SEMESTER III **Course Code: BSC-FT201-T** **Course Title: Introduction to Biology and Microbiology** **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 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	Describe the basic organization of microbial cell and its functionalities.
L2: Understand	CO2	Explain the nutritional requirements of microbial cell and their subsequent metabolism.
L3: Apply	CO3	Examine various factors affecting microbial growth in food systems.
L4: Analyse	CO4	Assess the role of various microorganisms in food processing.
L6: Create	CO5	Formulate nutritional requirements, growth conditions and food applications of microorganisms.

UNIT-I

Basic Cell Biology: Cells and Cell theory, Cell Structure, Function and chemical constituents of living cell, Cell reproduction (Binary fission, Sporulation, Budding), Types of cells (eukaryotic & prokaryotic), Basis of classification, Five kingdom classification.

UNIT-II

Nutrient Metabolism: structure and function of protein, carbohydrate (TCA, Pyruvate cycle etc.), fat and enzymes. Mineral nutrition: Essential minerals, macro and micro nutrients and their role.

UNIT-III

The nutritional requirements of microorganisms (Carbon, Hydrogen, nitrogen, phosphorus, Oxygen and growth factors); Microbiology of carbon, nitrogen, phosphorus and sulphur transformations.

UNIT-IV

Importance of bacteria, yeast, molds in food industry; Sources of Microorganisms, Microbial Growth curve, Measurement of Growth; Extrinsic and Intrinsic factors effecting microbial growth. Overview of Microorganisms associated with different fermented foods.

Recommended Readings:

1. ThyagaRajan S, Selvamurugan N, Rajesh M P, Nazeer R A, Thilagaraj R W, S. Barathi, and M. K. Jaganathan (2012) "*Biology for Engineers*," Tata McGraw-Hill.
2. Weaver R (2012) "*Molecular Biology*," McGraw-Hill (5th Ed).
3. Stainier R.Y. Ingraham J. L., Wheelis M. L. & Painter P. R. (2003) *General Microbiology.*
4. Tauro P. Kapoor K. K. & Yadav K. S. (1996) *Introduction to Microbiology. New Age International Pvt. Ltd. New Delhi.*
5. William Carroll Frazier (1967) *Food Microbiology.*

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

Course Code: BSC-FT201-T		Course Title: Introduction to Biology and Microbiology														
	Programme Outcomes (PO)													Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1		2	1										2		3
	CO 2				1	1						1		1	2	3
	CO 3		2			2						1		1	2	1
	CO 4	3	1	1											2	
	CO 5	3	1	2								1			1	

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

# SEMESTER III **Course Code: BSC-FT201-P** **Course Title: Introduction to Biology and Microbiology Lab** **Hours per week: 0 + 0 + 4** **Credits: 2**	**Course Assessment Method: Max. Marks: 100** **(Internal: 50; External: 50)** ***Evaluation:*** *There will be a 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 the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. 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 external examiner appointed by the Controller of Examination along with the internal examiner, preferably the laboratory course coordinator, appointed by the Chairperson of the Department.*

RBT Level	**Course Outcomes:** After the completion of the course, the students will be able to:	
L2: Understand	CO1	Describe the preparation of standard solutions and buffers.
L3: Apply	CO2	Estimate the various components of cells using different techniques.
L4: Analyse	CO3	Operate simple & micropipettes and microscope.
L5: Evaluate	CO4	Examine the cell structure using different instruments.
L6: Create	CO5	Evaluate the quantity of microorganisms using different methods.

To learn use of microscope and principles of fixation and staining, Preparation of Normal, molar and standard solutions, phosphate buffers, serial dilutions, Use of micropipettes, Separation of amino acids and chloroplast pigments by paper chromatography, Perform gram staining of bacteria, Study the cytochemical distribution of nucleic acids and

mucopolysaccharides in cells/tissues from permanent slides, Perform quantitative estimation of protein using the Lowry's method and determine the concentration of the unknown sample using the standard curve plotted, Separate and quantify sugars by thin layer chromatography, Raise the culture of E. coli and estimate the culture density by turbidity method and draw a growth curve from the available data, Isolation of genomic DNA from E.coli.

