

ST JOSEPH'S UNIVERSITY

BENGALURU-27



SCHOOL OF LIFE SCIENCES

**DEPARTMENT
OF
FOOD SCIENCE AND TECHNOLOGY**

SYLLABUS FOR POSTGRADUATE PROGRAMME

For Batch 2024 Onwards

Part A			
1	Title of the Academic Program	M.Sc. Food Science and Technology	
2	Program Code	(To be given by Examination Section)	
3	Name of the University	St Joseph's University	
4	Objective of the University	<ol style="list-style-type: none"> 1. Academic Excellence 2. Character Formation 3. Social Concern 	
5	Vision of the University	"Striving for a just, secular, democratic and economically sound society, which cares for the poor, the oppressed and the marginalized"	
6	Mission of the University	M1	St Joseph's University seeks to form men and women who will be agents of change, committed to the creation of a society that is just, secular and democratic.
		M2	The education offered is oriented towards enabling students to strive for both academic and human excellence.
		M3	The University pursues academic excellence by providing a learning environment that constantly challenges the students and supports the ethical pursuit of intellectual curiosity and ceaseless enquiry.
		M4	Human excellence is promoted through courses and activities that help students achieve personal integrity and conscientize them to the injustice prevalent in society.
7	Name of the Degree	Master of Science (M.Sc.) in Food Science and Technology	
8	Name of the Department offering the program	Food Science and Technology	
9	Vision of the Program	<ul style="list-style-type: none"> • To be a centre of excellence in training, research, outreach and consultancy services in Food Science and Technology with emphasis on value addition of agriculture produce, processing, technology driven conservation of food, nutritional goodness and food security. • To produce competent food technologists, scientists, researchers and entrepreneurs in the food domain through quality education. 	
10	Mission of the Program	<ul style="list-style-type: none"> • The Department of Food Science and Technology shares knowledge and creates awareness for safe and healthy food supply. • To upgrade the scientific knowledge in the area of food science, food processing and safety for development of food products through quality research. 	
11	Duration of the Program	2 years (Four semesters)	
12	Total No. of Credits	98	
13		PEO 1	To enable pursuit of ideas and to enhance the intellectual skills in the arena of Food Science and Technology

	Program Educational Objectives (PEOs)	PEO 2	To achieve excellence and quality in personal development through acquired skills in Food Science and Technology
		PEO 3	To build the students into proficient and qualified Food Scientists and Technologists for the society
		PEO 4	To enable students to strive for excellence in the food domain as Researchers and Entrepreneurs
14	Graduation Attributes		<p>The following graduate attributes reflect the particular quality and feature or characteristics of an individual, that are expected to be acquired by a graduate through studies at St Joseph's University.</p> <ul style="list-style-type: none"> • Disciplinary knowledge • Communication Skills • Critical thinking • Problem solving • Analytical reasoning • Research-related skills • Cooperation/Team work • Reflective thinking • Information/digital literacy • Self-directed learning and Lifelong learner • Multicultural competence • Moral and ethical awareness/reasoning • Leadership readiness/qualities • International Outlook
15	Program Outcomes (POs)	PO1	To inculcate and impart training in the basic and advanced features of Food Technology
		PO2	Amalgamation of interdisciplinary principles of associated sciences to illustrate and understand Food Science and Technology
		PO3	To enhance technical competencies for the Food Industry professionals
		PO4	To develop skills to analyse Food Quality
		PO5	To integrate and enable real world problems associated with Food Sciences
		PO6	To formulate environment friendly and nutritious Food Products
		PO7	To enable production of value-added products for Entrepreneurship development and Food Security

Part B

M.Sc. Food Science and Technology Curriculum

Courses and course completion requirements	No. of credits
Food Science and Technology	94
Outreach activity	04

SUMMARY OF CREDITS

DEPARTMENT OF FOOD SCIENCE AND TECHNOLOGY (PG)								
(2024)								
<u>Semester 1</u>	Code Number	Title	No. of Hours of Instructions	Number of Hours of teaching per week	Number of credits	Continuous Internal Assessment (CIA) Marks	End Semester Marks	Total marks
Theory	FST 1124	Principles of Food Processing & Preservation	60	04	04	50	50	100
Theory	FST 1224	Food Microbiology	60	04	04	50	50	100
Theory	FST 1324	Food Chemistry	60	04	04	50	50	100
Theory	FST1424	Technology of Milk and Milk Products	60	04	04	50	50	100
Practical	FST1P ₁ 24	Principles of Food Processing, Preservation and Food Microbiology	88	08	04	15	35	50
Practical	FST1P ₂ 24	Food Chemistry and Technology of Milk and Milk products	88	08	04	15	35	50
Total Number of credits:			24					
<u>Semester 2</u>	Code Number	Title	No. of Hours of Instructions	Number of teaching hrs /week	Number of credits	Continuous Internal Assessment (CIA) Marks	End Semester Marks	Total marks
Theory	FST 2124	Principles of Food Engineering	60	04	04	50	50	100
Theory	FST 2224	Technology of Cereals and Legumes	60	04	04	50	50	100
Theory	FST 2324	Technology of Fruits and Vegetables	60	04	04	50	50	100
Theory	FST 2424	Food Biotechnology	60	04	04	50	50	100
Theory	FST 2524	Food Packaging and Technology	60	04	04	50	50	100
Theory	FST 2624	Sensory Evaluation	60	04	04	50	50	100
Practical	FST2P ₁ 24	Principles of Food Engineering, Technology of Cereals and Legumes and Technology of Fruits	88	08	04	15	35	50

		and Vegetables						
Practical	FST2P ₂ 24	Food Biotechnology and Sensory Evaluation	88	08	04	15	35	50
Total Number of credits:			32					
Semester 3	Code Number	Title	No. of Hours of Instructions	Number of teaching hrs /week	Number of credits	Continuous Internal Assessment (CIA) Marks	End Semester Marks	Total marks
Theory	FST 3124	Fermentation Technology	60	04	04	50	50	100
Theory	FST 3224	Technology of Meat, Fish and Poultry Products	60	04	04	50	50	100
Theory	FST 3324	Food Additives, Contaminants and Toxicology	60	04	04	50	50	100
Theory	FST 3424	Food Quality, Safety Management and Statistics	60	04	04	50	50	100
Practical	FST3P ₁ 24	Fermentation Technology and Technology of Meat, Fish and Poultry Products	88	08	04	15	35	50
Practical	FST3P ₂ 24	Food Additives, Contaminants, Toxicology and Statistics	88	08	04	15	35	50
Internship	FST3P ₃ 24	Internship (Industrial training/workshop/pilot plant training) report and viva			02			50
Total Number of credits:			26					
Semester 4	Code Number	Title	No. of Hours of Instructions		Number of credits	Continuous Internal Assessment (CIA) Marks	End Semester Marks	Total marks
	FST 4124	Project Work	4 months		10			300
		IGNITORS/ OUTREACH			04			
Total Number of credits:			14					
Total No. of Credits: 96								

CORE COURSES (CC)	
Course Title	Code Number
Principles of Food Processing & Preservation	FST 1124
Food Microbiology	FST 1224
Food Chemistry	FST 1324
Technology of Milk and Milk Products	FST 1424
Principles of Food Processing, Preservation and Food Microbiology	FST 1P124
Food Chemistry and Technology of Milk and Milk products	FST 1P224
Principles of Food Engineering	FST 2124
Technology of Cereals and Legumes	FST 2224
Technology of Fruits and Vegetables	FST 2324
Food Biotechnology	FST 2424
Food Packaging and Technology	FST 2524
Sensory Evaluation	FST 2624
Principles of Food Engineering, Technology of Cereals and Legumes and Technology of Fruits and Vegetables	FST 2P124
Food Biotechnology and Sensory Evaluation	FST 2P224
Fermentation Technology	FST 3124
Technology of Meat, Fish and Poultry Products	FST 3224
Food Additives, Contaminants and Toxicology	FST 3324
Food Quality, Safety Management and Statistics	FST 3424
Fermentation Technology and Technology of Meat, Fish and Poultry Products	FST 3P124
Food Additives, Contaminants, Toxicology and Statistics	FST 3P224
Internship (Industrial training/workshop/pilot plant training) report and viva	FST3P324
Project work	FST 4124

SKILL ENHANCEMENT COURSE (SEC)	
Course Title	Code Number
Principles of Food Processing, Preservation and Food Microbiology	FST 1P124
Food Chemistry and Technology of Milk and Milk products	FST 1P224
Principles of Food Engineering, Technology of Cereals and Legumes and Technology of Fruits and Vegetables	FST 2P124
Food Biotechnology and Sensory Evaluation	FST 2P224
Fermentation Technology and Technology of Meat, Fish and Poultry Products	FST 3P124
Food Additives, Contaminants, Toxicology and Statistics	FST 3P224
Internship (Industrial training/workshop/pilot plant training)	FST 3P324

Course Outcomes and Course Content

Semester	I
Paper Code	FST 1124
Paper Title	Principles of Food Processing & Preservation
Number of teaching hours per week	04
Total number of teaching hours per semester	60
Number of credits	04

Objective of the paper:

A study on processing and preservation of foods to increase shelf life, avoid contamination, storage and to produce marketable products.

UNIT I

Scope and importance of food processing, national and international perspectives. Principles of fresh food storage: Nature of harvested crop, plant, animal; product storage; effect of cold storage and quality – storage of grains. **4**

UNIT II

Principles and methods of food preservation, hydrostatic pressure cooking, and aseptic processing. Storage of food and principles of modified atmosphere packaging. Processing of plantation crop: Tea, Coffee, Cocoa, Arecanut, Oil palm. **6**

UNIT III

Processing and preservation by heat: Blanching, pasteurization, sterilization and UHT processing, canning, extrusion cooking, dielectric heating, microwave heating, baking, roasting and frying. Retort processing of

Ready to eat (RTE) products. Newer methods of thermal processing – batch and continuous. Processing and preservation by low Temperature: refrigeration, freezing, and dehydrofreezing. The electro-magnetic spectrum, forms of radiant energy. Principles of using electromagnetic radiation in food processing, ionizing radiations and non-ionizing radiations, advantages and disadvantages. Controlling undesirable changes in food during irradiation.

