SEMESTER I **Course Code: 1MFT01** **Course Title: Advances in Food Engineering** **Hours per week: 3+0+0** **Credits: 3**	**Course Assessment Method: Max. Marks: 100** **(Internal: 30; External: 70)** ***Note for Paper Setter:*** *The end semester examination will be of 70 marks. Nine questions are to be set by the examiner. Question number one (01) is compulsory and will be based on entire syllabus i.e. all four units. It will contain seven (07) short answer type questions of two (02) marks each. In addition, eight more questions are to be set unit-wise comprising two questions from each unit. All questions including question number one shall carry equal marks i.e. fourteen (14) marks each. The candidates are required to attempt five questions in total including first compulsory question and four more questions by selecting one question from each unit.*

RBT Level	**Course Outcomes:** After the completion of the course, the students will be able to:	
L1: Remember	CO1	Describe the basic engineering concepts in context to food engineering.
L2: Understand	CO2	Illustrate working principles of various engineering operation.
L3: Apply	CO3	Examine the working and design features of various food process equipments.
L4: Analyze	CO4	Identify the role of food engineering in food processing operations.
L5: Evaluate	CO5	Plan the processing of food from engineering point of view.

UNIT-I

Engineering properties of foods, their significance in equipment design. Challenges for food engineering. Sterilization of continuous flowing fluid. process time evaluation for batch sterilization by graphical method; factors affecting rate of heat penetration; related numerical problems.

UNIT-II

Fluid flow handling systems for Newtonian liquids, derivation of Bernoulli equation. Measurement of viscosity, capillary tube viscometer. Flow characteristics of non-Newtonian fluids. Properties of non-Newtonian fluids. Velocity profile of a power law. Pump-characteristics, types and selection.

UNIT-III

Thermal properties of foods. Steady state and unsteady state heat transfer: Conduction in multilayered systems. Estimation of convective heat-transfer coefficient. Forced and free convection. Estimation of overall heat transfer coefficient. NTU method for designing heat changers. Design of a plate heat exchanger, Design of a tubular heat exchanger.

UNIT-IV

Pressure-sure-enthalpy charts. Frozen food properties. Freezing point curves, phase diagrams, methods of freeze concentration, design problems. Freezing of foods, freeze concentration and drying, freezing time: plank's equation and Pham's method, theory of centrifugal separation, theory of ultra-filtration and reverse osmosis, selection and types of membranes and properties, Properties of steam. Steam traps methods of estimating steam consumption.

Recommended Readings:

1. Rao, M. A., Rizvi, S. S. H. and Datta A.K. (2005). Engineering Properties of Foods, CRC Press.
2. Heldman, D. R. (2007). Food Process Engineering, AVI Publications.
3. Toledo, R. T. (1997). Fundamentals of Food Process Engineering (2 ed.), CBS Publications, New Delhi.
4. Rizvi, S. S. H. and Mittal, G. S. (1992). Experimental Methods in Food Engineering, Van Nostrand Reinhold.
5. Chanes, J.W. and Gustavo (2002). Engineering and Food for the 21st Century, CRC Press.
6. Theodoros, V.C. (2011). Food Engineering Handbook, CRC Press.

Mapping of Course Outcomes (CO), Programme Outcomes (PO) and Programme Specific Outcomes (PSO)

Course Code: 1MFT01		Course Title: Advances in Food Engineering					
		Programme Outcomes (PO)			Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1	1			1	3	2
	CO 2	1			3	2	2
	CO 3				1	2	2
	CO 4			1	1	3	2
	CO 5				2	3	3

***(1/2/3 indicates strength of the correlation) 1-Weak, 2-Medium, 3-Strong**

SEMESTER I **Course Code: 1MFT02** **Course Title: Advances in Food Analysis** **Hours per week: 3+0+0** **Credits: 3**	**Course Assessment Method: Max. Marks: 100** **(Internal: 30; External: 70)** ***Note for Paper Setter:*** *The end semester examination will be of 70 marks. Nine questions are to be set by the examiner. Question number one (01) is compulsory and will be based on entire syllabus i.e. all four units. It will contain seven (07) short answer type questions of two (02) marks each. In addition, eight more questions are to be set unit-wise comprising two questions from each unit. All questions including question number one shall carry equal marks i.e. fourteen (14) marks each. The candidates are required to attempt five questions in total including first compulsory question and four more questions by selecting one question from each unit.*

RBT Level	**Course Outcomes:** After the completion of the course, the students will be able to:	
L1: Remember	CO1	Describe the advanced analytical and instrumental techniques.
L2: Understand	CO2	Illustrate the principle and mechanism of analytical instruments.
L3: Apply	CO3	Judge the operational conditions and preciseness of different techniques used for qualitative and quantitative parameters of food.
L4: Analyze	CO4	Compare different methods used in instrumental quality evaluation.
L6: Create	CO5	Propose an appropriate technique for food analysis, sample preparation and interpretation of obtained results.

UNIT-I

Need of analysis, sampling: different techniques, Interpretation of results; Spectroscopy: UV-visible spectroscopy, atomic absorption spectroscopy, flame photometry, fluorescence spectroscopy, fourier transform infra-red spectroscopy.

UNIT-II

Methods of separation and analysis of biochemical compounds and macromolecules: Principles and applications of gas chromatography, high performance liquid chromatography, thin layer chromatography, Size exclusion chromatography.

UNIT-III

Microscopic techniques: light microscopy, scanning electron microscopy, transmission electron microscopy, neutron scattering, particle size analysis.

UNIT-IV

Thermal techniques in food analysis: differential scanning calorimetry and thermo gravimetric analysis. electrophoresis: different kinds of electrophoresis, western blotting, gel documentation.

Recommended Readings:

1. Pare, J. R. J. and Bélanger, J. M. R. (2015). Instrumental Methods of Food Analysis, Elsevier
2. Pomeranz, Y. and Meloan, C. E. (1996). Food Analysis: Theory and Practice (3ed.), CBS Publications, New Delhi.
3. Winton, A. L. (2001). Techniques of Food Analysis, Agrobios, Jodhpur.
4. Sharma, B. K. (1994). Instrumental Methods of Chemical Analysis, Krishna, Meerut.
5. Skoog, D. A., Holler, F. J. and Nieman, T. A. (1998). Principles of Instrumental Analysis (5ed.), Harcourt, Singapore.
6. Gopalan, R., Subramanian, P. S. and Rangarajan, K. (2008). Elements of Analytical Chemistry, S. Chand & Sons.

Mapping of Course Outcomes (CO), Programme Outcomes (PO) and Programme Specific Outcomes (PSO)

Course Code: 1MFT02					Course Title: Advances in Food Analysis		
	Programme Outcomes (PO)				Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1	1		1	1		
	CO 2	1		1	1		
	CO 3	2	1	1	2	1	1
	CO 4	2	1	2	1	1	1
	CO 5	3	2	3	2	2	3

***(1/2/3 indicates strength of the correlation) 1-Weak, 2-Medium, 3-Strong**

SEMESTER I **Course Code: 1MFT03 (i)** **Course Title: Food Safety and Quality Assurance** **Hours per week: 3+0+0** **Credits: 3**	**Course Assessment Method: Max. Marks: 100** **(Internal: 30; External: 70)** ***Note for Paper Setter:*** *The end semester examination will be of 70 marks. Nine questions are to be set by the examiner. Question number one (01) is compulsory and will be based on entire syllabus i.e. all four units. It will contain seven (07) short answer type questions of two (02) marks each. In addition, eight more questions are to be set unit-wise comprising two questions from each unit. All questions including question number one shall carry equal marks i.e. fourteen (14) marks each. The candidates are required to attempt five questions in total including first compulsory question and four more questions by selecting one question from each unit.*

RBT Level	**Course Outcomes:** After the completion of the course, the students will be able to:	
L1: Remember	CO1	Recognize different areas of food safety & quality assurance.
L2: Understand	CO2	Demonstrate knowledge of the quality assessments of different food products.
L3: Apply	CO3	Prepare food quality managements systems.
L4: Analyze	CO4	Distinguish various International and Indian food laws.
L6: Create	CO5	Test different food products as per standards and laws.

UNIT-I

Sampling, specification, labeling, safety and quality assessment of fruits and vegetable, cereals, dairy products, meat, fish, poultry and processed food products, Sensory evaluation: Introduction, panel screening, selection methods, interaction and thresholds.

UNIT-II

Developments, objective and functions of food safety and quality assurance, quality enhancement models, statistical quality control for food industry, food quality management systems, implementation of quality control programmes, quality control tools, quality control charts for food plant sanitation, food safety management systems, causes of failure of food safety programs.

UNIT-III

Indian food laws and regulations, food safety acts, regulations for waste disposals, codex Alimentations, ISO series, world trade organization, food and agricultural organization, world health organization, food safety and legislation in USA and Europe, technical barriers in trade, enforcers of food laws approval process for food additives, additives food labeling, intellectual property right, HACCP and its application.

UNIT-IV

Food adulteration: types of adulterants, common adulterants for foods like milk and milk products, honey, wheat flours, edible oils, cereals, condiments (whole and ground) pulses, coffee, tea, confectionery, baking powder, non-alcoholic beverages, vinegar, besan and curry powder.

Recommended readings:

1. Lawless, H. T. and Heymann, H. (2013). Sensory Evaluation of Food: Principles and Practices, Springer, New Delhi.
2. Shapton, D. A. and Shapton, N. F. (1993). Principles and Practice for the Safe Processing of Foods, Heinemann, Oxford.
3. Schmidt, R. H. and Rodrick, G. E. (2003). Food Safety Handbook, John Wiley, New Jersey.
4. Rees, N. and Watson, D. (2000). International Standards for Food Safety, Aspen, America.

5. Anjaneyulu, Y. and Marayya, R. (2009). Quality Assurance and Quality Management in Pharmaceutical Industry, Pharma, Hyderabad.
6. Ho, S. K. M. (1999). Operations and Quality Management, ITP, London.

Mapping of Course Outcomes (CO), Programme Outcomes (PO) and Programme Specific Outcomes (PSO)

Course Code: 1MFT03 (i)		Course Title: Food Safety and Quality Assurance					
		Programme Outcomes (PO)			Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1				3	2	2
	CO 2			1	1	3	3
	CO 3			1	2	1	3
	CO 4				2	2	3
	CO 5	1	1	2		2	3

***(1/2/3 indicates strength of the correlation) 1-Weak, 2-Medium, 3-Strong**

SEMESTER I **Course Code: 1MFT03 (ii)** **Course Title: Food Additives, Contaminants and Toxicology** **Hours per week: 3+0+0** **Credits: 3**	**Course Assessment Method: Max. Marks: 100** **(Internal: 30; External: 70)** ***Note for Paper Setter:*** *The end semester examination will be of 70 marks. Nine questions are to be set by the examiner. Question number one (01) is compulsory and will be based on entire syllabus i.e. all four units. It will contain seven (07) short answer type questions of two (02) marks each. In addition, eight more questions are to be set unit-wise comprising two questions from each unit. All questions including question number one shall carry equal marks i.e. fourteen (14) marks each. The candidates are required to attempt five questions in total including first compulsory question and four more questions by selecting one question from each unit.*

RBT Level	**Course Outcomes:** After the completion of the course, the students will be able to:	
L1: Remember	CO1	Describe various food additives and contaminants associated with food industry.
L2: Understand	CO2	Explain significance of food additives in food industries.
L3: Apply	CO3	Examine effect of industrial and food contaminants on human health and environment.
L4: Analyze	CO4	Compare the functionality of various additives in food products.
L6: Create	CO5	Prescribe maximum permissible limit for food additives and contaminants doses as per national and international standards.