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

Course Code: BSC-FT201-P		Course Title: Introduction to Biology and Microbiology Lab														
	Programme Outcomes (PO)													Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1		2	1									1	2		3
	CO 2				1	1						1	2	1	2	3
	CO 3		2			2						1		1	2	1
	CO 4		1	1									2		2	
	CO 5		1	2								1	1		1	

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

SEMESTER III **Course Code: PCC-FT201-T** **Course Title: Food Composition and 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 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	Describe the chemical composition of macro and micro food components.
L2: Understand	CO2	Illustrate the physical, chemical and functional properties of various food components.
L3: Apply	CO3	Classify different methods for qualitative and quantitative analysis of food components.
L4: Analyse	CO4	Distinguish enzyme applications with respect to their category and rate of action.
L5: Evaluate	CO5	Propose the appropriate method of food analysis by applying food composition knowledge.

UNIT-I

Constituents of foods: general classification and importance. Nutritive values of common foods. Water: significance, structure of water, types of water, role of water activity in foods.

Introduction to macro and micro nutrients and other food constituents like food flavours and pigments.

UNIT-II

Classification, structures, general and functional properties of carbohydrates, proteins and fats. Commercial sugars and fats, Introduction to enzymes and their significance in food processing.

UNIT-III

Classification, sources and functions of various fat soluble and water-soluble vitamins. Classification, sources and functions of macro, micro and trace minerals in foods.

UNIT-IV

Introduction to various analytical methods: sampling, moisture, crude fat, crude protein, crude fiber. Weighing devices, pH meters, gravimetry, titrimetry, spectrophotometry, chromatography.

Recommended Readings:

1. Wang, D. (2012). *Food Chemistry*: Nova Science Publishers.
2. Chopra, H. K. &Panesar, P. S. (2010). *Food chemistry*: Alpha Science International Ltd, Oxford, U.K.
3. Coultate, T. P. (2009). *Food: The Chemistry of Its Components* (5 ed.): American Chemical Society.
4. Newton, D.E. (2009). *Food Chemistry*: Facts on File, Incorporated.
5. Damodaran, S., Parkin, K. L., & Fennema, O. R. (2007). *Fennema's Food Chemistry*: CRC Press, Taylor and Francis group**.**

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

Course Code: PCC-FT201-T		Course Title: Food Composition and Analysis														
		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1		1	1			2							3	1	2
	CO 2	1	1	2	1										2	1
	CO 3	1	2	1	2		1							3	1	1
	CO 4		2	2	1	2	1								2	1
	CO 5	1	2	1			1							2	2	1

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

# SEMESTER III **Course Code: PCC-FT201-P** **Course Title: Food Composition and Analysis Lab** **Hours per week: 0 + 0 +4** **Credits: 2**	**Course Assessment Method: Max. Marks: 100** **(Internal: 50; External: 50)** ***Evaluation:*** *There will be a 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 the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. 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 external examiner appointed by the Controller of Examination along with the internal examiner, preferably the laboratory course coordinator, appointed by the Chairperson of the Department.*

RBT Level	**Course Outcomes:** After the completion of the course, the students will be able to:	
L2: Understand	CO1	Illustrate the different methods of food sampling.
L3: Apply	CO2	Explain the different methods used for food analysis.
L4: Analyse	CO3	Identify the food components by using qualitative and quantitative methods of food analysis.
L5: Evaluate	CO4	Evaluate the results of food analysis and use it for further data analysis.
L6: Create	CO5	Formulate different food products by varying components.