Processing and preservation by drying, concentration and evaporation: Drying – water activity, microbial spoilage due to moisture. Dehydration of fruits, vegetables, milk, animal products. Various methods employed in production of dehydrated commercial products, selection of methods based on characteristics of foods to be produced, advantages and disadvantages of different methods, sun drying, tray or tunnel drying, spray drying, drum drying, freeze drying, fluidized bed drying. Physical and chemical changes during drying control of chemical changes, desirable and undesirable changes. Packaging and storage of dehydrated products, Food Concentration- methods of food concentration, freeze concentration, Ultra-filtration, reverse osmosis. Losses of vitamins and minerals due to processing. **30**

UNIT IV

Processing and preservation by non-thermal methods: High pressure, pulsed electric field, hurdle technology. Food irradiation history and mechanism, GRAS and legal aspects for gamma irradiation. Use and application of enzymes and microorganism in processing and preservation of foods; food fermentations, pickling smoking. **8**

UNIT V

Spices and Condiments- Composition, processing and medicinal properties of ginger, cardamom, coriander, turmeric, nutmeg and pepper. **4**

NOTE: 8 hours of self-study to be assigned

REFERENCES:

1. Smith, J. S., & Hui, Y. H. (Eds.). (2008). *Food processing: principles and applications*. John Wiley & Sons.
2. Desrosier, N. W., & James, N. (2007). *Technology of food preservation*. AVI Publishers.
3. Fellows, P. J. (2005). *Food processing technology: Principle and Practice*. 2nd Ed. CRC Publishers.
4. Jelen, P. (2005). *Introduction to Food Processing*. Prentice Hall.
5. Mujumdar, A. S. (Ed.). (1995). *Handbook of industrial drying, revised and expanded*. (Vol. 2). CRC Press.
6. Fellows, P. J. (2009). *Food processing technology: principles and practice*. Elsevier.

7. Desrosier, N. W., & Desrosier, J. N. (1977). *The technology of food preservation*. 4th Ed. AVI Publishing Company. Inc.
8. Gould, G. W. (2012). *New methods of food preservation*. Springer Science & Business Media.
9. Mujumdar, A. S. (2014). *Handbook of industrial drying, revised and expanded*. 4th Ed. CRC Press.

BLUE PRINT

Code number: FST 1124

Title of the paper: PRINCIPLES OF FOOD PROCESSING & PRESERVATION

Total marks for which the questions are to be asked (including bonus questions)	Number of hrs.	Chapter/ Unit number
3	4	I
8	6	II
39	30	III
15	8	IV
6	4	V
71	52	TOTAL
Maximum marks for the paper (Excluding bonus question): 50		

Course Outcomes: At the end of the Course, the Student

CO1	Can relate to the basic concepts in Processing, Preservation and storage of foods
CO2	Can understand concepts and principles of traditional and modern methods of food preservation
CO3	Will be able to construct and develop attributes for processing of various foods and to preserve them
CO4	Will develop skills to inspect, analyze and survey food quality
CO5	Will be able to appreciate scientific principles and techniques of food processing and preservation
CO6	Can formulate environmental friendly and nutritious food products

Mapping of Course Outcomes to Program Outcomes

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	✓		✓				
CO2		✓					
CO3	✓						
CO4			✓	✓			
CO5	✓	✓					
CO6			✓		✓	✓	✓

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

Semester	I
Paper Code	FST 1224
Paper Title	Food Microbiology
Number of teaching hours per week	04
Total number of teaching hours per semester	60
Number of credits	04

Objectives of the paper:

To understand, evaluate and identify the role of microorganisms in foods.

UNIT I

History of microbiology of food, Microbial growth pattern, physical and chemical factors, History and development of Microbiology-Importance and significance of microorganisms in food science. Factors affecting the growth of microorganisms in food – Intrinsic and Extrinsic parameters. **6**

UNIT II

Types of micro-organism normally associated with food-mold, yeast, bacteria and viruses. Contaminants of foods-stuffs, vegetables, cereals, pulses, oilseeds, milk and meat during handling and processing. Biochemical changes caused by micro-organisms, deterioration of various types of food product. Factors influencing destruction of micro-organisms. **9**

UNIT III

Food borne diseases - Infections and intoxications: Bacterial food borne diseases (*Staphylococcal* intoxication, Botulism, Salmonellosis, Shigellosis, Enteropathogenic *Escherichia Coli* Diarrhoea, *Clostridium Perfringens* gastroenteritis, *Bacillus cereus* Gastroenteritis) Food Borne Viral Pathogens (Norovirus, Reovirus, Rotavirus, Astrovirus, Adenovirus, Parvovirus, Hepatitis-A Virus), Food Borne Animal Parasites Protozoa–Giardiasis, Amebiasis, Toxoplasmosis, Sarcocystosis, Cryptosporidiosis. Cysticercosis/Taeniasis. Roundworm–Trichinosis, Anisakiasis.

Mycotoxins and Mycotoxicosis: Aflatoxicosis, Deoxynivalenol Mycotoxicosis, Ergotism.

Drug resistance- phenomena and mechanism. Food poisoning and microbial toxins, microbial food fermentation.

UNIT IV

Determination of microorganisms and their products in food: Sampling, sample collection, transport and storage, sample preparation for analysis. Microscopic and culture dependent methods- Direct microscopic observation, culture, enumeration and isolation methods; Chemical and Physical Methods- Chemical, immunological and nucleic acid-based methods; Culture independent techniques – PCR Based, DGGE, Metagenomics, etc.; Analytical methods for microbial metabolites- microbial toxins and metabolites. **12**

UNIT V

Protection and preservation of Foods: Chemical, Radiation in foods from the microbiological angle. Indicators of water and food safety and quality: Microbiological criteria of foods, types and their Significance- standards, guidelines and specifications. Application of microbiological criteria in assessing HACCP systems. **7**

NOTE: 8 hours of self-study to be assigned

REFERENCES:

1. Doyle, M. P., Diez-Gonzalez, F., & Hill, C. (Eds.). (2020). *Food microbiology: fundamentals and frontiers*. John Wiley & Sons.
2. Banwart, G. (2012). *Basic food microbiology*. Springer Science & Business Media.
3. Jay, J. M., Loessner, M. J., & Golden, D. A. (2008). *Modern food microbiology*. Springer Science & Business Media.
4. Pelezar, M. I., & Reid, R. D. (1993). *Microbiology*. 5th Ed. McGraw Hill Book Company, New York.
5. Prescott, L. M., Willey, J. M., Sherwood, L., & Woolverton, C. J. (2014). *Prescott's microbiology*. McGraw-Hill Education.
6. Jay, J. M. (2000). *Modern Food Microbiology*. 2nd Ed. CBS Publisher.
7. Adams, M. R., & Moss, M. G. (1995). *Food Microbiology*. 1st Ed. New Age International (P) Ltd.
8. Frazier, W.C. (2017). *Food Microbiology*. 5th Ed. Mc Graw Hill Inc.
9. Doyle, P., Bonehat, L. R. & Mantville, T. J. (1997). *Food Microbiology, Fundamentals and Frontiers*. ASM Press, Washington DC.

BLUE PRINT

Code number: FST 1224

Title of the paper: FOOD MICROBIOLOGY

Total marks for which the questions are to be asked (including bonus questions)	Number of hrs.	Chapter/ Unit number
8	6	I
13	9	II
21	18	III
20	12	IV
9	7	V
71	52	TOTAL
Maximum marks for the paper (Excluding bonus question): 50		

Course Outcomes: At the end of the Course, the Student

CO1	Can relate to the interaction between microorganisms and food- Beneficial and harmful effects
CO2	Will be able to understand the general principles of Food Microbiology
CO3	Can make use of the knowledge on the Importance of food borne pathogens and spoilage microorganisms in foods with emphasis to food sanitation and control.
CO4	Will compare and survey outbreaks of food borne infections
CO5	Will determine the principles and methods of microbial examination of foods
CO6	Can design and develop procedures that influence the microbiological quality of fermented and microbial foods

Mapping of Course Outcomes to Program Outcomes

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	✓						
CO2	✓	✓					
CO3					✓		
CO4		✓			✓		
CO5			✓	✓			
CO6				✓		✓	✓

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

Semester	I
Paper Code	FST 1324
Paper Title	Food Chemistry
Number of teaching hours per week	04
Total number of teaching hours per semester	60
Number of credits	04

Objectives of the paper:

To study the structural and functional properties of chemicals in foods, their importance and assessment.

UNIT I

Food chemistry-definition and importance, Macro and micronutrients in food, Water: Water molecule structure, liquid water and ice, water activity, Phase transition of water molecule, WLF equation. Dispersed System: surface chemistry, colloidal interaction, creaming foams and emulsion, water in food, water activity and shelf life of food.

6

UNIT II

Carbohydrates-chemical reactions, functional properties of sugars and polysaccharides in foods. Monosaccharides: structure and nomenclature, conformation, physical and sensory properties, chemical reaction and derivatives. Oligosaccharides: Structure and nomenclature, properties and reaction. Enzyme degradation of polysaccharides, analysis of Polysaccharides.

10

UNIT III

Lipids in foods: classification, physical and chemical properties, effects of processing on functional properties and nutritive value. Fatty acids, Acylglycerols, Phospholipids, glycolipids, lipoproteins and unsaponifiables - nomenclature and classification, physical and chemical properties. Transfats, Waxes and Cutin. Fat replacers and Changes in Acyl lipids of foods.