UNIT-I

Additives in food processing and preservation: classification, need, properties, functions and safety, quality evaluation of additives, food labeling, laws and regulations for food additives.

UNIT-II

Chemistry, uses and functions: preservatives: antioxidants, anti-browning agents, anti-microbial agents, bio-preservatives, fortification, emulsifiers, humectants, stabilizers, chelating agents, pH control agents and acidulants, texturizing agents, plasticizers, flavor enhancers, coloring agents, sweeteners, flavoring agents.

UNIT-III

Food contaminants: biological, chemical, physical and environmental contaminants, Inorganic and organometallic food contaminants, Sources, their impact on human health.

UNIT-IV

Food contaminants from industrial wastes: Heavy metals, polychlorinated polyphenols, dioxins, Toxicants formed during food processing polycyclic aromatic hydrocarbons, nitrosamines, veterinary drug residues and melamine contaminations, Pesticide residues in food.

Recommended Readings:

1. Branen, A. L., Davidson, P. M. and Salminen, S. (2002). Food Additives, Marcel Dekker, New York.
2. Wood, R., Foster, L., Damant, A. and Pauline, K. (2004). Analytical Methods for Food Additives, Boca Raton, New York.
3. Watson, D. H. (2014). Food Chemical Safety: Additives, WP, New Delhi.
4. Steinhart, E., Doyle, M. E. and Cochrane, B. A. (1995). Food Microbiology and Toxicology, Marcel Dekker, New York.

Mapping of Course Outcomes (CO), Programme Outcomes (PO) and Programme Specific Outcomes (PSO)

Course Code: 1MFT03 (ii)	Course Title: Food Additives, Contaminants and Toxicology						
	Programme Outcomes (PO)				Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1				1	2	1
	CO 2					2	1
	CO 3					3	2
	CO 4			1	1	2	1
	CO 5	1			1	2	3

***(1/2/3 indicates strength of the correlation) 1-Weak, 2-Medium, 3-Strong**

SEMESTER I **Course Code: 1MFT03 (iii)** **Course Title: Food Microstructure and Texture** **Hours per week: 3+0+0** **Credits: 3**	**Course Assessment Method: Max. Marks: 100** **(Internal: 30; External: 70)** ***Note for Paper Setter:*** *The end semester examination will be of 70 marks. Nine questions are to be set by the examiner. Question number one (01) is compulsory and will be based on entire syllabus i.e. all four units. It will contain seven (07) short answer type questions of two (02) marks each. In addition, eight more questions are to be set unit-wise comprising two questions from each unit. All questions including question number one shall carry equal marks i.e. fourteen (14) marks each. The candidates are required to attempt five questions in total including first compulsory question and four more questions by selecting one question from each unit.*

RBT Level	**Course Outcomes:** After the completion of the course, the students will be able to:	
L1: Remember	CO1	Describe the advanced structural components of food.
L2: Understand	CO2	Illustrate the principle and mechanism of instruments used for food microstructure and texture.
L3: Apply	CO3	Assess the structural changes during extraction of voluble components.
L4: Analyze	CO4	Examine the microstructural changes during different processing techniques.
L6: Create	CO5	Propose an appropriate technique for food microstructure and texture, sample preparation and interpretation of obtained results.

UNIT I

Food Structuring: Introduction, food structure, factor affecting texture, Fundamentals of structuring: polymer, colloid; food polymers, polymer solutions, phase transitions, colloids and surface chemistry, mechanical and rheological properties.

UNIT II

Structure and Stability Gels, Gelation. Mechanisms, Mixed Gels, The Microstructure of Gels, Structure-Property Relations in Gels, Microstructural elements and their interactions: Polysaccharides, Proteins, fat, water, Ingredient interactions in complex foods.

UNIT III

Examining food microstructures and texture: history of food microstructure studies, light microscopy, transmission electron microscopy, scanning electron microscopy, other instrumentation and techniques, image analysis: image acquisition, image processing, textural measurement of food.

UNIT IV

Microstructure and mass transfer: solid-liquid extraction; fundamental aspects of extraction, extraction process, modifying microstructure, modeling the extraction process, Influence of processing like drying and frying on the structural properties.

Recommended Readings:

1. Julian, D. and Mc Clements, D. J. (2007). Understanding and controlling the microstructure of complex foods, CRC Press
2. Steff, J. F. (1996). Rheological Methods in Food Process Engineering, Freeman Press,1996.
3. Morris, V.J. and Groves, K. (2013). Food Microstructures, Microscopy, Measurement and Modelling, Woodhead Publishing.
4. Bechtel, D.B. (1983). New Frontiers in Food Microstructure, American Association of Cereal Chemists.

Mapping of Course Outcomes (CO), Programme Outcomes (PO) and Programme Specific Outcomes (PSO)

Course Code: 1MFT03 (iii)		Course Title: Food Microstructure and Texture					
	Programme Outcomes (PO)				Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1	1		1	1		
	CO 2	1		1	1		
	CO 3	2	2	1	2	1	1
	CO 4	2	2	2	1	1	1
	CO 5	3	3	3	2	2	3

***(1/2/3 indicates strength of the correlation) 1-Weak, 2-Medium, 3-Strong**

SEMESTER-I **Course Code: 1MFT04 (i)** **Course Title: Novel Food Packaging** **Hours per week: 3+0+0** **Credits: 3**	**Course Assessment Method: Max. Marks: 100** **(Internal: 30; External: 70)** ***Note for Paper Setter:*** *The end semester examination will be of 70 marks. Nine questions are to be set by the examiner. Question number one (01) is compulsory and will be based on entire syllabus i.e. all four units. It will contain seven (07) short answer type questions of two (02) marks each. In addition, eight more questions are to be set unit-wise comprising two questions from each unit. All questions including question number one shall carry equal marks i.e. fourteen (14) marks each. The candidates are required to attempt five questions in total including 1st compulsory question and four more questions by selecting one question from each unit.*

RBT Level	**Course Outcomes:** After the completion of the course, the students will be able to:	
L1: Remember	CO1	Define principles and applications of novel food packaging techniques.
L2: Understand	CO2	Explain active and intelligent packaging systems associated with food sector.
L3: Apply	CO3	Classify different modern types of food packaging.
L5: Evaluate	CO4	Assess effectiveness of different packaging systems on product quality of different foods.
L6: Create	CO5	Design packaging system requirements as per food commodity.

UNIT-I

Active and intelligent packaging techniques, oxygen, ethylene and other scavengers: oxygen scavenging technology, selection of right type of oxygen scavengers, ethylene scavenging technology, carbon dioxide and other scavengers, antimicrobial food packaging, antimicrobial packaging system, effectiveness of antimicrobial packaging.

UNIT-II

Advantages of non-migratory bioactive polymers, inherently bioactive synthetic polymers: types and application, polymers with immobilized bioactive compounds, defining and classifying time temperature indicators (TTIs), requirements for TTIs, development of TTIs, maximizing the effectiveness of TTIs to monitor shelf-life during distribution, use of freshness indicator in packaging: compounds indicating the quality of packaged food products, pathogen indicators.

UNIT-III

Developments in modified atmosphere packaging (MAP): novel MAP applications for fresh-prepared produce, novel MAP gases, testing novel MAP applications, applying high O_2 MAP. Combining MAP with other preservation techniques, packaging-flavour interactions: factors affecting flavour absorption, role of the food matrix, role of differing packaging materials.

UNIT-IV

Modern packaging systems: green plastics for food packaging, problem of plastic packaging waste, range of biopolymers, developing novel biodegradable materials, traceability: radio frequency identification, recycling packaging materials: recyclability of packaging plastics, improving the recyclability of plastics packaging, Testing the safety and quality of recycled material, using recycled plastics in packaging, methods for testing consumer responses to new packaging concepts.

Recommended Readings:

1. Jung, H. H. (2014). Innovations in Food Packaging, Oxford, London.
2. Ahvenainen, R. (2003). Novel Food Packaging Techniques, CRC Publications.
3. Robertson, G. L. (2010). Food Packaging and Shelf Life, CRC Publications, New York.
4. Robertson, G. L. (2006). Food Packaging: Principles and Practice (2 ed.), CRC Publications, Boca Raton.

Mapping of Course Outcomes (CO), Programme Outcomes (PO) and Programme Specific Outcomes (PSO)

Course Code: 1MFT04 (i)					Course Title: Novel Food Packaging		
	Programme Outcomes (PO)				Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1					2	
	CO 2					2	
	CO 3					2	
	CO 4			1		2	1
	CO 5			1		1	1

***(1/2/3 indicates strength of the correlation) 1-Weak, 2-Medium, 3-Strong**

SEMESTER I **Course Code: 1MFT04 (ii)** **Course Title: Technology of Frozen Foods** **Hours per week:3+0+0** **Credits: 3**	**Course Assessment Method: Max. Marks: 100 (Internal: 30; External: 70)** ***Note for Paper Setters:*** *The end semester examination will be of 70 marks. Nine questions are to be set by the examiner. Question number one (01) is compulsory and will be based on entire syllabus i.e. all four units. It will contain seven (07) short answer type questions of two (02) marks each. In addition, eight more questions are to be set unit-wise comprising two questions from each unit. All questions including question number one shall carry equal marks i.e. fourteen (14) marks each. The candidates are required to attempt five questions in total including first compulsory question and four more questions by selecting one question from each unit.*

RBT Level	**Course Outcomes:** After the completion of the course, the students will be able to:	
L1: Remember	CO1	Describe frozen food properties, microbiological aspects, mechanism and different methods of freezing and frozen storage.
L2: Understand	CO2	Discuss engineering aspects of cold chain design, monitoring, maintenance and handling.
L3: Apply	CO3	Use of principles of freezing in development of various frozen products and their shelf-life evaluation.
L4: Analyze	CO4	Identify various packaging materials and machines for manufacturing of industrial frozen products.
L5: Evaluate	CO5	Appraise improved technologies for development of quality value added frozen foods and their safety.