Introduction to laboratory maintenance/safety measures and familiarization with different type of instruments/equipments in food analysis laboratory. Study of different sampling techniques for preparation of different food sample. Introduction to preparation of various solutions commonly used in food analysis. Determination of moisture content of a food sample. Determination of titratable acidity and pH of given food sample. Estimation the total soluble solids (TSS) in given food sample. Determination of presence of starch in given food sample. Qualitative/quantitative determination of carbohydrates by different methods in given food samples. Determination of free fatty acid (FFA) content of given oil/ghee sample. Determination of crude fat of given food sample using Soxhlet extraction method. Determination Total solids of milk using gravimetric method and lactometer method along with its specific gravity and SNF. To determine wet and dry gluten content in given food sample. Qualitative/quantitative determination of proteins/ amino acids in different food samples. Determination of ash content and preparations for mineral estimation of a food sample. Determination of crude fibre in given food sample.

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

Course Code: PCC-FT201-P												Course Title: Food Composition and Analysis Lab				
	Programme Outcomes (PO)													Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1	2	1						2			1	2	1	2	2
	CO 2			1		2						2	2	1	2	1
	CO 3			2				1				2	1	2		2
	CO 4					2		1				1		2	1	
	CO 5	3	2										1			2

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

# SEMESTER III **Course Code: PCC-FT203-T** **Course Title: Introduction to Nutrition and Health** **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 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 the terms and concepts related to food nutrition and health.
L2: Understand	CO2	Explain the requirements and source of various nutrients essential for human health.
L3: Apply	CO3	Judge the role of nutrition in health maintenance and management.
L4: Analyze	CO4	Identify the role of various organizations in the field of nutrition and health.
L6: Create	CO5	Plan balanced diets according to specific health needs.

UNIT-I

Scope, concepts and importance of nutrition; definition of various terms related to nutrition, human digestive system, Malnutrition and its types, role of nutrition in immunity. Infection. Energy - definition, units of measurement of energy, basal metabolic rate (BMR), specific dynamic action (SDA) of foods, factors affecting BMR and respiratory quotient (RQ). Classification, functions, sources, requirements and deficiency of carbohydrates. Importance of dietary fiber and water in human health.

UNIT-II

Classification, functions, sources, requirements, and deficiency of proteins; Classification, functions, sources, requirements, and deficiency of lipids; Classification, functions, sources, requirements, and deficiency of vitamins; Classification, functions, sources, requirements, and deficiency of minerals

UNIT-III

Concept of Balanced diets, diets for different age groups, Role of nutrition in pregnancy, lactation, infancy, childhood. Nutrition of special groups: geriatric, sports, space

UNIT-IV

Importance of Nutrition Education, Role of different national and international organizations in maintaining health and nutritional status, present nutritional policies, Existing food fads and fallacies & how to overcome

Recommended Readings:

1. Joshi S. A., (1992) *Nutrition and Dietetics* Tata Mc Grow- Hill publishingCompany Ltd., New Delhi
2. M. Swaminathan, Vol I & II *Foods and Nutrition* NIN Publications
3. Manay S., and Shadksharawamis N., *Food: Facts and Principles*, New Age International Pvt. Ltd., New Delhi.
4. Mann J., and Truswell S., (2007) *Essentials of Human Nutrition3rd Ed*. Oxford University Press, 2007.
5. Khanna (1997) *Textbook of Nutrition and Dietitics,* Phoenix Publisher House Pvt. Ltd., New Delhi.
6. Eastwood M. S., (2003) *Principles of Human Nutrition2 ed*, Blackwell Publishers.

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

Course Code: PCC-FT203-T		Course Title: Introduction to Nutrition and Health														
	Programme Outcomes (PO)													Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1	1			1		1							2		1
	CO 2	1	1	2	1		1							1		1
	CO 3	1	2	2	1		1						1	2		2
	CO 4	1	1	2	2		2							1		
	CO 5	1	2	3	2	2	3							3		3

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

# SEMESTER III **Course Code: ESC-FT201-T** **Course Title: Engineering Properties of 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 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	Describe various physical and rheological properties of food.
L2: Understand	CO2	Explain measurement techniques of engineering properties of foods.
L3: Apply	CO3	Examine different engineering properties of foods.
L4: Analyse	CO4	Differentiate the food products based on engineering properties.
L6: Create	CO5	Devise processing conditions based on engineering properties of food.