13

UNIT IV

Protein, peptides and amino acids: structure, physical and chemical properties, sources, amount and functions of proteins in foods and effect of processing. Amino acids of significance in food fortification. Sensorial properties, functional properties and modifications of protein. Protein denaturation and browning reactions in foods. **12**

UNIT V

Enzymes: Nomenclature, Classification, specificity, and structure. Theory of Enzyme catalysis, Kinetics of Enzyme catalyzed reaction, and Enzyme inhibition. Enzymes of importance in foods, bio-deterioration of foods and application of Enzymes in food industries. Vitamins, Minerals and Co-factor. **11**

NOTE: 8 hours of self-study to be assigned

REFERENCES:

1. Velisek, J., Koplik, R., & Cejpek, K. (2020). *The chemistry of food*. John Wiley & Sons.
2. Beltz, H. D. (2009). *Food Chemistry*. Springer Verlag.
3. Fennema, O. R. (2006). *Food Chemistry*. Academic Press.
4. Meyer, L. H. (1987). *Food Chemistry*. CBS Publishers and Distributors, New Delhi.
5. Potter, N. N., & Hotchikiss, J. H. (2006). *Food Sciences*. 5th Ed. CBS Publishers and Distributors, New Delhi.
6. DeMan, J. M., Finley, J. W., Hurst, W. J., & Lee, C. Y. (1999). *Principles of food chemistry*. (Vol. 478, p. 446). Aspen Publishers, Gaithersburg.
7. Damodaran, S., Parkin, K. L., & Fennema, O. R. (Eds.). (2007). *Fennema's food chemistry*. CRC press.
8. Wong, D. W. (1989). *Mechanism and theory in food chemistry*. (Vol. 115). Van Nostrand Reinhold, New York.

BLUE PRINT

Code number: FST 1324

Title of the paper: FOOD CHEMISTRY

Total marks for which the questions are to be asked (including bonus questions)	Number of hrs.	Chapter/ Unit number
8	6	I
13	10	II
18	13	III
16	12	IV
16	11	V
71	52	TOTAL
Maximum marks for the paper (Excluding bonus question): 50		

Course Outcomes: At the end of the Course, the Student

CO1	Can recall and relate to the significant chemical processes in food components
CO2	Will understand the chemical bases of composition, reactivity and functionality of foods
CO3	Will experiment with Molecular rationalization and reactivity of major food components.
CO4	Can distinguish and examine the knowledge of food chemistry to control reactions in foods and major chemical reactions that limit the shelf life and quality of foods.
CO5	Are able to evaluate the chemical structures of the major components of foods
CO6	Will be able to create theoretical explanation for observed components and their rates of reactions in foods

Mapping of Course Outcomes to Program Outcomes

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1		✓					
CO2	✓	✓					
CO3			✓		✓		
CO4	✓		✓	✓			
CO5		✓		✓			
CO6	✓				✓		✓

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

Semester	I
Paper Code	FST 1424
Paper Title	Technology of Milk and Milk Products
Number of teaching hours per week	04
Total number of teaching hours per semester	60
Number of credits	04

Objective of the paper:

To understand the basic and advanced Knowledge of the properties, application and processing of milk and milk products

UNIT-I

History of Indian Dairy Industry- White revolution. Raw Milk – origin, types and composition. Physical and Chemical properties- Flavour, Colour, Freezing point, Specific gravity, Effect of heat, Acid, Alkali, and Enzymes in milk. Types of processed milk- Toned, Double toned, Standardized, Homogenized, Recombined, Reconstituted and Flavoured milks. 9

UNIT-II

Milk Processing: Production, collection, testing quality, cooling, storage, and transportation of liquid milk. Receiving and quality assessing of liquid milk in dairy industry for detection of adulteration, decision for acceptance/rejection, and determination of price of the milk. UHT milk- Aseptic packing of milk – Membrane Technology in milk processing- Bactofugation- Anti- microbial systems in milk 15

UNIT-III

Advances in milk processing: Milk procurement, buying methods, Raw Milk Reception Dock, Chilling methods, Storage of milk, Standardization, Homogenization, Types of pasteurization, Packaging of milk, Distribution of liquid milk and milk powder and milk consumption trends in India. Cleaning and sanitization of dairy equipment and plant as a whole. 12

UNIT-IV

Milk Products: Definition, composition, methods of preparation/production, quality and/or grading parameters, packaging, storage characteristics, uses and shelf-life of cream, butter and ghee; evaporated and condensed milks, skimmed, whole and instants milk powders. **8**

UNIT-V

Ice-Creams, fermented milks (Curd, yogurt etc.), Prebiotics, Probiotics and Synbiotic milk products, Cheeses, butter milk, lassi; other milk products (khoa, casein, whey proteins, lactose etc.); milk and milk product-based sweetmeats (burfi, rasogolla, milk-cake, kalakand, rabri, etc.), Milk alternatives - non-dairy (soymilk, almond milk, cereal milk, coconut milk, etc.) **8**

NOTE: 8 hours of self-study to be assigned

REFERENCES:

1. Tamime, A. Y. (Ed.). (2009). *Milk processing and quality management*. John Wiley & Sons.
2. Walstra, P. (1999). *Dairy technology: principles of milk properties and processes*. CRC Press.
3. Goldman, A., & Goldblum, R. (1995). *Handbook of Milk Composition: A Volume in Food Science and Technology*.
4. Bylund, G. (1995). *Dairy processing handbook*. Tetra Pak Processing Systems AB. Sweden.
5. Fox, P. F., McSweeney, P. L., & Paul, L. H. (1998). *Dairy chemistry and biochemistry*. (No. 637 F6.). Blackie Academic & Professional, London.
6. Robert, G. J. (Ed.). *Handbook of Milk Composition*. University of Connecticut, Storrs, Connecticut.

BLUE PRINT

Code number: FST 1424

Title of the paper: TECHNOLOGY OF MILK AND MILK PRODUCTS

Total marks for which the questions are to be asked (including bonus questions)	Number of hrs.	Chapter/ Unit number
13	9	I
21	15	II
18	12	III
9	8	IV
10	8	V
71	52	TOTAL
Maximum marks for the paper (Excluding bonus question): 50		

Course Outcomes: At the end of the Course, the Student

CO1	Can comprehend relevance of Dairy technology in the production of milk and milk products
CO2	Will understand the composition, nutritional quality, and processing of milk and milk products.
CO3	Can apply their knowledge for the processing of milk-based value-added products
CO4	Can test the efficacy procedures to enhance the quality of milk
CO5	Can determine the standards of packaged and stored milk products
CO6	Can develop high quality, safe and nutritious milk products

Mapping of Course Outcomes to Program Outcomes

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	✓				✓		
CO2		✓					
CO3	✓		✓		✓	✓	✓
CO4				✓			
CO5		✓					
CO6	✓					✓	✓

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

EST1P₁24: PRINCIPLES OF FOOD PROCESSING, PRESERVATION AND FOOD MICROBIOLOGY

Total: 88 Hours

Processing

1. Preparation of fruit preserves (jam, jelly).
2. Preparation of vegetable preserves (pickle).
3. Tomato processing.
4. Preparation and standardization of traditional Indian fermented foods.
5. Preparation of Bread and its evaluation.
6. Thermal Death Time and Point.
7. Product preparation by frying, steaming and baking.

Preservation

1. Blanching and browning control by physical and chemical methods.
2. Dehydrated products – vegetables dices tray drying, osmotic dehydration of seasonal fruits.

Food Microbiology

1. Preparation of common laboratory media and special media.
2. Microbiological analysis of typical processed and unprocessed food.
3. Staining: Gram's staining, endospore, capsule and flagellar staining, Motility of bacteria, Staining of yeast and molds.
4. Identification of important molds and yeast.
5. Microbiology of water.
6. Microbiology of hand and effect of sanitation on the hand microbiology in a small food joint.

REFERENCES:

1. Garg, N., Garg, K. L., & Mukerji, K. G. (2010). *Laboratory manual of food microbiology*. IK International Pvt Ltd.
2. Yousef, A. E., & Carlstrom, C. (2003). *Food microbiology: a laboratory manual*. John Wiley & Sons.
3. Roberts, D., & Greenwood, M. (2008). *Practical food microbiology*. John Wiley & Sons.
4. Penfield, M. P., Campbell, A. M., & Penfield, M. P. (1990). *Experimental food science*. (pp. 362-421). Academic press, San Diego, CA.

EST1P₂24: FOOD CHEMISTRY AND TECHNOLOGY OF MILK AND MILK PRODUCTS

Total: 88 Hours

Food Chemistry

1. Preparation of standard solutions and its standardization.
2. Water analysis, organoleptic and chemical (minerals) parameters and moisture isotherm, Specific gravity and Refractive Index.
3. Emulsions and foaming properties of proteins.
4. Quantitative estimation of protein by biuret method from egg white.
5. Fehling's test for reducing sugars, Microscopic examination of starch.
6. Lipids: Solubility, specific gravity and refractive index of fats.
7. Fat extraction and estimation, oxidative rancidity of fats.

Technology of Milk and Milk products

1. Enumeration and microscopic examination of psychotropic, thermophilic, thermotolerant and spore forming bacteria in milk.
2. Detection of important pathogens using selective media; *E. coli*, *Staphylococcus aureus*, *Salmonella* and *Bacillus cereus*.
3. Estimation of microbial load in milk by SPC, DMC and Dye reduction tests- (MBRT, RRT).
4. Detection of adulteration of milk.
5. Determination of efficiency of pasteurization.
6. Preparation of milk products - yoghurt/probiotic, ghee, paneer/channa, khoa, milk beverages.