UNIT-I

Food freezing: importance, potentialities and nutritive values of frozen foods. Microbiology of

frozen foods, freezing methods and equipments, sharp freezers, the quick-freezing systems – freezing cabinets and walk in freezers, frozen food locker plants, glass transitions in frozen foods and biomaterials, thermo-physical properties of frozen foods, freezing loads and freezing time calculation, innovations in freezing process.

UNIT-II

Cold Chain: cold store design and maintenance, packaging and machineries, transportation, retail display equipments and management, household refrigerators and freezers, monitoring and control of the cold chain, cold storage and thawing of foods – adaptability of vegetables to freezing, preparation and freezing of meat, poultry and fish, dairy products, precooked frozen foods and storage of frozen food.

UNIT-III

Quality and safety of frozen foods: Importance and standards in the frozen food industries, quality and safety of frozen meat and meat products, frozen fish, shellfish, and related products, frozen vegetables, frozen fruits, frozen dairy products, frozen ready meals, frozen bakery products, frozen eggs and egg products. Sensory analysis of frozen foods. monitoring and measuring techniques for quality and safety, chemical measurements, food borne illnesses and detection of pathogenic microorganisms, shelf-life prediction of frozen foods.

UNIT-IV

Packaging of frozen foods: Introduction to frozen food packaging, plastic packaging of frozen foods, paper and card packaging of frozen foods, Packaging of frozen foods with other materials, packaging machinery.

Recommended Readings:

1. Sun, Da-Wen (2012). Handbook of Frozen Food Processing and Packaging, Taylor & Francis, United State of America.
2. Kennedy, C. J. (2000). Managing Frozen Foods, CRC Press, New York.
3. Potter, S. (2006). Food Science, Sage, New Delhi.

Mapping of Course Outcomes (CO), Programme Outcomes (PO) and Programme Specific Outcomes (PSO)

Course Code: 1MFT04 (ii)					**Course Title: Technology of Frozen Foods**		
	Programme Outcomes (PO)				**Programme Specific Outcomes (PSO)**		
		PO1	**PO2**	**PO3**	**PSO1**	**PSO2**	**PSO3**
Course Outcomes (CO)	**CO 1**				1	2	
	CO 2					3	1
	CO 3	1			1	1	
	CO 4					2	1
	CO 5					1	2

***(1/2/3 indicates strength of the correlation) 1-Weak, 2-Medium, 3-Strong**

SEMESTER I **Course Code: 1MFT04 (iii)** **Course Title: Powder Technology** **Hours per week: 3+0+0** **Credits: 3**	**Course Assessment Method: Max. Marks: 100** **(Internal: 30; External: 70)** ***Note for Paper Setter:*** *The end semester examination will be of 70 marks. Nine questions are to be set by the examiner. Question number one (01) is compulsory and will be based on entire syllabus i.e. all four units. It will contain seven (07) short answer type questions of two (02) marks each. In addition, eight more questions are to be set unit-wise comprising two questions from each unit. All questions including question number one shall carry equal marks i.e. fourteen (14) marks each. The candidates are required to attempt five questions in total including first compulsory question and four more questions by selecting one question from each unit.*

RBT Level	**Course Outcomes:** After the completion of the course, the students will be able to:	
L1: Remember	CO1	Describe microstructure of the different powders.
L2: Understand	CO2	Explain the surface composition and rehydration properties of powder.
L3: Apply	CO3	Examine suitable method for powder production.
L5: Evaluate	CO4	Assess different flow patterns, mass flow in storage vessel.
L6: Create	CO5	Develop different food powders of having high storage stability using advance techniques.

UNIT-I

Introduction to food powders: Crystalline and amorphous microstructure of powders, cohesive forces in powders, adhesive forces and surface energies, stickiness of powders during formation and handling, surface structure of powders, fluidity of powders, compressibility of powders, mixing property of powders, segregation of powder particles, hydration property of powders

UNIT-II

Powder production: spray drying, freeze drying, roller and drum drying, grinding of food powder production. Agglomeration/granulation in food powder production: powder characteristics, physicochemical reactivity of food powders, agglomeration processes and mechanisms, wet controlled growth agglomeration technologies, wet agglomeration mechanisms and powder reactivity

UNIT-III

Fluidization in food powder production: principles of fluidization, techniques and equipment, applications of fluidization in the production of food powders, limitations, future trends. Handling of food powders: flow patterns and storage design: basic flow patterns in storage vessels, storage vessel design, mass-flow operation, the Jenike silo design method, the flow-no-flow criterion, silo design worked example.

UNIT-IV

Surface composition of food powders: microscopy and spectroscopy techniques for analysing the surface of food powder, factors affecting food powder surface composition, impact of powder surface composition on powder functionality. Food powder rehydration: principles of powder rehydration-wettability and sinkability, dispersibility, solubility, improvement of rehydration properties, water absorption and desorption of food powders

Recommended Readings:

1. Bhandari, B.S., Bansal, N., Zang, M., Schuck, P. (2013). Hand book of food powders-process and properties, Woodhead publishing.

2. Yasuo, A. (1996). Chemistry of powder production, Chapman & Hall Publishing, Tokyo.

3. Rhodes, M. J. (1990). Principles of powder technology, Wiley, USA.

4. Masuda, H., Higashitani, K., and Yoshida, H. (2006). Powder technology: fundamentals of particles, powder beds, and particle generation. CRC Press,

Mapping of Course Outcomes (CO), Programme Outcomes (PO) and Programme Specific Outcomes (PSO)

Course Code: 1MFT04 (iii)					Course Title: Powder Technology		
	Programme Outcomes (PO)				Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1						
	CO 2				2		1
	CO 3					3	1
	CO 4					3	
	CO 5	1		2		2	2

***(1/2/3 indicates strength of the correlation) 1-Weak, 2-Medium, 3-Strong**

SEMESTER I **Course Code: 1MFT05** **Course Title: Programme Core Lab I** **Hours per week: 0+0+4** **Credits: 2**	**Course Assessment Method: Max. Marks: 100** **(Internal: 50; External: 50)** ***Evaluation:*** *There will be continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their time table. The chairperson of the department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by the external examiner appointed by the controller of examination along with the internal examiner, preferably the laboratory coordinator appointed by the chairperson.*

RBT Level	**Course Outcomes:** After the completion of the course, the students will be able to:	
L2: Understand	CO1	Estimate different characteristics of food through various analytical techniques.
L3: Apply	CO2	Illustrate principle and working of instrument used for analysis.
L4: Analyze	CO3	Judge the operational conditions and preciseness of different techniques used for qualitative and quantitative parameters of food.
L5: Evaluate	CO4	Compare different methods used in instrumental quality evaluation.
L6: Create	CO5	Propose an appropriate technique for food analysis, sample preparation and interpretation of obtained results.

Preparation of solutions and buffers, Determination of titratable acidity in foods using a potentiometric titration, diastatic activity of honey, UV-Visible spectro-photometric analysis of a carotenoid, determination of hydroxy methyl furfural in honey, atomic absorption spectroscopic analysis of heavy metals in foods, Secondary structure analysis of starch and proteins using fourier transform infra-Red (FTIR), gas chromatography (GC) quantification of alcohol content in beverages using the internal standard method, high performance liquid chromatography (HPLC) quantification of sugars in foods and beverages, separation and identification of food constituents using HPLC, thin layer chromatography (TLC) of food colours, microstructural and particle size analysis of starch, determination of thermal properties of food samples, extraction of different types of proteins and identification using electrophoresis, DNA isolation and fingerprinting of plant tissues.

Mapping of Course Outcomes (CO), Programme Outcomes (PO) and Programme Specific Outcomes (PSO)

Course Code: 1MFT05					Course Title: Programme Core Lab I		
	Programme Outcomes (PO)				Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1	1			1		1
	CO 2	1		1			1
	CO 3	2	1	2	2		
	CO 4	3	2	1	1	1	2
	CO 5	3	2	2	2	2	3

***(1/2/3 indicates strength of the correlation) 1-Weak, 2-Medium, 3-Strong**

SEMESTER I **Course Code: 1MFT06** **Course Title: Programme Elective Lab II** **Hours per week: 0+0+4** **Credits: 2**	**Course Assessment Method: Max. Marks: 100** **(Internal: 50; External: 50)** ***Evaluation:*** *There will be continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their time table. The chairperson of the department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by the external examiner appointed by the controller of examination along with the internal examiner, preferably the laboratory coordinator appointed by the chairperson.*

RBT Level	**Course Outcomes:** After the completion of the course, the students will be able to:	
L1: Remember	CO1	Outline the concepts of food production, packaging and food safety.
L3: Apply	CO2	Apply unit operations on food production, characterization and safety.
L5: Analyze	CO3	Determine the quality characteristics of powdered foods, frozen foods, packaged foods and food additives.
L6: Create	CO4	Develop the food processing and preservation methods based on freezing, packaging and incorporation of additives.

Note: Students will conduct Programme Elective Lab II experiments as per combination of elective subjects opted by them.

Food Safety and Quality Assurance

Techniques of sampling and quality assessment of different food products, detection of adulteration in food products viz. honey, other sweetening agents, spices (whole and powder), pulses, oils, cereals, sweets, tea, coffee, determination of water quality, microbial analysis of different food products, SWAB test, Development of HACCP plan/TQM for various food industries.

Food Additives, Contaminants and Toxicology

Determination of benzoic acid in the ready-to serve beverages, estimation of nitrate and nitrite, aspartame, caffeine, identification of natural colours isolation and estimation of synthetic food colours, oil soluble colours, antioxidants, detection of brominated vegetable oils in soft drinks, magnesium carbonate in pan masala / gutka, food applications of emulsifiers, stabilizers, thickeners, flavours and flavour enhancers, analysis of edible common salt for moisture content and total chlorides, estimation of contaminants, chemical residues and aflatoxins, pesticides and heavy metals contaminants in foods, visits to the testing laboratories of the food industry, educational institutions and testing centers.

Food Microstructure and Texture

Determination of microstructures in selected foods using light microscopy, TEM and SEM, image analysis and image processing techniques, evaluation of phase transition in colloidal systems, evaluation of structure texture function relations, evaluation of micro-structural components of food assemblies including water, ice, food components, cell and cell membranes animal and plant tissues. Extraction of valuable components using different techniques, Evaluation of structure in extruded foods, gels, dehydrated and fried products.

Novel Food Packaging

To estimate the oxygen percentage in packaged food products by using oxygen analyzer. To estimate the oxygen transmission rate in different food packaging materials. To estimate the Water vapor transmission rate in different food packaging materials. To estimate the mechanical strength of different food packaging materials. To estimate the chemicals strength of different food packaging materials.

Technology of Frozen Foods

To demonstrate the freeze-drying process and equipment. To study the effect of freezing time on colour, texture and overall acceptability of whole fruits /vegetables. Determine the effect of freezing on quality of fruits and vegetables. preparation of frozen foods. Physico chemical analysis of frozen food sample. Freeze drying of food sample by Lyophilizer. Packaging materials and storage study of frozen foods.