UNIT-I

Mass, volume, area related properties of foods and their measurement techniques; Rheological properties of food: stress, strain, Hooke's law, elasticity, Plasticity, ductility; flow behavior: Newtonian and Non-Newtonian fluid, Time dependent and independent flow behavior.

UNIT-II

Thermal properties of food: specific heat capacity, thermal conductivity, enthalpy, thermal diffusivity, Thermodynamic properties of food: sorption energy, significance of thermal properties; Psychrometrics: Properties of dry air, composition of air, specific heat of dry air, enthalpy of dry air, psychometric chart, application of psychometric chart in food processing.

UNIT-III

Dielectric properties of food: principle, measurement, frequency and temperature dependence, composition dependence of dielectric properties; assessment of food quality by using dielectric properties, effects of processing and storage on dielectric properties of foods.

UNIT-IV

Surface properties: surface tension, fundamental consideration, Gibbs adsorption equation and contact angle measurement techniques; colorimetric properties of food: measurement of colour, colour spectrum etc.

Recommended Readings:

1. Rao M. A., Rizvi S. S. H., Datta A. K. &Jasim A. (2014) *Engineering properties of foods*, 4th edition, CRC Press.
2. Lewis M. J. (1990) *Physical Properties of Foods and Food Processing Systems.* Woodhead Publishing.
3. Devahastin S. (2011) *Physicochemical aspects of food engineering and processing*, CRC Publication.
4. Singh R. P. & Heldman D. R. (2009) *Introduction to Food Engineering 4th edition,* Academic Press.

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

Course Code: ESC-FT201-T		Course Title: Engineering Properties of Foods														
	Programme Outcomes (PO)													Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1	2	1				1							2	2	1
	CO 2	2	2		1	1	1							3		1
	CO 3	2	2		2									2	2	1
	CO 4	3	2	1	2		1							3	3	2
	CO 5	2	2		2									3		2

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

SEMESTER III **Course Code: ESC-FT203-T** **Course Title: Thermodynamics** **Hours per week: 3 + 1 + 0** **Credits: 4**	**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	Describe basic concepts of engineering thermodynamics and the practical application of thermodynamic laws.
L2: Understand	CO2	Illustrate the implementation of 1st law of thermodynamics for different flow processes and apply the basic concepts of heat engine, heat pump and refrigerator used in engineering field.
L3: Apply	CO3	Use basic concepts of thermodynamics in problem solving.
L4: Analyse	CO4	Determine the ideal thermodynamic air standard cycles and mathematical relationships between different thermodynamic properties.
L6: Create	CO5	Generate ideas to solve thermodynamic models using various properties.

UNIT-I

Basic Concepts: Macroscopic and microscopic approaches, thermodynamic systems, surrounding and boundary, thermodynamic property – intensive and extensive, thermodynamic

equilibrium, state, path, process and cycle, quasi-static, reversible and irreversible processes, working substance; Concept of thermodynamic: work and heat, equality of temperature, zeroth law of thermodynamic and its utility, problems; First Law of thermodynamics: energy and its forms, energy and 1st law of thermodynamics, internal energy and enthalpy, PMMFK, steady flow energy equation, 1st law applied to non- flow process, steady flow process and transient flow process, throttling process and free expansion process, problems.