Visit to modern milk processing and milk manufacturing plants/Visit to a dairy plant.

REFERENCES:

1. Weaver, C. M., & Daniel, J. R. (2003). *The food chemistry laboratory: a manual for experimental foods, dietetics, and food scientists*. CRC Press.
2. Nielsen, S. S. (Ed.). (2003). *Food analysis laboratory manual*. (p. 557). Kluwer Academic/Plenum Publishers, New York.
3. Aggarwala, A. C., & Sharma, R. M. (1961). *A laboratory manual of milk inspection*. 4th Ed.
4. Sokolova, Z. S., Lakomova, L. I., Chekulyaeva, L. V., Tinyakov, V. G., & Rostrova, N. K. (1984). *Laboratory manual for milk and milk products technology*.

Semester	II
Paper Code	FST 2124
Paper Title	Principles of Food Engineering
Number of teaching hours per week	04
Total number of teaching hours per semester	60
Number of credits	04

Objective of the Paper:

To understand fundamental concepts and principles of food engineering in food manufacturing industries.

UNIT I

Introduction to food engineering & processes: Units and dimensions, Unit operations (drying, sieving, grinding, extraction, milling), Principle of heat and mass transfer, Principles of thermodynamics and heat transfer applied to food engineering; fundamentals of heat and analogy to mass transfer in food processing. **6**

UNIT II

Kinetics of biological reactions - kinetics of reactions occurring in processed foods, reaction velocity constant, order of reaction; quality changes during storage of foods; application of Arrhenius equation to biochemical reactions in food. **7**

UNIT III

Method for thermal process evaluation - Commercial sterility, pasteurization and sterilization methods based on slowest heating region; determination of the process time based on region of greatest temperature lag, calculation of process time for fluids on stream line flow and turbulent flow heated in heat exchangers. Hydrostatic sterilizer and aseptic packaging practices and design problems. **14**

UNIT IV

Food chilling and freezing – Precooling and cold storage, Properties of frozen foods, freezing point depression; general introduction to enthalpy change during freezing; Plank's equation for predicting rates of product freezing, Cryogenic freezing and IQF, design of food freezing equipment such as air blast freezers, plate freezers and immersion freezers. **11**

UNIT V

Process Heat Transfer - Modes of heat transfer and overall heat transfer; thermal properties of foods such as specific heat and thermal conductivity; Fourier's law, steady state and unsteady state conduction; heat exchange equipment; energy balances; rate of heat transfer; thermal boundary layer; heat transfer by forced convections; heat transfer to flatplate and in non-Newtonian fluids; heat transfer in turbulent flow; heating and cooling of fluids in forced convection outside tube; natural convection. **14**

NOTE: 8 hours of self-study to be assigned

REFERENCES:

1. Singh, R. P., & Heldman, D. R. (1984). *Introduction to Food Engg.* Academic Press. INC, London.
2. Earle, R. L. (1983). *Unit Operations in Food processing.* 2nd Ed. Pergamon Press Oxford, U.K.
3. Toledo, R. T. (1997). *Fundamentals of Food Process Engineering.* CBS Publishers, New Delhi.
4. Batty, J. C., & Folkman, S.L. (1983). *Food Engineering Fundamentals.* John Wiley and Sons, New York.

BLUE PRINT

Code number: FST 2124

Title of the paper: PRINCIPLES OF FOOD ENGINEERING

Total marks for which the questions are to be asked (including bonus questions)	Number of hrs	Chapter/ Unit number
8	6	I
10	7	II
18	14	III
16	11	IV
19	14	V
71	52	TOTAL
Maximum marks for the paper (Excluding bonus question): 50		

Course Outcomes: At the end of the Course, the Student

CO1	Will have a knowledge on sustainable and environmentally safe designs of manufacturing units for Quality foods
CO2	Will understand the Principles of Thermodynamics, heat and mass transfer in Food Process Engineering
CO3	Will be able to apply Principles of utilization of heat and analogy of mass transfer in unit operations and assessment of process time in Food Industry
CO4	Can assess the Kinetics of biological reactions and thermal processing methods of foods
CO5	Can explain the Laws of heat transfer, refrigeration cycles and freezing curves
CO6	Can adapt and construct new designs of Food Processing Equipment

Mapping of Course Outcomes to Program Outcomes

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	✓				✓		
CO2		✓					
CO3							
CO4		✓		✓			
CO5				✓	✓		
CO6	✓		✓				✓

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

Semester	II
Paper Code	FST 2224
Paper Title	Technology of Cereals and Legumes
Number of teaching hours per week	04
Total number of teaching hours per semester	60
Number of credits	04

Objective of the Paper:

To understand the importance of nutrients in cereals and legumes and rational of processing technology to develop value added products.

UNIT I

Importance of cereals and legumes: Production trend, Post-harvest quality and quantity losses. Recommended pre-processing practices for handling of cereals and pulses for their safe storage, including control of infestation, National and International quality and grading standards. **6**

UNIT II

Structure, types, composition, quality characteristics and physicochemical properties of wheat. Cleaning, tempering and conditioning, and milling processes for wheat. Blending of flours, Milling equipment and milling products (Dalia, Atta, Semolina and flour). Technology of Bread making: importance of critical unit operations, bread making systems; functions of ingredients and additives such as fat, emulsifiers, oxidants, reducing agents and conditioners; bread faults and staling. Quality characteristics and rheological properties of wheat milling products and its assessment. By-product utilization. Technology of biscuit, cookies, crackers and cakes manufacturing; leavening agents in bakery products. Technology of noodles and pasta products. **20**

UNIT III

Structure, types, composition, quality characteristics and physicochemical properties of rice. Milling and parboiling of paddy, Curing and ageing of paddy and rice. Criteria in and assessment of milling, cooking, nutritional and storage qualities of raw & parboiled rice. Processed rice products (flaked, expanded and puffed rice). By-product (husk and rice bran) utilization. **8**

UNIT IV

Structure and composition of corn grain, different types of corn, Dry and wet milling of corn starch, Processed corn products (popped corn, corn flakes etc.) Structure and composition of barley, bajra, jowar and other cereal grains and millets. Pearlring of millets, Parched and snack products, corn sweeteners (high fructose corn syrups) and their uses, Barley malting process: steeping, germination and drying; significance of malting; different types of malts and their food applications. **12**

UNIT V

Structure, composition and properties of legumes. Cleaning, grading, pre-treatments for difficult-to-mill (urad, arhar, moong, moth) and easy-to-mill (chana, masoor and pea) legumes, milling practices and actual milling of different legumes. Sweet and savoury products from legumes in India. **6**

NOTE: 8 hours of self-study to be assigned

REFERENCES:

1. Sahay, K. M., & Singh, K. K. (2001). *Unit operations of agricultural processing*. Vikas Publishing house Pvt. Ltd.
2. Ferreira Guiné, R. P., & Reis Correia, P. M. (Eds.). (2014). *Engineering Aspects of Cereals and Cereal-based products*. CRC Press.
3. Dendy, D. A. V., & Braszczok, B. J. (2001). *Cereal and Cereal Products*. Aspen.
4. Hosney, R. S. (1994). *Principles of Cereal Science and Technology*. 2nd Ed. AACC.
5. Kay, D. E. (1979). *Food Legumes*. Tropical Products Institute.
6. Kent, N. L. (1983). *Technology of Cereals*. 4th Ed. Pergamon Press.

BLUE PRINT

Code number: FST 2224

Title of the paper: TECHNOLOGY OF CEREALS AND LEGUMES

Total marks for which the questions are to be asked (including bonus questions)	Number of hrs	Chapter/ Unit number
8	6	I
28	20	II
11	8	III
16	12	IV
8	6	V
71	52	TOTAL
Maximum marks for the paper (Excluding bonus question): 50		

Course Outcomes: At the end of the Course, the Student

CO1	Gains knowledge on the importance and benefits of cereals and legumes for production of quality products
CO2	Can compare the structural illustration and nutritional quality of food grains, importance of post-harvest quality losses and processing practices of cereals and legumes
CO3	Can identify the unit operations associated with gradations, handling and storage of cereals and pulses
CO4	Will be able to compare and categorize important factors involved in post-harvest processes affecting the quality, quantity, nutrient composition of cereal and legume products
CO5	Can determine the quality standard of cereals and legumes, their products and processing efficacy
CO6	Can formulate value added product development with by-product utilization

Mapping of Course Outcomes to Program Outcomes

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	✓	✓					
CO2	✓	✓			✓		
CO3			✓				
CO4	✓		✓	✓	✓		
CO5				✓			
CO6						✓	✓

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

Semester	II
Paper Code	FST 2324
Paper Title	Technology of Fruits and Vegetables
Number of teaching hours per week	04
Total number of teaching hours per semester	60
Number of credits	04

Objective of the Paper:

Processing and Preservation of fruits and vegetables for the production of Quality and value-added products.

