plant and animal sources. *Journal of Food Quality, 2023*, Article 5546753. https://doi.org/10.1155/2023/5546753 6. Bagchi, D., Bhat, H. S., & Gupta, R. C. (Eds.). (2020). *Handbook of functional foods and nutraceuticals*. CRC Press. https://doi.org/10.1201/9780367414254
Web Resources:	1. Food Safety and Standards Authority of India. (2016). *Food Safety and Standards (Health Supplements, Nutraceuticals, Food for Special Dietary Use, Food for Special Medical Purpose, Functional Food and Novel Food) Regulations, 2016*. Ministry of Health and Family Welfare, Government of India. https://fssai.gov.in/upload/uploadfiles/files/Compendium_Nutra_29_09_2021.pdf 2. Food Safety and Standards Authority of India. (2016). *Notification on Nutraceutical Regulations*. Ministry of Health and Family Welfare, Government of India. https://fssai.gov.in/upload/uploadfiles/files/Nutraceuticals_Regulations.pdf 3. Food Safety and Standards Authority of India. (2022). *Food Safety and Standards (Health Supplements, Nutraceuticals, Food for Special Dietary Use, Food for Special Medical Purpose, and Prebiotic and Probiotic Food) Regulations, 2022*. Ministry of Health and Family Welfare, Government of India. https://www.fssai.gov.in/upload/advisories/2022/03/6243ef28079ceDirection_Nutra_30_03_2022.pdf

Title of the Course	Internship
Course Code	FTC-5209
Number of Credits	4
Theory/Practical	Practical
Level	400
Effective from AY	2025-2026
New Course:	No
Bridge Course/	No
Course for advanced learners:	No

Pre-requisites for the Course:	Nil
Course Objectives:	1. To apply foundational principles of food science, quality assurance methodologies relevant to the Indian food industry, and hygiene management practices in real-world settings within food production facilities and/or hotel environments in India. 2. To analyze and evaluate current practices in food production, quality testing procedures, and hygiene protocols observed during their internship in India, identifying areas of strength and potential improvement based on theoretical knowledge and industry best practices. 3. To develop essential professional skills such as effective communication, teamwork, problem-solving, and time management through active participation in internship tasks and interactions with industry professionals in the Indian food sector. 4. To critically reflect on their experiential learning by connecting their practical observations and tasks within the Indian food industry to relevant academic concepts and theories, and to articulate their personal and professional growth gained through the internship.

Course Outcomes:	**On the completion of the course, the student will be able to:**			**Mapped to PSO**
	CO 1. Demonstrate an understanding of the key stages in food production within a specific industry in India.			PSO 1
	CO 2. Apply basic principles of food quality testing relevant to the Indian context (considering FSSAI standards).			PSO 1, PSO 2, PSO 4
	CO 3. Identify and analyze hygiene and sanitation practices in food production and/or hotel kitchens in India.			PSO 1, PSO 2, PSO 4
	CO 4. Document and critically reflect on their internship experiences and learning outcomes.			PSO 8
	CO 5. Understand the professional expectations and ethical considerations within the Indian food industry. communicate effectively about their observations and contributions during the internship.			PSO 1, PSO 6, PSO 8
Content:	**Internship Duration (120 hours)**	**No. of hours**	**Mapped to CO**	**Cognitive Level**
	Components of the Internship	120		
	1.1 Mandatory On-Site Work: A minimum of 120 hours spent at the host organization(s) engaging in the activities outlined previously (food production, quality testing, hygiene management).		CO 1, CO 2, CO 3, CO 4, CO 5	K4, K5, K6
	1.2 Reflective Journaling: Regular and detailed entries in a reflective journal documenting observations, tasks performed, challenges faced, and learning insights.		CO 4, CO 5	K4, K5, K6
	1.3 Internship Report: A comprehensive written report detailing the internship experience, including a description of the host organization(s), specific tasks undertaken, key learnings related to food production, quality testing, and hygiene management in the Indian context, and a critical reflection on the overall experience and its connection to their academic studies.		CO 3, CO 4	K4, K5, K6

	1.4 Supervisor Evaluation: Formal feedback provided by the internship supervisor(s) on the student's performance, professionalism, and engagement.		CO 5	-
	1.5 Presentation: A brief presentation to faculty summarizing the internship experience and key takeaways.		CO 4, CO 5	K4, K5, K6
Pedagogy:	Hands-on-training, Experiential learning, Reflective journaling, Seminars			