UNIT-II

Second law of thermodynamics: limitations of first law, thermal reservoir, heat source and heat sink, heat engine, refrigerator and heat pump, kelvin- planck and clausius statements and their equivalence, PMMSK, Carnot cycle, Carnot heat engine and Carnot heat pump, Carnot theorem and its corollaries; Thermodynamic temperature scale; Entropy, Clausius inequality, principle of entropy increase, temperature entropy plot, entropy change in different processes, problems; Introduction to third Law of thermodynamics. availability and irreversibility: high and low-grade energy, availability and unavailable energy, dead state of a system, availability of a non-flow or closed system, availability of a steady flow system, Helmholtz and Gibb's Functions, effectiveness and irreversibility, second law efficiencies of processes & cycles, problems.

UNIT-III

Pure Substance: pure substance and its properties, phase and phase transformation, vaporization, evaporation and boiling, saturated and superheat steam, solid – liquid – vapour equilibrium, T-V, P-V and P-T plots during steam formation, properties of dry, wet and superheated steam, property changes during steam processes, temperature – entropy (T-S) and enthalpy – entropy (H-S) diagrams, throttling and measurement of dryness fraction of steam, problems.

UNIT-IV

Ideal and Real Gases: concept of an ideal gas, basic gas laws, characteristic gas equation, Avogadro's law and universal gas constant, P-V-T surface of an ideal gas; Vander Waal's equation of state, reduced co-ordinates, Mixture of gases, mass, mole and volume fraction, Gibson Dalton's law, gas constant and specific heats, problems; Thermodynamic relations: Maxwell relations, Clapyron equation, relations for changes in enthalpy and internal energy & entropy, specific heat capacity relations

Recommended Readings:

1. Jones & Dugan (1995) *Engineering Thermodynamics,* Prentice Hall of India.
2. Radhakrishnan E. (2006) *Fundamentals of Engineering Thermodynamics*, *2nd edition,* Prentice Hall of India.
3. Rao Y. V. C. (1994) *Theory and Problems of Thermodynamics*, Wiley Eastern Ltd.
4. Arora C. P. (2001) *Thermodynamics*, Tata McGraw Hill.
5. Nag P. K. (2005) *Engineering Thermodynamics,* Tata McGraw Hill.

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

Course Code: ESC-FT203-T													Course Title: Thermodynamics		
	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1	1	1	1			1							2	1	3
	CO 2	1	1	1			1						1	2	1	3
	CO 3	1	1		2	1							1	2	1	2
	CO 4	1	1		1								1	2	1	1
	CO 5	1	1	1		1							1	1	1	2

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

SEMESTER IV **Course Code: PCC-FT202-T** **Course Title: Food Biochemistry** **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	Describe the terminology and basics of biochemistry of food.
L2: Understand	CO2	Associate the concepts of water and energy balance with bio molecules.
L3: Apply	CO3	Classify various nutrients according to structures, sources and their functions.
L4: Analyse	CO4	Identify physico-chemical properties of various nutrients.
L6: Evaluate	CO5	Compare metabolic processes of macro nutrients.

UNIT-I

Importance of food biochemistry, functions of food; basic food groups; nutrients supplied by food; energy balance and basal metabolism. Introduction to metabolism; digestion and absorption of food components. Introduction to enzyme and hormones, water in foods and its importance.

UNIT-II

Metabolic pathways of carbohydrates; glycolytic pathway, pentose phosphate pathway, citric acid cycle, electron transport chain, ATP balance, gluconeogenesis.

UNIT- III

Metabolism of proteins; nitrogen balance and nitrogen pool; transamination, deamination, ammonia metabolism, urea cycle. Lipids; Metabolic pathways of lipids; fatty acid oxidation, ketone bodies. Lipids of biological importance like essential fatty acids (PUFA, MUFA), cholesterol, phospholipids, nucleotides and nucleic acids.

UNIT- IV

Classification, functions, absorption, importance and deficiency of fat soluble and water-soluble vitamins. Classification, functions, absorption, importance and deficiency of macro and micro minerals. Role Enzymes and co-enzymes in metabolism.