UNIT I

Indian and global scenario on production, processing and consumption of fruits and vegetable; Quality requirements of raw materials for processing; sourcing and receiving at processing plants; primary processing: grading, sorting, cleaning, washing, peeling, slicing and blanching; minimal processing, quality characteristics of water for fruit and vegetable processing industry. Quality control in food processing industry. **12**

UNIT II

Canning of fruits and vegetables, preparation of syrups and brines, spoilage of canned fruits and stages of new product development. value added products from fruit and vegetable wastes, and waste management. Production of mushroom and its processed products, Cashew and coconut: chemical composition, processing technology and their processed products. RTS fruit beverages, Technology for processed products like pickles, chutneys, sauces particularly from raw mango, lime and other regional fruits and vegetables of importance, Processing of fruits for candies, bars, toffees, jams and jellies, squashes and syrups using locally available fruits like papaya, mango, canola and other under-utilized fruits. **19**

UNIT III

Freezing of fruits and vegetables: methods of freezing-sharp and quick freezing, cryogenic freezing, dehydro-freezing, changes during freezing and storage, thawing, IQF and frozen fruits and vegetables; for peas, mango pulps. **8**

UNIT IV

Methods of storage, refrigerated, hypobaric storage, MAP recent developments for fruit and vegetable industries, advantages and disadvantages. Food colors: Natural coloring matter and synthetic colors. Food additives- flavor compounds and types of flavors, brominated vegetable oil (BVO). Important methods for analysis of fruit, vegetable and their products-Determination of TSS, acids, starch, vitamin C and determination of pigments. **8**

UNIT V

Dehydration of fruits and vegetables using various drying technologies like sun drying, solar drying (natural and forced convection), osmotic, tunnel drying, fluidized bed drying, freeze drying, convectional and adiabatic drying; applications to raisins, dried figs, vegetables, intermediate moisture fruits and vegetables. Fruit powders using spray drying. **5**

NOTE: 8 hours of self-study to be assigned

REFERENCES:

1. Srivastava, R. P., & Kumar, S. (2001). *Fruit and Vegetable Preservation Principles and Practices*. 3rd Ed. International Book distributing Co. Lucknow (India).
2. Thompson, A. K. (2003). *Fruit and Vegetables – Harvesting, handling and storage*. 2nd Ed. Blackwell Publishing.
3. Pantastico, E. B. (1975). *Post-harvest Physiology, handling and utilization of tropical and subtropical fruits and vegetables*. AVI Publishing Company, Inc.

BLUE PRINT

Code number: FST 2324

Title of the paper: TECHNOLOGY OF FRUITS AND VEGETABLES

Total marks for which the questions are to be asked (including bonus questions)	Number of hrs	Chapter/ Unit number
16	12	I
26	19	II
11	8	III
11	8	IV
7	5	V
71	52	TOTAL
Maximum marks for the paper (Excluding bonus question): 50		

Course Outcomes: At the end of the Course, the Student

CO1	Will gain knowledge on quality food production from fruits and vegetables
CO2	Can outline the characteristics of raw materials, handling, processing and preservation of Fruits and Vegetables.
CO3	Will be able to identify and develop preservation techniques and storage methods in fruits and vegetable processing
CO4	Can examine and compare the quality control of fruits and vegetable processing industries
CO5	Can evaluate the storage, packaging and preservation techniques for fruits and vegetables
CO6	Can adapt by-product utilization of fruits and vegetables with added value

Mapping of Course Outcomes to Program Outcomes

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	✓	✓					
CO2	✓						
CO3	✓	✓	✓		✓		
CO4		✓		✓			
CO5				✓			
CO6						✓	✓

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

Semester	II
Paper Code	FST 2424
Paper Title	Food Biotechnology
Number of teaching hours per week	04
Total number of teaching hours per semester	60
Number of credits	04

Objective of the Paper:

Improvisation and benefits of biotechnology in innovative food production to enhance quality of food and food security.

UNIT I

History and development of biotechnology, Application of genetics to food production. Methods of molecular cloning, immobilization of microbial and cultured plant cells. **4**

UNIT II

Basic principles of molecular biology and biotechnology: Introduction to Genetics, Microbial gene transfer mechanisms, Mutation, Types of mutations, Molecular mechanism and practical applications of mutations – site-directed mutagenesis. Recombinant DNA Technology. Nutrigenomics – concept and significance. Biosensors and novel tools and their application in food science. **15**

UNIT III

Principles of upstream and downstream processing. Bacterial starter culture, Methods of inoculum, and medium preparation, slurry processing and product isolation. Technological aspects of industrial production of beer, wine, enzymes amylase, pectinase, proteases, organic acids (vinegar), amino acids (MSG), vitamins (Vit B12), antibiotics (nisin), baker's yeast, single cell protein, immobilized and nano-enzymes. **15**

UNIT IV

Traditional applications of biotechnology in food - Fermented foods: ex: dairy products, oriental fermentations, alcoholic beverages, and food ingredients. Health benefits of fermented foods. Fermented food: origin, scope and development, Types of fermented foods: sauerkraut, yoghurt, cheese, miso, tempeh, idly, dosa. Importance of food fermentation in food preservation and nutritional enhancement. Application of enzymes in food industry, production of food flavour, colour, enzymes. **10**

UNIT V

Plant and animal culture, transgenic plants, application of genetic engineering in food science and technology. Genetically modified foods – concept, types and application. Examples of genetically modified crops- Bt brinjal, Bt maize and golden rice. Regulations concerning Genetically Modified Foods in India and at the International level; Ethical issues concerning GM foods; testing for GMOs; current guidelines for the production, release and movement of GMOs; labelling and traceability; trade related aspects; bio safety; risk assessment and risk management. Public perception of GM foods. **8**

NOTE: 8 hours of self-study to be assigned

REFERENCES:

1. Stanbury, P. F., Whitaker, A., & Hall, S.J. (1995). *Principles of Fermentation Technology*. 2nd Ed. Butterworth-Heinemann Ltd.
2. Bamforth, C. W., & Cook, D. J. (2019). *Food, Fermentation, and Micro-organisms*. 2nd Ed. Wiley-Blackwell.
3. Slater, A., Scott, N. W., & Mark, R. F. (2003). *Plant Biotechnology: The Genetic Manipulation of Plants*. Oxford University Press.
4. Snustad, D. P., & Simmons, M. J. (2011). *Principles of genetics*. 6th Ed., John Wiley & Sons, Inc.
5. Primrose, S. B., & Twyman, R. M. (2006). *Principles of Gene Manipulation and Genomics*. 7th Ed., Blackwell Publishing.
6. Brown, T. A. (2016). *Gene Cloning and DNA Analysis -An Introduction*. 7th ed., Wiley Blackwell.

BLUE PRINT

Code number: FST 2424

Title of the paper: FOOD BIOTECHNOLOGY

Total marks for which the questions are to be asked (including bonus questions)	Number of hrs	Chapter/ Unit number
6	4	I
21	15	II
21	15	III
13	10	IV
10	8	V
71	52	TOTAL
Maximum marks for the paper (Excluding bonus question): 50		

Course Outcomes: At the end of the Course, the Student

CO1	Can relate to the enhancement of quality and production of genetically modified foods
CO2	Can understand the concepts and skills in biotechnological processes underlying food transformation
CO3	Will be able to apply the knowledge for improved production, modification and enhancement of food quality
CO4	Will be able to analyze molecular and genetic basis of foods and compare the genomics of quality food producers
CO5	Can evaluate the safety of biotechnologically derived foods
CO6	Will be competent to produce functional and fermented foods, and improvise the production of enzymes for food applications

Mapping of Course Outcomes to Program Outcomes

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	✓				✓		
CO2	✓						
CO3		✓	✓				✓
CO4		✓	✓	✓			
CO5				✓	✓		
CO6						✓	✓

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

Semester	II
Paper Code	FST 2524
Paper Title	Food Packaging and Technology
Number of teaching hours per week	04
Total number of teaching hours per semester	60
Number of credits	04

Objective of the paper:

To impart knowledge on various areas related to functions and applications of food packaging, materials used and the technology involved.

UNIT I

Introduction to Food Packaging: definition, factors involved in the evolution and selection of a food package, functions of food packaging (containment, protection, convenience and communication). Paper and paper-based packaging materials: types of paper (Kraft, bleached, greaseproof, glassine), paper products (paper bags, cartons, drums and moulded paper containers), functional properties of paper; testing of paper packaging materials. **8**

UNIT II

Plastic packaging materials: classification of polymers, functional and mechanical properties of thermoplastic polymers; processing and converting of thermoplastic polymers (extrusion, blow moulding, injection moulding, compression moulding, lamination and heat sealing); testing of plastic packages. Bioplastics and its applications. **8**

UNIT III

Metal packaging materials: container making processes (end manufacture, three-piece can manufacture and protective and decorative coatings); functional properties of metal containers; Tin plate containers- quality control tests. Glass packaging materials: composition and manufacture of glass containers; glass container nomenclature; glass containers-closure functions, closure terminology and construction; properties of glass containers – mechanical, thermal and optical properties; testing of glass containers. **7**

UNIT IV

Aseptic packaging of foods: sterilization of packaging material food contact surfaces & aseptic packaging systems; active food packaging – definition, scope, physical and chemical principles involved. Edible films and coatings– use of edible active layers to control water vapor transfer, gas exchange, modification of surface conditions with edible active layers. Oxygen absorbents – classification and main types of oxygen absorbents, factors influencing the choice of oxygen absorbents, factors influencing the choice of oxygen absorbents, application of oxygen absorbents for shelf-life extension of food and advantages and disadvantages of oxygen absorbents.

19

UNIT V

Ethanol vapor: ethanol vapour generator, uses of ethanol for shelf-life extension of food, effect of ethanol vapour on food spoilage/food poisoning bacteria, and advantages and disadvantages of ethanol/vapour generators. Safety considerations in food packaging – types of food safety problems associated with package, package labelling and food safety. Packaging requirements of selected foods- cereal and snack food, beverages, milk and dairy products, poultry & eggs, red meat, frozen foods, horticultural products and microwavable foods.