Powder Technology

Study of construction and operation of Spray dryer and fluidized bed dryer. Particle size analysis and bulk properties of milk powder. Microscopy and spectroscopy techniques for analysing the surface of food powder. Food Powder rehydration properties: Wettability, sinkability, dispersibility, solubility. Shelf- life of food powders: water absorption and desorption of food powders, crystallization of amorphous powder.

Mapping of Course Outcomes (CO), Programme Outcomes (PO) and Programme Specific Outcomes (PSO)

Course Code: 1MFT06					Course Title: Programme Elective Lab II		
	Programme Outcomes (PO)				Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1					1	2
	CO 2					1	3
	CO 3					2	2
	CO 4			1	1	2	1
	CO 5			1	1	2	3

***(1/2/3 indicates strength of the correlation) 1-Weak, 2-Medium, 3-Strong**

SEMESTER I **Course Code: 1MFT07** **Course Title: Research Methodology and IPR** **Hours per week: 2+0+0** **Credits: 2**	**Course Assessment Method: Max. Marks: 100** **(Internal: 30; External:70)** ***Note for Paper Setter:*** *The end semester examination will be of 70 marks. Nine questions are to be set by the examiner. Question number one (01) is compulsory and will be based on entire syllabus i.e. all four units. It will contain seven (07) short answer type questions of two (02) marks each. In addition, eight more questions are to be set unit-wise comprising two questions from each unit. All questions including question number one shall carry equal marks i.e. fourteen (14) marks each. The candidates are required to attempt five questions in total including first compulsory question and four more questions by selecting one question from each unit.*

RBT Level	**Course Outcomes:** After the completion of the course, the students will be able to:	
L1: Remember	CO1	Describe concept of research methodology and intellectual property rights.
L2: Understand	CO2	Discuss importance of research methodology and research ethics in the area of research.
L3: Apply	CO3	Use knowledge of research techniques and IPR with respect to industrial applications.
L5: Evaluate	CO4	Assess method for licensing and assignment of patent and other IPR's.
L6: Create	CO5	Propose a patent application for new product development.

UNIT - I

Defining research methodology and a research problem. Importance of research methodology. Objectives of research and types of research. Criteria of good research. Research process – formulating the research problem, literature survey, development of working hypothesis,

preparation of research design, implementation of research hypothesis, collection of data and analysis.

UNIT - II

Writing a research thesis and paper: characteristics of good thesis, outline of a thesis, effective technical writing. Scientific paper writing. Effective literature studies approaches, plagiarism, and research ethics.

UNIT - III

Introduction to IPR, concept of patent, product / process patents and terminology, preparation of patent documents, process for examination of patent application, procedure for filing of patent application and types of applications, assignment and licensing of patents, patent infringement.

UNIT - IV

Definition and concept of trademarks, different kinds of marks (brand names, logos, signatures, symbols, well known marks, certification marks and service marks), non-registrable trademarks, procedure for registration of trademarks, assignment/transmission / licensing of trademarks, infringement of trademarks. nature of copyright, works in which copyrights subsist, rights conferred by copyright, assignment, transmission, licensing of copyrights, infringement of copyrights.

Recommended Readings:

1. Kothari, C. R. (2019). Research Methodology: Methods and Techniques (4th Ed). New Age International Publishers.
2. Melville, S. and Goddard, W. (2001). Research Methodology: An introduction for Science and Engineering students. Juta & Co Ltd.
3. Kumar, R. (2014). Research Methodology: A Step-by-Step Guide for beginners (2nd Ed), Sage Publications.

Mapping of Course Outcomes (CO), Programme Outcomes (PO) and Programme Specific Outcomes (PSO)

Course Code: 1MFT07					Course Title: Research Methodology and IPR		
	Programme Outcomes (PO)				Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1	1	1		3		
	CO 2	1	2				
	CO 3	1	1	1			
	CO 4			1			
	CO 5			1			

***(1/2/3 indicates strength of the correlation) 1-Weak, 2-Medium, 3-Strong**

SEMESTER II **Course Code: 2MFT11** **Course Title: Advances in Post-harvest Technology of Fruits and Vegetables** **Hours per week: 3+0+0** **Credits: 3**	**Course Assessment Method: Max. Marks: 100** **(Internal: 30; External:70)** ***Note for Paper Setter:*** *The end semester examination will be of 70 marks. Nine questions are to be set by the examiner. Question number one (01) is compulsory and will be based on entire syllabus i.e. all four units. It will contain seven (07) short answer type questions of two (02) marks each. In addition, eight more questions are to be set unit-wise comprising two questions from each unit. All questions including question number one shall carry equal marks i.e. fourteen (14) marks each. The candidates are required to attempt five questions in total including first compulsory question and four more questions by selecting one question from each unit.*

RBT Level	**Course Outcomes:** After the completion of the course, the students will be able to:	
L1: Remember	CO1	Recognize the causes of post-harvest losses and factors affecting postharvest qualities of fruits and vegetables.
L2: Understand	CO2	Illustrate about postharvest physiology, maturity and ripening changes of fresh fruits and vegetables.
L3: Apply	CO3	Produce the concepts of various postharvest treatments and handling operations on quality assessment of fresh commodities.
L4: Analyze	CO4	Identify various quality deteriorating postharvest diseases and disorders of fruits and vegetables along with determination of their control measures.
L6: Create	CO5	Appraise various advanced preprocessing operations and technologies for better postharvest management of fruits and vegetables.

UNIT-I

Fruit and vegetable production, classification, structure, and composition; importance and scope of post-harvest management of fruits and vegetables in Indian economy, post-harvest losses, pre-harvest factors affecting post-harvest qualities, maturity indices and instrumental methods of maturity determination, standards and specifications for fresh fruits and vegetables, assessment of fruit quality, advances in non-destructive quality measurement of fruits and vegetables.

UNIT-II

Advanced harvesting tools and their design aspects, advances in post-harvest handling operations; cleaning, washing, sorting, and grading of fruits and vegetables, cleaning and washing of fruits and vegetables, types of cleaners, air cleaners, cleaning efficiency, various washers, sorters, and grading machines; size grading, color grading, specific gravity grading, grading efficiency, screens: rotary screens, vibrating screens, and other machineries for cleaning of fruits and vegetables, separation techniques: magnetic separator, electro-static separators, pneumatic separators, and de-stoners.

UNIT-III

Post-harvest physiological and biochemical changes in fruits and vegetables; maturity and ripening of climacteric and non-climacteric fruits, changes during ripening; role of ethylene in fruit ripening, Ripening chambers, Advances in pre-processing operations, Storage and transportation, Mechanism and advances in CA, MA, hypobaric storage, cold storage design and zero energy cool chamber, Various post-harvest treatments.

UNIT-IV

Post-harvest disorders and diseases, Biological, physical and chemical control of post-harvest diseases, packaging operations, Advances in drying and packaging of fruits and vegetables, Cushioning materials used in packaging of fresh fruits, Minimal processing.

Recommended readings:

1. Haard, N.F. and Salunkhe, D.K. (1975). Postharvest Biology and Handling of Fruits and Vegetables, AVI, Westport.
2. Kader, A. A. (1992). Post-harvest Technology of Horticultural Crops, (2ed.), University of California, Division of Agriculture and National Resources, California.
3. Salunkhe, D.K. and Kadam, S.S. (2005). Handbook of Fruit Science and technology, Production, Composition, Storage, and Processing, Marcel Dekker, USA.
4. Thompson, A.K. (1995). Post-Harvest Technology of Fruits and Vegetables, Blackwell publication.
5. Wills-Ron, B.H. and Golding, J.B. (2015). Advances in Postharvest Fruit and Vegetable Technology, Taylor and Francis, CRC Press.
6. Siddiqui, M. W. (2015). Post-Harvest Biology and Technology of Horticultural Crops, Principles and Practices for Quality Maintenance, Apple Academic Press Inc.

Mapping of Course Outcomes (CO), Programme Outcomes (PO) and Programme Specific Outcomes (PSO)

Course Code: 2MFT11 Course Title: Advances in Post-harvest Technology of Fruits and Vegetables

		Programme Outcomes (PO)			Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1	2		1	1	2	1
	CO 2	1	1	1	2		1
	CO 3	2	1	1	1	1	1
	CO 4	1	2	1		1	1
	CO 5	2	1	1	2	3	2

***(1/2/3 indicates strength of the correlation) 1-Weak, 2-Medium, 3-Strong**

SEMESTER II **Course Code: 2MFT12** **Course Title: Advances in Cereal Science and Technology** **Hours per week: 3+0+0** **Credits: 3**	**Course Assessment Method: Max. Marks: 100 (Internal: 30; External: 70)** ***Note for Paper Setter:*** *The end semester examination will be of 70 marks. Nine questions are to be set by the examiner. Question number one (01) is compulsory and will be based on entire syllabus i.e. all four units. It will contain seven (07) short answer type questions of two (02) marks each. In addition, eight more questions are to be set unit-wise comprising two questions from each unit. All questions including question number one shall carry equal marks i.e. fourteen (14) marks each. The candidates are required to attempt five questions in total including first compulsory question and four more questions by selecting one question from each unit.*

RBT Level	**Course Outcomes:** After the completion of the course, the students will be able to:	
L1: Remember	CO1	Describe the morphological and nutritional characteristics of cereals, millets and their processed products and by-products.
L2: Understand	CO2	Demonstrate the modern processing techniques of cereals in food industries.
L3: Apply	CO3	Examine the functionalities of flour components and ingredients in differen food products
L5: Evaluate	CO4	Analyze the effect of processing technologies on the process efficiency and product quality.
L6: Create	CO5	Design new approaches for sustainable solutions for cereal-based industries.

UNIT-I

Present status and future prospects of cereal grains in India, food grain production and consumption trends. Coarse grain processing. Wheat kernel structure, wheat grading, roller flour milling, influence of wheat type and grain quality on flour yield, grain hardness and its relevance to end product quality, advances in wheat cleaning, conditioning and milling, wheat flour

component interactions (protein-starch, protein-lipid and starch-lipid) and their influence on end product quality, advances in isolation, biochemical characterization, micro-structural and functionality of wheat gluten proteins.

UNIT-II

Advances in role of wheat proteins in dough and gluten visco-elasticity, micro-structure of dough, conversion of dough foam structure to bread sponge structure during bread baking, concept of gas retention in wheat dough during fermentation and baking, advances in bread making processes, effect of wheat components and ingredients on the growth of yeast during fermentation operation, bread staling and its prevention, production of variety biscuits, breads and pasta products.

UNIT-III

Paddy varieties, their composition and quality characteristics, advances in methods of paddy parboiling, advantages and limitation of parboiling, paddy dehusking processes, Rice ageing, accelerated ageing, modern rice milling, factors affecting head rice yields and losses at different stages of milling, rice mill machinery, Rice based products and their quality. Methods of rice bran oil extraction and refining.

UNIT-IV

Dry and wet milling of maize, modern methods of maize processing, gluten and starch separation, maize starch conversion into value added products, acid hydrolysis, enzyme hydrolysis, processing for dextrose, malto-dextrin and other products, Barley varieties, composition and quality characteristics, malting process and industrial applications of barley malt and malt products.

Recommended Readings:

1. Kulp, K. and Ponte J. G. (2014). Handbook of Cereal Science & Technology, (2nd ed): CRC press.
2. Wrigley, C.W. and Batey, I. L. (2010). Cereal grains, assessing and managing quality, CRC press.

3. Dendy, D. A. V. and Dobsasoczyk, B. J. (2001). Cereal and Cereal Products, Chemistry and Technology, An ASPEN publication.
4. Owens, G. (2000). Cereal Processing Technology: CRC Press.
5. Faridi, H. and Faubin, J. M. (1997). Dough rheology and baked product texture, CBS Publishers.

Mapping of Course Outcomes (CO), Programme Outcomes (PO) and Programme Specific Outcomes (PSO)

Course Code: 2MFT12		Course Title: Advances in Cereal Science and Technology					
		Programme Outcomes (PO)			Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1			1	1		
	CO 2			1	1	1	
	CO 3			2	2	1	
	CO 4		2	2	2	2	2
	CO 5	2	3	3	3	2	3

***(1/2/3 indicates strength of the correlation) 1-Weak, 2-Medium, 3-Strong**

SEMESTER II **Course Code: 2MFT13 (i)** **Course Title: Advances in Dairy Technology** **Hours per week: 3+0+0** **Credits: 3**	**Course Assessment Method: Max. Marks: 100** **(Internal: 30; External: 70)** ***Note for Paper Setter:*** *The end semester examination will be of 70 marks. Nine questions are to be set by the examiner. Question number one (01) is compulsory and will be based on entire syllabus i.e. all four units. It will contain seven (07) short answer type questions of two (02) marks each. In addition, eight more questions are to be set unit-wise comprising two questions from each unit. All questions including question number one shall carry equal marks i.e. fourteen (14) marks each. The candidates are required to attempt five questions in total including first compulsory question and four more questions by selecting one question from each unit.*

RBT Level	**Course Outcomes:** After the completion of the course, the students will be able to:	
L1: Remember	CO1	Describe concepts related to the composition, properties, processing and utilization of milk.
L2: Understand	CO2	Explain milk processing techniques and subsequent manufacturing of milk products.
L3: Apply	CO3	Use technology for value addition and dairy plant sanitation.
L5: Evaluate	CO4	Assess the quality characteristics of various dairy products.
L6: Create	CO5	Prescribe processing conditions and new technologies related to dairy sector.

UNIT-I

Technology of market milk: dairy industry in India: present status and scope; milk: definition, composition and nutritive value; grading of milk; factors affecting composition of milk; physico-chemical properties of milk; FSSAI standards and legislations for market milk. Liquid milk processing: filtration/clarification; bactofugation; standardization; homogenization;

pasteurization (LTLT, HTST); sterilization; UHT processing; aseptic packaging; storage and distribution. Technology of special milks: Technology of sterilized/ flavored milk, acidophilus milk, bulgarian milk, kumis, kefir; reconstituted and recombined milk, toned, double toned milk.

UNIT-II

Technology of fat rich dairy products: cream: definition and legal standards, consumer cream products, standardization and production of cream, processing of cream (neutralization and pasteurization), butter: definition, butter-making process, overrun, yield, theories of churning, quality of butter, fat losses in cream and butter, defects in cream and butter. Ice-cream: definition, classification and composition of ice-cream, technological aspects of ice cream preparation, packaging, hardening, storage and shipping of ice cream.

UNIT-III

Technology of condensed and dried milk: definition and legal standards for evaporated and condensed milks, methods of manufacture and physico-chemical properties of evaporated and condensed milk, concept of heat stability and its control, defects in condensed and evaporated milks, Quality of raw milk for dried milks, definition and legal standards for dried milks, milk drying system (film, roller, drum, spray, foam spray drying), method of manufacture of dried milks (WMP & SMP), defects in dried milk, Technology of yoghurt and cheese: Yoghurt - definition and technology of yoghurt manufacturing, technology of different varieties of cheese manufacturing (cheddar and mozzarella), changes during ripening of cheese, yield of cheese; manufacture of processed cheese, defects in cheese, accelerated ripening of cheese.

UNIT-IV

Technology of indigenous dairy products: Introduction to traditional dairy products, khoa, channa, paneer, dahi, shrikhand, ghee, khoa and channa based sweets, miscellaneous traditional dairy foods, dairy industry by-products and sanitation: by-products: introduction, definition, composition, Importance and food applications, whey protein concentrates and isolates, dairy plant sanitation: hygiene in dairy industry, different types of cleansing/sanitizing agents and their applications, cleaning systems in dairy industry.

Recommended Readings:

1. Winton, A. L. and Winton, K. B. (2000). Milk and Milk Products, Agrobios, India.
2. Kutty, C. I. and Khamer, S. (2004). Milk Production and Processing, Daya, Delhi.
3. Fox, P. F. and McSweeney, P. L. H. (1998). Dairy Chemistry and Biochemistry, Kluwer Academic, New York.
4. Kurmann, J. A., Rasic, J. L. and Kroger, M. (1992). Encyclopedia of Fermented Fresh Milk Products: An International Inventory of Fermented Milk, Cream, Buttermilk, Whey and Related Products, CBS Publications, New Delhi.
5. Davis, J. G. (1994). Milk Testing: The Laboratory Control of Milk, Agro Botanical, Bikaner.

Mapping of Course Outcomes (CO), Programme Outcomes (PO) and Programme Specific Outcomes (PSO)

Course Code: 2MFT13 (i)					Course Title: Advances in Dairy Technology		
	Programme Outcomes (PO)				Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1				2	2	
	CO 2				2	3	
	CO 3			1	2	3	3
	CO 4			1	2		3
	CO 5			1	2	2	

***(1/2/3 indicates strength of the correlation) 1-Weak, 2-Medium, 3-Strong**

SEMESTER II **Course Code: 2MFT13 (ii)** **Course Title: Beverage Technology** **Hours per week: 3+0+0** **Credits: 3**	**Course Assessment Method: Max. Marks: 100** **(Internal: 30; External: 70)** ***Note for Paper Setter:*** *The end semester examination will be of 70 marks. Nine questions are to be set by the examiner. Question number one (01) is compulsory and will be based on entire syllabus i.e. all four units. It will contain seven (07) short answer type questions of two (02) marks each. In addition, eight more questions are to be set unit-wise comprising two questions from each unit. All questions including question number one shall carry equal marks i.e. fourteen (14) marks each. The candidates are required to attempt five questions in total including first compulsory question and four more questions by selecting one question from each unit.*

RBT Level	**Course Outcomes:** After the completion of the course, the students will be able to:	
L1: Remember	CO1	Outline the scope, types and importance of food beverages
L2: Understand	CO2	Explain various unit operations adopted for processing and packaging of beverages
L3: Apply	CO3	Classify various beverages along with their specifications
L5: Evaluate	CO4	Assess various processing changes during production of beverages
L6: Design	CO5	Formulate and quality analysis of food beverages

UNIT-I

Beverages, importance of beverages in our diet, treatment of water for food industry. Technology of alcoholic and non-alcoholic beverages- wine, cider, brandy, perry, toddy. Fruit juice beverages methods of production, preservation and packaging, physiological aspects of

fruit juice production and methods of fruit juice clarification.

UNIT-II

Technology of soft drinks, mineral water, ingredients, and additives used in production of soft drinks. Manufacturing of carbonated and non-carbonated beverages, technology of carbonation, and application of CO2 in juice preservation.

UNIT-III

Citrus beverages, whey beverages and utilization of whey in development of fortified drinks, use of low-calorie sweeteners in beverages. Equipments and machineries for juice pressing, methods of bottling, enzymatic clarification and debittering of juices. Fruit juice beverages, squash, cordial, crush, RTS, nectar, syrups, their types and production, blending of juices.

UNIT-IV

Production, processing and chemistry of tea manufacturing, tea products such as soluble tea, tea concentrate, de-caffeinated and flavoured tea. Production, processing, roasting and brewing of coffee, soluble coffee manufacture, standards and specifications of coffee products, de-caffeinated coffee, and coffee brew concentrate and chicory. Cocoa processing and cocoa beverages.

Recommended Readings:

1. Rao, L. J. M. & Ramalakshmi, K. (2011). Recent trends in soft beverages, AFST, India.
2. Priest, F. G. & Campbell, I. (1996). Brewing Microbiology (2nd ed.), Chapman and Hall, London.
3. Hui, Y. H. (2004). Handbook of Food and Beverage Fermentation Technology, Marcel Dekker, New York.
4. Varnam, A. H. & Sutherland, J. P. (1994). Beverages: Technology, Chemistry and Microbiology, Chapman, London.
5. Varnam, A. H. & Sutherland, J. P. (2009). Beverages Technology, Chemistry and Microbiology, Springer, UK.

Mapping of Course Outcomes (CO), Programme Outcomes (PO) and Programme Specific Outcomes (PSO)

Course Code: 2MFT13 (ii)				Course Title: Beverage Technology			
	Programme Outcomes (PO)				Programme Specific Outcomes (PSO)		
Course Outcomes (CO)		PO1	PO2	PO3	PSO1	PSO2	PSO3
	CO 1						
	CO 2					3	
	CO 3						
	CO 4				3	2	
	CO 5	1		1	3		3

***(1/2/3 indicates strength of the correlation) 1-Weak, 2-Medium, 3-Strong**

SEMESTER II **Course Code: 2MFT13 (iii)** **Course Title: Flavour Technology** **Hours per week: 3+0+0** **Credits: 3**	**Course Assessment Method: Max. Marks: 100** **(Internal: 30; External: 70)** ***Note for Paper Setter:*** *The end semester examination will be of 70 marks. Nine questions are to be set by the examiner. Question number one (01) is compulsory and will be based on entire syllabus i.e. all four units. It will contain seven (07) short answer type questions of two (02) marks each. In addition, eight more questions are to be set unit-wise comprising two questions from each unit. All questions including question number one shall carry equal marks i.e. fourteen (14) marks each. The candidates are required to attempt five questions in total including first compulsory question and four more questions by selecting one question from each unit.*

RBT Level	**Course Outcomes:** After the completion of the course, the students will be able to:	
L1: Remember	CO1	Describe the basic concepts of different food flavors.
L2: Understand	CO2	Explain different technologies for flavor development, extraction, and isolation.
L3: Apply	CO3	Examine different food flavors and their industrial applications.
L4: Analyze	CO4	Separate the different food flavors both quantitatively and qualitatively.
L6: Create	CO5	Design new technologies and methods for the food flavor industry.