10

NOTE: 8 hours of self-study to be assigned

REFERENCES:

1. Robertson, G.L. (2006). Food Packaging: Principles and Practice (2nd ed.), Taylor & Francis
2. Sacharow, S. and Griffin, R.C. (1980) Principles of Foods Packaging, 2nd Ed., Avi, Publication Co. Westport, Connecticut, USA.
3. Athalye, A.S. (1992), Plastics in Packaging, Tata McGraw –Hill Publishing Co., New Delhi.
4. Rooney, M.L. (1995). Active Food Packaging, Blackie Academic & Professional, Glasgow, UK.
5. Bakker, M. (1986) The Wiley Encyclopaedia of Packaging Technology, John Willey & Sons. Inc; New York.
6. Food Packaging Technology Handbook. NIIR Board, National Institute of Industrial Research, 2003
7. Ahvenainen, R. (Ed.) Novel Food Packaging Techniques, CRC Press, 2003
8. Han, J.H. (Ed.) Innovations in Food Packaging, Elsevier Academic Press, 2005
9. Coles, R., McDowell, D. and Kirwan, M.J. (Eds.) Food Packaging Technology, CRC Press, 2003

BLUE PRINT

Code number: FST 2524

Title of the paper: FOOD PACKAGING AND TECHNOLOGY

Total marks for which the questions are to be asked (including bonus questions)	Number of hrs.	Chapter/ Unit number
11	8	I
13	8	II
8	7	III
26	19	IV
13	10	V
71	52	TOTAL
Maximum marks for the paper (Excluding bonus question): 50		

Course Outcomes: At the end of the Course, the Student will be able to

CO1	Describe the different types of Food packaging, its merits and demerits.
CO2	Associate the importance of Food Packaging and its various applications in food Industry
CO3	Illustrate the Knowledge on the technological aspects of Food Packaging materials and its production.
CO4	Analyse and compare the various types of food packaging materials and its safety aspects.
CO5	Evaluate the Role and Functions of active ingredients in Food Packaging
CO6	Design and develop innovative Food Packaging.

Mapping of Course Outcomes to Program Outcomes

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	✓				✓	✓	✓
CO2		✓	✓				
CO3				✓	✓		
CO4					✓	✓	
CO5				✓		✓	✓
CO6			✓			✓	✓

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

Semester	II
Paper Code	FST 2624
Paper Title	Sensory Evaluation
Number of teaching hours per week	04
Total number of teaching hours per semester	60
Number of credits	04

Objective of the Paper:

Evaluation of foods based on consumer preferences as a measuring tool for interpretation and analysis of different foods.

UNIT I

Sensory evaluation: Introduction and History, Application, Sensory evaluation and Food Acceptance, Prerequisites of a successful sensory evaluation programme, Sensory evaluation and computers. **6**

UNIT II

Mechanical properties of foods, Mechanical models to visualize behaviour of foods, basic and rheological considerations and their applications to foods. **5**

UNIT III

Central Nervous system: Introduction, Functioning of CNS, Sensory division of CNS: Brain and Spinal cord, Peripheral Nervous system: Cranial nerves and spinal nerves, Sensory organs: Eyes, ear, nose tongue, teeth and sensory interaction, Information processing, integration, Transmission and storage **16**

UNIT IV

Sensory Evaluation methods: Basic concept, Application of sensory evaluation in food industry, Sensory evaluation laboratory designing and infrastructure requirement, Panel member requirement and selection, Factors affecting sensory verdict, Sensitivity test, Discrimination test, Qualitative and Quantitative test, Consumer Test, Score card development. Classification of taste and odours, threshold value factors affecting senses, visual, auditory, tactile and other responses, consumer research-affective tests, objective methods, types or questionnaire. **20**

UNIT V

Food Texture– basic concept, Principles of determining food texture, Texture measurement instrument. Textural attributes of fruits and vegetables, Textural attributes of pasta and baked products, Textural properties of meat and their instrumental measurement. **6**

NOTE: 8 hours of self-study to be assigned

REFERENCES:

1. Lawless, H. T., & Heymann, H. (2010). *Sensory Evaluation of Food: Principles and Practices*. 2nd Ed., Springer.
2. Thomas, B. C., Gail, V. C., & Morten, C. M. (2010). *Sensory Evaluation Techniques*. 4th Ed., CRC press.
3. Michael, M. (1986). *Sensory Evaluation of Food: Statistical Methods and Procedures*. CRC, Taylor and Francis press.

BLUE PRINT

Code number: FST 2624

Title of the paper: SENSORY EVALUATION

Total marks for which the questions are to be asked (including bonus questions)	Number of hrs	Chapter/ Unit number
8	6	I
6	5	II
21	16	III
26	20	IV
10	5	V
71	52	TOTAL
Maximum marks for the paper (Excluding bonus question): 50		

Course Outcomes: At the end of the Course, the Student

CO1	Can interpret and understand the sensory attributes of food products through consumer response and computational analysis
CO2	Can compare and contrast the physical and sensory attributes of food and the methods of sensory evaluation
CO3	Can identify the correct, contextual and appropriate methods for marketing of food and beverages
CO4	Will be able to categorize consumer preference, competitor product analysis and buying behaviour
CO5	Can choose and evaluate the qualitative, quantitative, sensory test, and determine the score card
CO6	Can discuss theoretical concepts, recommend, justify and critique commonly used methods of sensory analysis

Mapping of Course Outcomes to Program Outcomes

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	✓				✓	✓	
CO2		✓					
CO3	✓						✓
CO4		✓		✓	✓		
CO5			✓	✓			
CO6		✓					

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

FST2P124: PRINCIPLES OF FOOD ENGINEERING, TECHNOLOGY OF CEREALS AND LEGUMES AND TECHNOLOGY OF FRUITS AND VEGETABLES

Total: 88 Hours

Technology of Cereals and Legumes

1. Determination of physical (eg. angle of repose) and nutritional properties of different cereal grains.
2. Determination of sedimentation value of the Maida.
3. Determination of alcoholic acidity of the sample of the wheat flour/Maida.
4. Determination of adulterant (NaHCO₃) in wheat flour/Maida.
5. Preparation of expanded & puffed rice from raw and parboiled materials and assessment of quality of products including expansion in volume.
6. Traditional and improved pre-treatments and its effect on dehusking of some legumes.
7. Determination of dry and wet gluten of a given flour sample.

Technology of Fruits and Vegetables

1. Fruit pulp preparation.
2. Fruit preserve and candy; fruit RTS, nectar, cordial, squash, syrup; preparation of grape raisin /dried fig.
3. Preparation of anardana, Papaya/guava cheese, banana and potato wafers.
4. Demonstration of vacuum packaging for fruits and vegetables.
5. Determination of Vitamin C by titrimetric method.

Visit to working rice mill, collection and analysis of samples at various steps of milling.

REFERENCES:

1. Srivastava, R. P., & Kumar, S. (2019). *Fruits and Vegetable Preservation, Principle and practices*. 3rd Ed., International Book Distributing Co.
2. *Manual of methods of analysis of foods – Water*. (2015). FSSAI.
3. Ndirika, V. (2005). *Post –Harvest and Processing Technologies of Legumes and Oil Seeds*. Ade Commercial Press.
4. *Manual of methods of analysis of foods – Cereals & Legumes*. (2012). FSSAI.

FST2P₂₄: FOOD BIOTECHNOLOGY AND SENSORY EVALUATION

Total: 88 Hours

Food Biotechnology

1. Preparation of Buffers.
2. Analysis of water (estimation of chloride, calcium and magnesium, quality of water- H₂S method).
3. Analysis of the following fermentation products.
 - a) Alcohol
 - b) Baker's yeast
 - c) Citric acid
 - d) Pectinase
 - e) Proteases
 - f) Sauerkraut
4. Effect of inoculum size in fermented beverage preparation and its analysis.
5. Estimation of proteins in mushroom by Kjeldahl/ Bradford's method.

Sensory Evaluation

1. Sample preparation and presentation techniques.
2. Demonstration of threshold value for sweet, salt, and sour taste.
3. Development of sensory score card and designing of Consumer test questionnaire.
4. Determination of viscosity by viscometer/ rheometer.
5. Demonstration of difference tests-paired comparison, Triangle test and Duo-Trio test.
6. Recognition of odour components in different media-Coconut oil and groundnut oil.
7. Demonstration of sensitivity test- Colour and Finger feel.
8. Ranking test to determine individual attributes and overall quality in food samples.
9. Demonstration of Flavour profile of fruit beverages-squash, RTS, Nectar.
10. Determination of Quality Profile-Biscuit, Chocolate and candy.

Visit to analytical lab/Research Institute for demonstration of Protein, Dietary fiber, Fat and Sensory evaluation.

REFERENCES:

1. Meilgaard, M., Civille, G. V., & Carr, B. T. (1999). *Sensory Evaluation Techniques*. 3rd Ed. CRC Press, Boca Raton, London.
2. Christman, R. J. (Ed.). (1979). *Sensory experience*. Harper and Row Publications, New York.
3. Bell, G. A., & Watson, A. J. (Eds.). (1999). *Tastes and aromas*. Blackwell Science Limited, London.
4. Barman, N.S., Badwaik, L. S., & Deka, S. C. (2015). Pectinase production by *Aspergillus niger* using banana (*Musa balbisiana*) peel as substrate and its effect on clarification on banana juice, *J Food Sci Technol*. 52(6).

Semester	III
Paper Code	FST 3124
Paper Title	Fermentation Technology
Number of teaching hours per week	04
Total number of teaching hours per semester	60
Number of credits	04

Objective of the paper:

The course aims to explain the various techniques of upstream and downstream processing associated with fermentation. It illustrates the details of different fermentation systems, bioreactor design, configuration, types, validation, operation, process parameters, and scale-up and scale-down studies. The course will also help students to comprehend the concepts of the fermentation kinetics, heat and mass transfer, KLa, rheology and viscosity. It describes techniques of product isolation, purification and quantification along with various types of fermented food products.