UNIT-I

Introduction: Definition of flavour, classification of food flavour, chemical compounds responsible for flavours, difficulties of flavour chemistry research. Anatomy of chemical senses. Chemical compounds classes and their flavour response. Flavour extraction methods: isolation, separation, and equipment.

UNIT-II

Flavour development during biogenesis. Flavour compounds from carbohydrates, proteins, and lipid oxidation. Flavoring compounds during food processing-volatile and non-volatile flavoring compounds, non-enzymatic browning reactions. Food flavours in different food products: principal components and properties, fried products baked products, cheese, milk, meat, fish, wine, coffee, tea, and chocolate.

UNIT-III

Essence (flavour) recovery techniques from fruits, spices, and herbs along with the equipment used: liquid and solid flavour production; Flavouring remixing: flavour intensifiers: synthetic flavours; effect of processing on flavour quality. Flavour analysis: Sensory evaluation, discrimination analysis, descriptive analysis, Instrumental analysis (Absorption Spectroscopy (W/VIS), chromatography, mass spectrometry)

UNIT-IV

Flavour encapsulation and stabilization: principles and techniques of flavour encapsulation, types of encapsulation, factors affecting stabilization of encapsulated flavour and applications in the food industry, packaging and flavour compounds interaction, packaging, and storage

Recommended readings

1. Ashurst, P. R. (1999). Food Flavorings, (3rd Ed), Aspen Publication.
2. Charalambous, G. Food Flavors (1995). Generation, Analysis and Process Influence. Elsevier.
3. Fisher, C. 1997. Food Flavours: Biology and Chemistry, Royal Society of Chemistry,
4. Heath, H.B., and Reineccius G. (1996). Flavor Chemistry and Technology, CBS
5. Hofman, Thomas, Chi-Tang-Ho and Wilhelm Pickenhagen (2003). Challenges in Taste Chemistry and Biology, ACS Publications.
6. Reineccius, G. (2006). Flavor Chemistry and Technology (2nd Ed), Taylor & Francis.

Mapping of Course Outcomes (CO), Programme Outcomes (PO) and Programme Specific Outcomes (PSO)

Course Code: 2MFT13 (iii)					Course Title: Flavour Technology		
	Programme Outcomes (PO)				Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1				1	1	
	CO 2				1	1	1
	CO 3					2	2
	CO 4	1		1		1	2
	CO 5	2	1			2	3

***(1/2/3 indicates strength of the correlation) 1-Weak, 2-Medium, 3-Strong**

SEMESTER II **Course Code: 2MFT14 (i)** **Course Title: Advances in Meat, Fish, Poultry and Egg Processing** **Hours per week: 3+0+0** **Credits: 3**	**Course Assessment Method: Max. Marks: 100 (Internal: 30; External: 70)** ***Note for Paper Setter:*** *The end semester examination will be of 70 marks. Nine questions are to be set by the examiner. Question number one (01) is compulsory and will be based on entire syllabus i.e. all four units. It will contain seven (07) short answer type questions of two (02) marks each. In addition, eight more questions are to be set unit-wise comprising two questions from each unit. All questions including question number one shall carry equal marks i.e. fourteen (14) marks each. The candidates are required to attempt five questions in total including first compulsory question and four more questions by selecting one question from each unit.*

RBT Level	**Course Outcomes:** After the completion of the course, the students will be able to:	
L1: Remember	CO1	Describe the composition, structure and properties of meat
L2: Understand	CO2	Explain various preservation techniques of meat, poultry, egg and fish
L3: Apply	CO3	Examine the safety and quality aspects of meat, fish, poultry and egg products
L4: Analyze	CO4	Infer the need for the utilization of by-products of the meat, fish, poultry and egg industry
L6: Create	CO5	Prescribe suitable processing conditions and quality assessment for foods of animal origin

UNIT-I

Status and scope–of meat industry, meat spoilage, meat composition, structure and nutritive value, post-mortem muscle chemistry and composition, design of handling facilities:

slaughtering and dressing, pre and post slaughter factors affecting meat quality, effects of processing and preservation on meat and meat products.

UNIT-II

Structure, composition and nutritive value of poultry meat, processing and preservation of poultry meat and its products lay-out and design of poultry processing plants, plant sanitation, by-products.

UNIT-III

Egg structure, structural abnormalities, functional properties of egg, technology of egg products-whole egg powder, egg yolk products, by-products, eating quality of eggs, quality evaluation and grading, preservation and safe handling.

UNIT-IV

Technology of fish and fish products- processing, preservation and quality evaluation. By-products utilization of fish industry. Commercially important marine products from India, product export and its sustenance, transportation in refrigerated vehicles, recent advancement in meat, fish, poultry and egg.

Recommended readings:

1. Lawrie, R. A. (1998). Lawrie's Meat Science (6th ed.), Woodhead Publications, Cambridge.
2. Alan, H. V. and Jane, P. S. (1995). Meat and Meat Products: Technology, Chemistry and Microbiology, Champan & Hill, London.
3. Carmen, R. O. and George, J. M. (1997). Poultry Meat and Egg Production, CBS Publications, New Delhi.
4. Winton, A. L. and Barberwinton, K. (1999). Fish and Fish Products, Agrobios, Bikaner.
5. Winton, A. L. and Winton, K. B. (1993). The Structure and Composition of Animal Product, Agro Botanical, Bikaner.

Mapping of Course Outcomes (CO), Programme Outcomes (PO) and Programme Specific Outcomes (PSO)

Course Code: 2MFT14 (i) Course Title: Advances in Meat, Fish, Poultry and Egg Processing							
	Programme Outcomes (PO)				Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1	2	1	1	2	2	1
	CO 2	2		1	3	3	1
	CO 3	2	1	3	2	3	3
	CO 4	2		2	2	3	3
	CO 5	3	1	3	2	3	3

***(1/2/3 indicates strength of the correlation) 1-Weak, 2-Medium, 3-Strong**

SEMESTER II **Course Code: 2MFT14 (ii)** **Course Title: Snack Food Technology** **Hours per week: 3+0+0** **Credits: 3**	**Course Assessment Method: Max. Marks: 100** **(Internal: 30; External: 70)** ***Note for Paper Setter:*** *The end semester examination will be of 70 marks. Nine questions are to be set by the examiner. Question number one (01) is compulsory and will be based on entire syllabus i.e. all four units. It will contain seven (07) short answer type questions of two (02) marks each. In addition, eight more questions are to be set unit-wise comprising two questions from each unit. All questions including question number one shall carry equal marks i.e. fourteen (14) marks each. The candidates are required to attempt five questions in total including first compulsory question and four more questions by selecting one question from each unit.*

RBT Level	**Course Outcomes:** After the completion of the course, the students will be able to:	
L1: Remember	CO1	Recognize the concept and importance of snack foods
L2: Understand	CO2	Distinguish technological aspects of traditional and modern snack foods.
L3: Apply	CO3	Examine various equipments used for value addition in snack food areas.
L4: Analyze	CO4	Assess the changes due to various factors in snack food processing.
L6: Create	CO5	Design economical, nutritionally adequate and organoleptically acceptable snack foods.

UNIT-I

Introduction to snack foods- definition, classification and importance. Extrusion: Introduction in the food industry, history and uses. Extruders: working, principles, types of extruders and its components, factors affecting extrusion process, co-kneaders. pre-conditioning, chemical and

nutritional changes in food during extrusion. Post-extrusion processes- colouring, flavouring and packaging of extruded snack foods.

UNIT-II

Breakfast cereals: Introduction and classification (flaked cereals, oven puffed cereals, gun puffed cereals, shredded products). Manufacturing processes (traditional and modern methods), high shear cooking process and steam cookers. Technology for grain-based snacks: Whole grains- roasted, toasted, puffed, popped, flaked. Coated grains and nuts- salted, spiced and sweetened.

UNIT-III

Technology for fruit and vegetable-based snacks- chips, wafers. Formulation, processing and quality assessment of chips and wafers, papads, instant premixes of traditional Indian snack foods. Technology of frying-chemistry, changes in food due to frying and application of frying in snack food preparation.

UNIT-IV

Texturized vegetable protein: definition, processing techniques. Direct expanded (DX) and third generation (3G) snacks and types. Equipments for frying, baking, drying, toasting, roasting, flaking, popping, blending, coating and chipping. Concept of junk and fried foods and their impact on human health. Recent advances in Snack Foods.

Recommended readings:

1. Booth, R. G. (1997). Snack Food, CBS, New Delhi.
2. Raymond, W. L. and Rooney, L. W. (2001). Snack Foods Processing, CRC, London.
3. Lusas, E. W. and Rooney, L. W. (2015). Snack Foods Processing, CRC. London.
4. Guy, R. (2001). Extrusion Cooking: Technologies and Applications, Woodhead, USA.
5. Riaz, M. N. (2000). Extruders in Food Applications, Technomic, Lanchester.

Mapping of Course Outcomes (CO), Programme Outcomes (PO) and Programme Specific Outcomes (PSO)

Course Code: 2MFT14 (ii)				Course Title: Snack Food Technology		
	Programme Outcomes (PO)			Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1	1		1	1	2	
	CO 2	2		2	2	2	1
	CO 3	2	1	2	2	3	2
	CO 4	2		2	3	3	3
	CO 5	3	1	3	2	3	3

***(1/2/3 indicates strength of the correlation) 1-Weak, 2-Medium, 3-Strong**

SEMESTER II **Course Code: 2MFT14 (iii)** **Course Title: Food Equipment and Plant Design** **Hours per week: 3+0+0** **Credits: 3**	**Course Assessment Method: Max. Marks: 100** **(Internal: 30; External: 70)** ***Note for Paper Setter:*** *The end semester examination will be of 70 marks. Nine questions are to be set by the examiner. Question number one (01) is compulsory and will be based on entire syllabus i.e. all four units. It will contain seven (07) short answer type questions of two (02) marks each. In addition, eight more questions are to be set unit-wise comprising two questions from each unit. All questions including question number one shall carry equal mark i.e. fourteen (14) marks each. The candidates are required to attempt five questions in total including first compulsory question and four more questions by selecting one question from each unit.*

RBT Level	**Course Outcomes:** After the completion of the course, the students will be able to:	
L1: Remember	CO1	Outline various equipment design and plant layout for different food processing plants
L2: Understand	CO2	Explain the principle and working of different equipments use in unit operation
L3: Apply	CO3	Use different conditions to choose new plant location
L4: Analyze	CO4	Compare design and manufacturing of various equipment and machineries for food processing plant.
L5: Evaluate	CO5	Develop thinking skills to design various types of equipments

UNIT-I

Overall design of an enterprise: Plant design, sales planning for plant design, strength of material engineering materials, material science, use of various metals, including plastic, glass in food industry. Selection and specification –material design, concepts and manufacturing of various equipment and machineries for food processing plant.

UNIT-II

Plant location, levels of plant location, location of layout: location factors, plant site selection, location theory and models, industrial buildings and grounds, classification of dairy and food plants, farm level collection and chilling center, space requirement, estimation of services and utilities, office layout, line balancing, flexibility, practical layouts maintenance of food plant building, illumination and ventilation, cleaning and sanitization, painting and color coding, fly and insect control.

UNIT-III

Preparation of a plant layout: plant layout problem, importance, objectives, classical types of layouts, evaluation of plant layout, organizing for plant layout, data forms common problems in plant layout and process scheduling, setting of process sections, equipment selection and capacity determination, arrangement of process, and service equipment, layout of multi-product and composite food plants, waste treatment and management of food plant.

UNIT-IV

Materials and properties: materials for fabrication, design of pressure and storage vessels: operating conditions, design conditions and stress; design of tank and its component, mountings and accessories, design of heat exchangers: design of shell and tube heat exchanger, plate heat exchanger, scraped surface heat exchanger, sterilizer and retort, design of evaporators: design of dryers, design of extruders: cold and hot extruder design, design of screw and barrel, design of twin screw extruder, safety measures in equipment design, pressure relief devices.

Recommended Readings:

1. Hall, H.S. (1968). Milk Plant Layout, FAO Pub., Rome

2. Moore, J.M. (1971). Plant Layout and Design, Mac Millan, New York

3. Sean, M. 2015 Applied guide to process and plant design, Elsevier.

4. Sarvacos, G. and Athanacios, E.K. (2016). Handbook of Food Processing Equipment, (2ndEd), Springer.

5. Stanbury, P, F., Whitakar, Allan and Stephen J. Hall, (1995). Principles of Fermentation Technology, (2ndEd.), Elsevier, USA.

Mapping of Course Outcomes (CO), Programme Outcomes (PO) and Programme Specific Outcomes (PSO)

Course Code: 2MFT14 (iii)		Course Title: Food Equipment and Plant Design					
		Programme Outcomes (PO)			Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1	1	1	1	2	3	3
	CO 2	1	1	2	2	2	2
	CO 3		1	1	3	2	3
	CO 4	1	1	1	2	3	2
	CO 5		1		2	2	3

***(1/2/3 indicates strength of the correlation) 1-Weak, 2-Medium, 3-Strong**

SEMESTER II **Course Code: 2MFT15** **Course Title: Programme Core Lab III** **Hours per week: 0+0+4** **Credits: 2**	**Course Assessment Method: Max. Marks: 100** **(Internal: 50; External: 50)** ***Evaluation:*** *There will be continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their time table. The chairperson of the department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by the external examiner appointed by the controller of examination along with the internal examiner, preferably the laboratory coordinator appointed by the chairperson.*

RBT Level	**Course Outcomes:** After the completion of the course, the students will be able to:	
L3: Apply	CO1	Classify cereal grains, fruits and vegetable on the basis of the different quality parameters.
L4: Analyse	CO2	Compare the technology of processing & preservation of fruits & vegetables.
L5: Evaluate	CO3	Determine physicochemical and functional characteristics of different food products.
L6: Create	CO4	Develop new products with improved quality and technology.

Post-harvest quality evaluation of different fresh fruits and vegetables. Minimal processing of the cut fruits and vegetables. Shelf-life studies of different fruits and vegetables. Preparation and

quality evaluation of different products of fruits and vegetables. Dehydration of fruits and vegetables and their quality evaluation. Grading of wheat varieties, milling quality of hard and soft wheat varieties, effect of grains parameters on the flour yield and quality, quality assessment of wheat gluten, damaged starch and bread flour quality, effect of damaged starch of flour on biscuit quality, factors affecting water absorption of wheat flour, effect of ingredients and processing parameters of yeast growth, assessment of dough rheology using dough Lab and mixolab, bread, biscuits, noodles making potential of different wheat flours, quality assessment of bakery products.

Mapping of Course Outcomes (CO), Programme Outcomes (PO) and Programme Specific Outcomes (PSO)

Course Code: 2MFT15				Course Title: Programme Core Lab III		
	Programme Outcomes (PO)				Programme Specific Outcomes (PSO)	
		PO1	PO2	PO3	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1						
	CO 2				1	1	
	CO 3		1		2	1	2
	CO 4	1	2	2	2	2	2
	CO 5	2	3	3	3	2	3

***(1/2/3 indicates strength of the correlation) 1-Weak, 2-Medium, 3-Strong**

SEMESTER II **Course Code: 2MFT16** **Course Title: Programme Elective Lab IV** **Hours per week: 0+0+4** **Credits: 2**	**Course Assessment Method: Max. Marks: 100** **(Internal: 50; External: 50)** ***Evaluation:*** *There will be continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their time table. The chairperson of the department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by the external examiner appointed by the controller of examination along with the internal examiner, preferably the laboratory coordinator appointed by the chairperson.*

RBT Level	**Course Outcomes:** After the completion of the course, the students will be able to:	
L2: Understand	CO1	Illustrate the techniques involved in production of dairy, beverage and snack foods.
L3: Apply	CO2	Examine the physico-chemical changes in different food products viz. dairy, beverages and snack foods.
L5: Evaluate	CO3	Judge the quality characteristics of dairy, beverages, snack foods and food equipments.
L6: Create	CO4	Formulate consumer specific products as per current needs.

Note: Students will conduct Programme Elective Lab IV experiments as per combination of elective subjects opted by them.

Advances in Dairy Technology

Sampling of milk and milk products, Platform tests of milk: Organoleptic test, Sediment test, COB test, Alcohol test, Alcohol-Alizarin test, Titratable acidity and pH of milk. Determination of specific gravity of milk, total solids and solid-not-fat using lactometer. Detection of milk adulterant; added water, starch, cane sugar, neutralizers and preservatives (formalin and hydrogen peroxide), synthetic milk (urea test, detergent test, common salt). Alkaline phosphatase test to determine adequacy of pasteurization. Fat estimation in milk using gerber and rose-gottlieb method. Testing of ghee and butter: Reichert-Meissel number and Polenske value, Moisture in butter (Dean and Stark distillation), curd and salt in butter, Peroxide value, Iodine value of ghee, Acid value of ghee, Saponification value of ghee. Development of some indigenous dairy products- Standardization and preparation of khoa/ice cream/Rasogulla.

Beverage Technology

Quantitative analysis of water samples as per carbonated beverage requirements. Analysis of marketed beverage samples for nutraceutical ingredients and permitted additives. Preparation and determination of quality parameters for alcoholic and non-alcoholic beverages. Juice extraction, clarification and debittering methods.

Flavour Technology

Different methods of flavour extraction; estimation of non-enzymatic browning; flavour analysis using different methods viz. discriminative and descriptive analysis; calorimetric estimation of different flavouring compounds, different encapsulation techniques for different flavouring compounds and stability studies.

Snack Food Technology

Identifying and transforming a traditional salty snack into healthy designer snack food utilizing protein and fibre rich raw material, identify and analyze the ingredients and nutritional value of popular snacks in terms pf their specifications and impact on human health respectively. To compare the quality of chips prepared by different cooking methods. To study various machines employed in manufacturing snack food products at a commercial scale. To prepare and assess

the quality of biscuits, cookies, muffins and cakes as healthy bakery snacks. Preparation and sensory evaluation of Noodles. Preparation of millet based fried snack foods. Effect of Pre drying and par frying on the crispiness of French fries Potato. Isolation and estimation of synthetic food color.

Food Equipment and Plant Design

To prepare a feasibility report and location report, to study design and layout of milk processing, fruit processing, beverage processing, meat and meat products plant, grain processing, bakery and confectionery plant, to study design and layout of cold storage and warehouse, flow process charts, machine flow diagrams, selection of processing and handling machine, application of system design and principles, layout plans for different machines and utilities.

Mapping of Course Outcomes (CO), Programme Outcomes (PO) and Programme Specific Outcomes (PSO)

Course Code: 2MFT16					Course Title: Programme Elective Lab IV		
	Programme Outcomes (PO)				Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1	1			1	1	
	CO 2	1	1		1	1	1
	CO 3					2	2
	CO 4	1		1		1	2
	CO 5	1	1			2	3

***(1/2/3 indicates strength of the correlation) 1-Weak, 2-Medium, 3-Strong**

SEMESTER II **Course Code: 2MFT18** **Course Title: Mini Project** **Hours per week: 0+0+4** **Credits: 2**	**Course Assessment Method: Max. Marks: 100** **(Internal: 100)** ***Evaluation:*** *The assessment will be of 100 marks done at the end of the semester II by the project coordinator.*

RBT Level	**Course Outcomes:** After the completion of the course, the students will be able to:	
L5: Evaluate	CO1	Assess current research findings pertaining to food science and engineering and identify the gaps that need attention.
L3: Apply	CO2	Prepare research project pertaining to food engineering.
L4: Analyze	CO3	Identify the relevant methodology and conduct the research.
L6: Create	CO4	Organize the research findings in the form of a document.

Mapping of Course Outcomes (CO), Programme Outcomes (PO) and Programme Specific Outcomes (PSO)

Course Code: 2MFT18						**Course Title: Mini Project**	
	Programme Outcomes (PO)				**Programme Specific Outcomes (PSO)**		
		PO1	**PO2**	**PO3**	**PSO1**	**PSO2**	**PSO3**
Course Outcomes (CO)	**CO 1**	1	1		1	1	3
	CO 2	1	3		1	1	1
	CO 3	3	1	1	1	1	1
	CO 4	1		1	1	1	1

***(1/2/3 indicates strength of the correlation) 1-Weak, 2-Medium, 3-Strong**

SEMESTER III **Course Code: 3MFT21 (i)** **Course Title: Bioprocess Engineering** **Hours per week: 3+0+0** **Credits: 3**	**Course Assessment Method: Max. Marks: 100** **(Internal: 30; External: 70)** ***Note for Paper Setter:*** *The end semester examination will be of 70 marks. Nine questions are to be set by the examiner. Question number one (01) is compulsory and will be based on entire syllabus i.e. all four units. It will contain seven (07) short answer type questions of two (02) marks each. In addition, eight more questions are to be set unit-wise comprising two questions from each unit. All questions including question number one shall carry equal mark i.e. fourteen (14) marks each. The candidates are required to attempt five questions in total including first compulsory question and four more questions by selecting one question from each unit.*

RBT Level	**Course Outcomes:** After the completion of the course, the students will be able to:	
L1: Remember	CO1	Describe the kinetics of microbial growth and enzymes, bioreactors and downstream processing.
L2: Understand	CO2	Illustrate the growth conditions and instrumentation used in bioprocesses.
L3: Apply	CO3	Classify various types of bioreactors and its components.
L4: Analyze	CO4	Identify the various unit operations involved in bioprocessing.
L6: Create	CO5	Plan the production of industrially important metabolites.