UNIT I

Introduction and scope of fermentation technology: fermentation kinetics, types of fermentation systems: batch and continuous systems, fed-batch culture, solid substrate fermentation instrumentation and control; various types of food fermentations and significance and advantages of fermented foods. **9**

UNIT II

Design of bioreactors: the basic objective of fermenter design, aseptic operation & containment, body construction, agitator and sparger design, baffles, stirrer glands and bearings. Process parameters and measurement techniques: measurement of temperature, pressure and pH, DO, foam etc.; flow rate of liquid and gases; Automation (processes computerization), Validation of Fermenter. **16**

UNIT III

Bioreactor configurations and types: Bubble column, airlift reactor, packed bed, fluidized bed, trickle bed, Membrane reactor, Photobioreactor, solid-state fermenter, Animal and plant cell bioreactors. Scale-up and Scale-down studies of bioreactors. Heat and Mass transfer in bioprocess, Relationship in between heat transfer, cell concentrations and stirring conditions, Measurement of KLa, Rheological properties of fermentation broths, Factors affecting broth viscosity. **15**

UNIT IV

Downstream Processing: Various equipment for product recovery; micro-filters and Ultrafiltration systems for separation of cells and fermentation medium and for the concentration of medium containing product; chromatographic systems of separation; extraction of product with solvent; evaporation and crystallization; centrifugation, different types of centrifuges; drying techniques; Instrumentation and controls. **10**

UNIT V

General methods of industrial production, basic calculations, beverages, analysis of the final product, Protein-based contaminants, Removal of altered forms of the protein of interest from the product stream, Product potency, Determination of protein concentration (Biuret, Lowry's, Bradford and BCA method). **8**

NOTE: 8 hours of self-study to be assigned

References:

1. Young, M. M. (2004). Comprehensive Biotechnology. Pergamon press.
2. Stanburry, P.F. & Whitaker. (2005). Principles of Fermentation Technology. Pergamon Press, Butterworth Heinemann-Elsevier.
3. Mudler, M. (2007). Basic Principles of Membrane Technology. Springer.
4. Drioli, E. & Gicorna, L. (2004). Biocatalytic Membrane Reactors. Taylor Francis Group.
5. Techniques used in Bioproduct Analysis. (1992). Butterworth Heinemann Ltd.
6. Prescott and Dunn's Industrial Microbiology. (1999). Reed, G. (Ed.). 4th Ed., CBS Publishers and Distributors, New Delhi.

BLUE PRINT

Code number: FST 3124

Title of the paper: FERMENTATION TECHNOLOGY

Total marks for which the questions are to be asked (including bonus questions)	Number of hrs	Chapter/ Unit number
3	3	I
22	16	II
21	15	III
14	10	IV
11	8	V
71	52	TOTAL
Maximum marks for the paper (Excluding bonus question): 50		

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Describe Fermentation technology in food industries and allied fields.
CO2	Differentiate and discuss the importance of various principles and techniques associated with upstream and downstream processing in fermentation technology.
CO3	Illustrate the techniques for fermentation, process control, scaling and production of fermented products.
CO4	Compare and explain the factors involved in upstream and downstream processing which influence fermentation and fermented product quality.
CO5	Evaluate and summarize the process parameters for scale-up and scale-down in fermentation to increase the production and purification efficiency.
CO6	Design a complete production and purification strategy employing bioprocess concepts.

Mapping of Course Outcomes to Program Outcomes

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	✓		✓				
CO2		✓					
CO3	✓						
CO4			✓	✓			
CO5	✓	✓					
CO6			✓		✓	✓	✓

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

Semester	III
Paper Code	FST 3224
Paper Title	Technology of Meat, Fish and Poultry Products
Number of teaching hours per week	04
Total number of teaching hours per semester	60
Number of credits	04

Objective of the Paper:

The course aims to provide a platform to understand the importance of livestock, fish and poultry industry, along with describing the structure, composition and nutritional quality of animal products, the changes related to muscle and various other tissues during slaughter. The study illustrates the processing technology of meat, poultry and fish and explains the value addition and packaging of meat, fish and poultry products.

UNIT I

Status and scope of meat industry in India; Structure and physico-chemical properties of muscle meat: composition and nutritive value, conversion of muscle into meat, environmental and animal production factors that affect meat quality, post mortem changes in meat, Rigour Mortis, cold shortening, pre-rigour processing; stunning and slaughtering methods. **9**

UNIT II

Aging of meat, meat tenderization- natural and artificial methods; cooking methods for meat: roasting, frying and braising; storage and preservation of meat: chilling, freezing, curing, smoking, dehydration, freeze-drying, irradiation, canning. **9**

UNIT III

Cooking, palatability and eating quality of meat, microbial spoilage of meat; meat analogues; meat industry by-products: importance and applications, restructured meat products (sausages), intermediate moisture and dried meat products and value-added products; meat plant hygiene and good manufacturing practices; packaging of meat products. **10**

UNIT IV

Egg: Structure, composition and nutritive value of eggs, Storage and shelf-life problems. Quality evaluation of eggs: international and external quality evaluation, candling, albumen index, Haugh unit, yolk index etc. Egg preservation: grading of eggs, whole egg preservation, pasteurization, dehydration, freezing, egg products: egg powder, value-added egg products (e.g., Meringues and Foams etc.), packaging of egg and egg

products Poultry products: types, chemical and nutritive value of poultry meat, slaughtering and evaluation of poultry carcasses; poultry cut-up parts and meat/bone ratio; preservation, grading and packaging of poultry meat.

18

UNIT V

Fish: factors affecting the quality of fresh fish, fish dressing, chilling, freezing, glazing, salting and canning of fish; manufacturing of fish paste, fish oil, fish protein concentrate and fish meal; by-products of fish industry and value-added products and their utilization. 6

NOTE: 8 hours of self-study to be assigned

REFERENCES:

1. Joshi, B. P. (1994). Meat Hygiene for Developing Country, Shree Almora Book Depot, India.
2. William J. & Owen J., (1977). Egg Science & Technology, AVI Publishing Company, INC. Westport, Connecticut.
3. Lawrie, R.A. (1998). Meat Science. Woodhead Publishers.
4. Mead, G. (2004). Poultry Meat Processing and Quality. Woodhead Publishers.
5. Panda, P.C. (1992). Text Book on Egg and Poultry Technology, Vikas Publishers.

BLUE PRINT

Code number: FST 3224

Title of the paper: TECHNOLOGY OF MEAT, FISH AND POULTRY PRODUCTS

Total marks for which the questions are to be asked (including bonus questions)	Number of hrs	Chapter/ Unit number
13	9	I
13	9	II
13	10	III
23	18	IV
9	6	V
71	52	TOTAL
Maximum marks for the paper (Excluding bonus question): 50		

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Recall the importance and benefits of meat, fish and poultry for production of quality products.
CO2	Understand the technology for raw material characteristics, handling, processing, and preservation of meat, poultry and fish products and by-product utilization.
CO3	Implement the hygiene, sanitation and mechanized practices of meat, fish and poultry products industry.
CO4	Distinguish the factors involved in processes affecting the quality, quantity, nutrient composition of meat, poultry and fish products.
CO5	Comprehend and compare the food standards in relation to these food commodities.
CO6	Develop various value-added products.

Mapping of Course Outcomes to Program Outcomes

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	✓		✓				
CO2		✓					
CO3	✓						
CO4			✓	✓			
CO5	✓	✓					
CO6			✓		✓	✓	✓

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

Semester	III
Paper Code	FST 3324
Paper Title	Food Additives, Contaminants and Toxicology
Number of teaching hours per week	04
Total number of teaching hours per semester	60
Number of credits	04

Objectives of the paper:

Helps to understand the applications of food additives in food processing and preservation. The paper aims to understand the chemical and biological principles that determine the toxicity of substances in foods. It enables the students to become familiar with the properties, mode of action and methods of analysis for the contaminants in foods.

UNIT I

Food additives- definitions, classification and functions. Food preservatives - classifications, regulatory issues in India, international legal issues **4**

UNIT II

Chelating agents: types, uses and mode of action. Colouring agents: colour retention agents, applications and levels of use, natural colourants and its sources, colour extraction techniques, colour stabilization Flavoring agents: flavours (natural and synthetic flavours), flavour enhancers, flavour stabilization, flavour encapsulation. Flour improvers: leavening agents, humectants and sequestrants, hydrocolloids, acidulants, anticaking agents, etc. **7**

UNIT III

Sweeteners: natural and artificial sweeteners, nutritive and non-nutritive sweeteners, properties and uses. Emulsifiers: Types, selection of emulsifiers, emulsion stability, functions and mechanism of action. Nutrient supplements & thickeners, polysaccharides, bulking agents, anti-foaming agents, synergists, antagonists' additives, food uses and functions in formulations; permitted dosages, indirect food additives; harmful effects/side effects associated with various additives (various diseases), additives and natural alternatives. **11**

UNIT IV

Agricultural and industrial contaminants in foods: pesticides residues in fruits and vegetables, metal contaminants in foods and their toxicity in the human body; animal drug residues in food and water, dioxins and related compounds in food; metals such as lead, arsenic, cadmium and mercury. Allergens, toxic constituents and anti-nutritional factors of plant foods (enzyme inhibitors, trypsin and chymotrypsin inhibitor, amylase inhibitor, sugars causing flatulence, Phyto-lectins). **14**

UNIT V

Introduction to food toxicology: classification, dose, determinants of toxins in foods; naturally occurring toxins (NOTS) from animals, bacterial, fungal, plants and seafood sources. Food additives as toxicants: artificial colours, preservatives, sweeteners; toxicants formed during food processing such as nitrosamines, Maillard reaction products acrylamide, benzene, heterocyclic amines and aromatic hydrocarbons and irradiation; risk of genetically modified food and food supplements, persistent organic pollutants, toxicity implications of nanotechnology in food. Risk assessment in food toxicology; environmental contaminants, pesticides and antibiotic residues. **16**

NOTE: 8 hours of self-study to be assigned

REFERENCES:

1. Branen AL, Davidson PM & Salminen S. (2001). Food Additives. 2nd Ed. Marcel Dekker.
2. George AB. (1996). Encyclopedia of Food and Color Additives. Vol. III. CRC Press.
3. George AB. (2004). Fenaroli's Handbook of Flavor Ingredients. 5th Ed. CRC Press.
4. Timbrell, J., & Barile, F. A. (2023). Introduction to toxicology. CRC Press.
5. Kotsonis, F. N., & Burdock, G. A. (2008). Food toxicology. Casarett and Doull's Toxicology: The Basic Science of Poisons, 1191-1236.
6. Altug, T. (2002). Introduction to toxicology and food. CRC press

BLUE PRINT

Code number: FST 3324

Title of the paper: FOOD ADDITIVES, CONTAMINANTS AND TOXICOLOGY

Total marks for which the questions are to be asked (including bonus questions)	Number of hrs.	Chapter/ Unit number
5	4	I
10	7	II
15	11	III
19	14	IV
22	16	V
71	52	TOTAL
Maximum marks for the paper (Excluding bonus question): 50		

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Recognize the different types of food additives, contaminants and its importance
CO2	Understand the application of food additives in food preparation and relate to the toxicity of heavy metals and contaminants in animals and humans
CO3	Use Food additives in food processing and preservation
CO4	Compare, analyze the toxic nature and effects of contaminants and food additives in animals and human beings
CO5	Evaluate the role of food additives in the improvement of sensorial properties
CO6	Formulate strategies for testing toxicity of food additives and contaminants

Mapping of Course Outcomes to Program Outcomes

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	✓		✓				
CO2		✓					
CO3	✓						
CO4			✓	✓			
CO5	✓	✓					
CO6			✓		✓	✓	✓

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

Semester	III
Paper Code	FST 3424
Paper Title	Food Quality, Safety Management and Statistics
Number of teaching hours per week	04
Total number of teaching hours per semester	60
Number of credits	04

Objectives of the paper:

The course provides the information on Food quality standards, FSSAI regulations, BIS standards and updated food safety guidelines. The course also provides insights on biostatistical methods used in Food Sciences and its industrial applications.

UNIT I

Introduction to concepts of food quality, food safety, food quality assurance and food quality management; objectives, importance and functions of quality control, Current challenges to food safety. Principles of food quality assurance. **5**

UNIT II

Quality assessment of food materials, Processed products: RTC, RTE, Alcoholic, Non-Alcoholic Beverages-RTS, Spices and condiments. Statistical quality control in food industry. Food adulteration, nature of adulterants, methods of evaluation of food adulterants and toxic constituents. **5**

UNIT III

Food safety management, applications of HACCP in food safety, concept of food traceability for food safety, Food safety and Standards Act 2006: salient provision and prospects. total quality management (TQM) – good manufacturing/management practices, good hygienic practices, good lab practices, general awareness and role of management practices in quality control. **12**

UNIT IV

Role of national and international regulatory agencies, Bureau of Indian Standards (BIS), AGMARK, Food Safety and Standards Authority of India (FSSAI), Introduction to WTO agreements: SPS and TBT agreements, Codex Alimentarius commission, USFDA, International organization for standards (ISO) and its standards for food quality and safety (ISO 9000 series, ISO 22000, ISO 15161, ISO 14000). **10**

UNIT V

Methods of data collection, sampling and sampling methods, measurement of central tendency, mean, median, mode, standard deviation, standard error, variance. Correlation & regression analysis, analysis of variance (ANOVA), tests of significance, t-test, z-test and f- test, correlation, coefficient of correlation and its interpretation, rank correlation, regression equations and predictions. **20**

NOTE: 8 hours of self-study to be assigned

REFERENCES:

1. Early. R. (1995): Guide to Quality Management Systems for the Food Industry, Blackie, Academic and Professional, London.
2. Gould, W.A and Gould, R.W. (1998). Total Quality Assurance for the Food Industries, CTI Publications Inc. Baltimore.
3. Pomeraz, Y. and MeLoari, C.E. (1996): Food Analysis: Theory and Practice, CBS publishers and Distributor, New Delhi.
4. Bryan, F.L. (1992): Hazard Analysis Critical Control Point Evaluations A Guide to Identifying Hazards and Assessing Risks Associated with Food Preparation and Storage. World Health Organization, Geneva
5. Kirk, R.S and Sawyer, R. (1991): Pearson s Composition and Analysis of Foods, Longman Scientific and Technical. 9th Edition, England.
6. Food and Agricultural Organization (1980): Manuals of Food Quality Control. 2 Additives Contaminants Techniques, Rome.

BLUE PRINT

Code number: FST 3424

Title of the paper: FOOD QUALITY, SAFETY MANAGEMENT AND STATISTICS

Total marks for which the questions are to be asked (including bonus questions)	Number of hrs.	Chapter/ Unit number
6	5	I
5	5	II
18	12	III
13	10	IV
29	20	V
71	52	TOTAL
Maximum marks for the paper (Excluding bonus question): 50		

Course Outcomes: At the end of the Course, the Student will be able to:

CO1	Gain knowledge of quality & safety of food processing sector.
CO2	Understand the various food safety guidelines, practices and ISO standards.
CO3	Apply concepts of food safety in food processing sector to achieve good quality products.
CO4	Analyse and compare the various data using statistical tools for safety.
CO5	Evaluate the quality standards of a product using HACCP, TQM tools.
CO6	Create and integrate standard operating protocols for food sectors.

Mapping of Course Outcomes to Program Outcomes

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	✓		✓				
CO2		✓					
CO3	✓						
CO4			✓	✓			
CO5	✓	✓					
CO6			✓		✓	✓	✓

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

FST3P124: FERMENTATION TECHNOLOGY AND TECHNOLOGY OF MEAT, FISH AND POULTRY PRODUCTS

Total: 88 Hours

Fermentation Technology

1. Study of typical fermenter (Spotter).
2. Production and analysis of organic acids (citric acid and Lactic acid).
3. Production, extraction, screening and partial purification of Bacteriocin.
4. Study of Antibiotics assay.
5. Study of microbial growth kinetics (MM equation).
6. Cell disruption by Ultrasonication.
7. Isolation, screening and partial purification of industrially important enzymes by ammonium sulphate precipitation.
8. Purification of industrially important metabolites / enzymes by chromatography.

Technology of Meat, Fish and Poultry Products

1. Quality Evaluation of Meat using Organoleptic, Physical, and Chemical parameters.
2. Quality estimation of eggs- Quality check of eggshells and grading of eggs.
3. Product Preparation from eggs- poached eggs, Souffles, Meringues, custard.
4. Preparation of fish and meat products using different techniques.

Industrial visit to study of Poultry processing and tenderization techniques.

REFERENCES:

1. Barman, N.S., Badwaik, L. S., & Deka, S. C. (2015). Pectinase production by *Aspergillus niger* using banana (*Musa balbisiana*) peel as substrate and its effect on clarification on banana juice. J Food Sci Technol., 52(6).
2. Kulandaivel, S., & Janarthanan, S. (2012). Practical Manual on Fermentation Technology. I K International Publishing House Pvt. Ltd.
3. Singh, T.A., Sarangi, P.K., & Singh, N.J. (2018). Tenderisation of Meat by Bromelain Enzyme Extracted from pineapple wastes. Int J Curr Microbiol App Sci., 7(9): 3256-64.

FST3P₂24: FOOD ADDITIVES, CONTAMINANTS, TOXICOLOGY AND STATISTICS

Total: 88 Hours

1. Qualitative test for detection of adulterants in food sample such as Spices, Cereal and pulses.
2. Qualitative test for detection of adulterants in food sample such as edible oils and honey.
3. Detection of aflatoxin in food samples.
4. Isolation and identification of naturally occurring pigments.
5. Evaluation/statistical analysis of various GRAS additives in packed food products.
6. Analysis of total chlorophyll (A & B) by spectrophotometric method.
7. Role of leavening agents in different baked food products.
8. Estimation of antioxidants in food samples.
9. Estimation of non-nutritive sweeteners in food samples.
10. Estimation of benzoic acid in food samples.
11. Estimation of Total Phenolics in Foods.

REFERENCES:

1. Detect Adulteration with Rapid Test (DART) book- Version02. FASSAI, pp 5-24.
2. Manual Method of Analysis for Adulterant and Contaminants in Foods. ICMR 1990, pp 53.
3. Pandya, Dipen, et al. "Standardization of solvent extraction process for Lycopene extraction from tomato pomace." J Appl Biotechnol Bioeng 2.1 (2017): 00019.
4. Lichtenthaler, H.K(1987) Chlorophylls and Carotenoids: Pigments of Photosynthetic Biomembranes. Methods in Enzymology, 148:350-382.

FST3P₃24: Internship (Industrial training/workshop/pilot plant training) report and viva

Duration: 1 Month

Credits: 02

Marks: 50

Semester	IV
Paper Code	FST 4124
Paper Title	Project work
Number of hours per week/duration	4 months
Total Marks	300
Number of credits	10

PROJECT WORK

Project work in the food industries/ research institutes of 4 months duration with Dissertation, Presentation and Viva-Voce.

Semester	IV
Paper Title	Ignitors/ Outreach
Number of credits	04

IGNITORS/ OUTREACH

Field Visits, Rural Exposure, Documentation and Public Events.

MAPPING

Mapping OF Mission statements with Program Educational Objectives

Mission Statements	PEO1	PEO2	PEO3	PEO4
M1			✓	✓
M2		✓		✓
M3	✓			
M4				✓

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)

Mapping of PEOs with POs

PEOs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
PEO1	✓		✓	✓			
PEO2		✓				✓	✓
PEO3					✓	✓	✓
PEO4			✓	✓			✓

(Tick mark or level of correlation: 3-High, 2-Medium, 1-Low can be used)