UNIT-I

Introduction to bioprocessing, historical developments, enzyme kinetics- Micaelis-menton model, effect of temperature on reaction rate, microbial growth kinetics- batch culture, continuous culture, fed batch culture. Sterilization and sanitation: thermal death kinetics,

medium sterilization (batch and continuous design), sterilization of fermenter, feed and wastes; filter sterilization of media, air and exhaust air; theory of depth filters, Upstream processing-isolation, preservation and improvement of industrially important micro-organisms.

UNIT-II

Fermenter design- basic functions of fermenters, types of fermenter, construction material, pipes and tubes, valves and steam traps, agitator and impeller, stirrer and bearing (seals and drives), sparger, baffles, achievement and maintenance of aseptic conditions (sterilization of air, exhaust gas and fermenter), sampling port, controlling devices.

UNIT-III

Product recovery- foam separation, precipitation, filtration (batch, continuous, cross flow filtration), filtration equipment, filtration theory, centrifugation, centrifuge equipment, centrifugation theory, liquid- liquid extraction– solvent recovery, two phase aqueous extraction, supercritical fluid extraction, chromatography techniques, membrane processes (ultra-filtration, reverse osmosis, liquid membranes), drying, crystallization.

UNIT-IV

Bioprocess instrumentation- offline analytical methods, physical, chemical and biosensors, online sensors. Advancement in the application of bioprocessing engineering.

Recommended readings:

1. Doran, P. M. (1995). Bioprocess Engineering Principles, Academic Press, New Delhi.
2. Shuler, M. L. (2002). Bioprocess Engineering Basic Concepts (2 ed.), PHI, New Delhi.
3. Sablani, S. S., Rahman, M. S., Datta, A. K. and Mujumdar, A. S. (2007). Handbook of Food and Bioprocess Modeling Techniques, CRC Publications, New York.

Mapping of Course Outcomes (CO), Programme Outcomes (PO) and Programme Specific Outcomes (PSO)

Course Code: 3MFT21 (i)				Course Title: Bioprocess Engineering			
	Programme Outcomes (PO)				Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1	2	1		1	2	1
	CO 2	2	2	1	2		2
	CO 3	1	2	2	2	1	2
	CO 4	1	1	2	2	2	1
	CO 5	3	1	3		2	3

***(1/2/3 indicates strength of the correlation) 1-Weak, 2-Medium, 3-Strong**

# SEMESTER III **Course Code: 3MFT21 (ii)** **Course Title: Nutraceuticals and Functional Foods** **Hours per week: 3+0+0** **Credits: 3**	**Course Assessment Method: Max. Marks: 100** **(Internal: 30; External: 70)** ***Note for Paper Setter:*** *The end semester examination will be of 70 marks. Nine questions are to be set by the examiner. Question number one (01) is compulsory and will be based on entire syllabus i.e. all four units. It will contain seven (07) short answer type questions of two (02) marks each. In addition, eight more questions are to be set unit-wise comprising two questions from each unit. All questions including question number one shall carry equal marks i.e. fourteen (14) marks each. The candidates are required to attempt five questions in total including first compulsory question and four more questions by selecting one question from each unit.*

RBT Level	**Course Outcomes:** After the completion of the course, the students will be able to:	
L1: Remember	CO1	Outline the concepts of nutraceuticals and functional foods
L2: Understand	CO2	Explain the mechanism of action of nutraceuticals in health management
L3: Apply	CO3	Identify the efficacy and potential applications of different nutraceuticals in the field of food and pharma
L4: Analyze	CO4	Compare the compatibility and interactions of different nutraceuticals while creating a functional food
L6: Create	CO5	Prescribe the industry professionals dealing with nutraceuticals with respect to safety and regulations

UNIT-I

Nutraceuticals and functional foods: definition, types and scope, need, food applications and their health benefits, Nutraceutical compounds and their classification, Nutraceuticals for specific situations such as cancer, heart disease, stress, osteoarthritis, hypertension.

UNIT-II

Phytochemicals and various nutraceuticals from different sources: Definition, classification, extraction, mechanism of action, stability and health benefits.

UNIT-III

Development of functional foods. Effects of processing conditions and storage. Development of biomarkers to indicate efficacy of functional ingredients. Marketing and regulatory issues for functional foods and nutraceuticals.

UNIT-IV

Cereals as functional foods. Functional vegetable products, oil seeds, spices, herbs, and foods of animal origin. Coffee, tea and other fruit/vegetable-based drinks as functional foods/drinks and their protective effect. Probiotics as functional foods.

Recommended readings:

1. Mine, Y and Fereidoon, S. (2006). Nutraceutical Proteins and Peptides in Health and Disease, TF, Bocaraton.
2. Bagchi, D. (2008). Nutraceutical and Functional Food Regulations in United States and Around the World, Elsevier, London.
3. Shi, J. (2007). Functional Food Ingredients and Nutraceuticals: Processing Technologies, CRC Press, London.
4. Guo, M. (2009). Functional Food: Principles and Technology, WP, New Delhi.

Mapping of Course Outcomes (CO), Programme Outcomes (PO) and Programme Specific Outcomes (PSO)

Course Code: 3MFT21 (ii)		Course Title: Nutraceuticals and Functional Foods					
		Programme Outcomes (PO)			Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1				1		
	CO 2				1	1	
	CO 3	2	1		1	1	2
	CO 4					1	2
	CO 5	2	2	1		2	2

***(1/2/3 indicates strength of the correlation) 1-Weak, 2-Medium, 3-Strong**

SEMESTER III **Course Code: 3MFT21 (iii)** **Course Title: Valorization of Food By-Products** **Hours per week: 3+0+0** **Credits: 3**	**Course Assessment Method: Max. Marks: 100 (Internal: 30; External: 70)** ***Note for Paper Setter:*** *The end semester examination will be of 70 marks. Nine questions are to be set by the examiner. Question number one (01) is compulsory and will be based on entire syllabus i.e. all four units. It will contain seven (07) short answer type questions of two (02) marks each. In addition, eight more questions are to be set unit-wise comprising two questions from each unit. All questions including question number one shall carry equal mark i.e. fourteen (14) marks each. The candidates are required to attempt five questions in total including first compulsory question and four more questions by selecting one question from each unit.*

RBT Level	**Course Outcomes:** After the completion of the course, the students will be able to:	
L1: Remember	CO1	Describe classification and processing technologies for food waste valorization.
L2: Understand	CO2	Explain type of by-products and their composition generated from food processing industries.
L3: Apply	CO3	Examine functional properties of the valorized by-products.
L4: Analyze	CO4	Assess quality parameters valorized products obtained from by-products from plant and animal processing industries.
L6: Create	CO5	Develop valorized products from food processing wastes.

UNIT- I

Present status of food processing by-products, classification of food waste by-products, valorisation processing technologies, need for valorisation of food processing by-products and

wastes, food and non – food applications of food waste, biochemical and nutritional microbiological aspect of food processing by-products.

UNIT- II

Valorization of by-products from plant-based food processing industries: cereals, oilseeds, roots and tubers, sugarcane, plantation products, fruits and vegetables, bakery and confectionery, fermented and non-fermented beverages.

UNIT- III

Valorization of by-products from animal products-based food processing industries: dairy by-products, sea foods, meats, poultry, and eggs environmental concerns, future prospects of valorization of food processing by-products.

UNIT- IV

Enzyme technologies for bioconversion of food processing by-products, major concern and regulatory issues of valorization of food by-products, environmental concerns and sustainable development.

Recommended readings:

1. Waldron, K.W. (2009). Handbook of waste management and co-product recovery in food processing, Elsevier,

2. Chandrasekaran, M. (2012). Valorization of food processing by-products. CRC Press,

3. Oreopoulou, V., & Russ, W. (2007). Utilization of by-products and treatment of waste in the food industry, New York, NY, USA, Springer.

4. Arvanitoyannis, I. S. (2010). Waste management for the food industries. Academic Press, 2010.

5. Wang, L.K., Hung, Y.T., Lo, H.H., & Yapijakis, C. (2005). Waste treatment in the food processingng industry. CRC Press,

Mapping of Course Outcomes (CO), Programme Outcomes (PO) and Programme Specific Outcomes (PSO)

Course Code: 3MFT21 (iii)					Course Title: Valorization of Food By-Products		
	Programme Outcomes (PO)				Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1				1	2	
	CO 2				1	3	1
	CO 3					2	1
	CO 4				1	2	
	CO 5			1		2	1

***(1/2/3 indicates strength of the correlation) 1-Weak, 2-Medium, 3-Strong**

SEMESTER III **Course Code: 3MFT-801A** **Course Title: Dissertation Phase-I** **Hours per week: 0+0+20** **Credits: 10**	**Course Assessment Method: Max. Marks: 100** **(Internal: 100)** ***Evaluation*** *At the end of the dissertation Phase-I (during 3rd semester), the evaluation will be done at the end of the 3rd semester by a committee constituted by the chairperson including supervisor and two faculty members.*

RBT Level	**Course Outcomes:** After the completion of the course, the students will be able to:	
L4: Analyse	CO1	Identification of area of research based on review of literature.
L6: Create	CO2	Planning of research problems in the food domain.
L4: Analyse	CO3	Identify the relevant methodology and preparation of the synopsis.

Mapping of Course Outcomes (CO), Programme Outcomes (PO) and Programme Specific Outcomes (PSO)

Course Code: 3MFT-801A					**Course Title: Dissertation Phase-I**		
	Programme Outcomes (PO)				**Programme Specific Outcomes (PSO)**		
		PO1	**PO2**	**PO3**	**PSO1**	**PSO2**	**PSO3**
Course Outcomes (CO)	**CO 1**	1	1		1	1	
	CO 2	1	3	1	1	1	
	CO 3	1	3	1	1	1	

***(1/2/3 indicates strength of the correlation) 1-Weak, 2-Medium, 3-Strong**

SEMESTER IV **Course Code: 4MFT-801B** **Course Title: Dissertation Phase-II/Thesis** **Hours per week: 0+0+32** **Credits: 16**	**Course Assessment Method: Max. Marks: 100 (External: 100)** ***Evaluation*** *The research project shall be evaluated by the internal and external examiner at the end of the Semester IV.*

RBT Level	**Course Outcomes:** After the completion of the course, the students will be able to:	
L5: Evaluate	CO1	Design and conduct of experiments to achieve stated objectives of the research problem.
L6: Create	CO2	Generate logical conclusions based on analysis and validation of research data.
L6: Create	CO3	Organize research findings in the form of thesis/ dissertation and its publication for the benefit of society.

Mapping of Course Outcomes (CO), Programme Outcomes (PO) and Programme Specific Outcomes (PSO)

Course Code: 4MFT-801B		Course Title: Dissertation Phase-II/Thesis					
		Programme Outcomes (PO)			Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1	3	1	1	3	1	3
	CO 2	1	2	2	2	1	3
	CO 3	1	3	3		1	3

***(1/2/3 indicates strength of the correlation) 1-Weak, 2-Medium, 3-Strong**