Recommended Readings:

1. Principles of Biochemistry by Lehninger, New York Publication.
2. Food Chemistry by L. H. Muyer
3. Donald Voet and Judith G. Voet. 2011. Biochemisry, 4th Ed. John Wiley and Sons, Inc., NY, USA.
4. Lubertstryer, Biochemistry, Freeman & Co, N.Y. 4. Voet&Voet, Fundamentals of Biochemistry, Jonh Willey & Sons
5. M. Swaminathan, Vol I & II *Foods and Nutrition* NIN Publications

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

Course Code: PCC-FT202-T													Course Title: Food Biochemistry		
	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1	1												2	2	2
	CO 2	1		2	1		2						1	2	1	2
	CO 3		1	1	1									2		2
	CO 4		2				2	2						2	1	1
	CO 5			2	2								2	3		2

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

SEMESTER IV	Course Assessment Method: Max. Marks: 100
Course Code: PCC-FT204-T	**(Internal: 30; External: 70)**
Course Title: Principles and Methods of Food Processing	***Note for Paper Setter:***
Hours per week: 3+0+0	*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.*
Credits: 3	

RBT Level	**Course Outcomes:** After the completion of the course, the students will be able to:	
L1: Remember	CO1	Outline on food spoilage, principles and methods of food processing and preservation.
L2: Understand	CO2	Demonstrate the importance, scope and need of food processing and preservation.
L3: Apply	CO3	Classify various preservation methods and their advantages.
L4: Analyze	CO4	Identify the novel methods for preservation of various types of foods.
L6: Evaluate	CO5	Judge the food handling practices for reduction of food spoilage in industries.

UNIT-I

Classification of foods, types of food spoilage, viz. microbiological, enzymatic, chemical, physical and their effects on food quality. Introduction to food processing: basic principles, importance of food processing and preservation; techniques Methods of food preservation; Use of class 1 and class 2 preservatives: Sugar and salt preservation, use of chemical preservatives in food, smoking, sulphur fumigation and pickling, purposes and advantages

UNIT-II

High temperature processing: principles of thermal processing, pasteurization and sterilization, microbial destruction in batch and continuous sterilization; methods of heat transfer, heat resistance in microorganisms, factors affecting heat resistance in micro-organisms, Thermal Death Time (TDT) curve; ultra-heat treatment UHT processing; Industrial applications of canning and bottling: commercial canning operation, spoilage of canned food and its quality evaluation; food irradiation (commercial applications, quality/technological aspects); application of ultra violet (UV) rays in food, microwave heating, its mechanism, effects and applications in food preservation.

UNIT-III

Low temperature processing: low temperature requirement for different foods, refrigeration, components of refrigerators, chilling and freezing of food, freezing principles, low and fast freezing, freezing process, determining freezing load, refrigeration systems, freezing rate, estimation of freezing time of foods, types of freezers, thawing of frozen food, advantages of cold preservation.

UNIT-IV

Processing by moisture removal: evaporation, concentration and dehydration, drying equipments, types of dryers, their advantages and disadvantages, evaporation and functions, continuous, multiple effect, falling and rising film evaporators, water activity (a_w) in foods: role of water activity in food preservation, control of a_w by addition of solutes and moisture removal, moisture sorption isotherm, measurements of water activity; intermediate moisture food (IMF), principles.

Recommended Readings:

1. Norman N. P., and Joseph H. H., (1997) Food Science 5th edition, CBS Publication, New Delhi.
2. Frazier W. C., and Westhoff D. C., (1996) Food Microbiology 4th Ed, Tata McGraw Hill Pvt Ltd., New Delhi.
3. Fellows P. J., (2002) Food Processing Technology: Principles and Practice 2nd Ed, Woohead Pub. Ltd.
4. Sivasankar B., (2002) Food Processing & Preservation, Prentice Hall of India.
5. Khetarpaul N., (2005) Food Processing and Preservation, Daya Publications.
6. Norman W. Desrosier; (2018) The Technology of food preservation, Medtech, New

Jersey

7. Brennam, G.James (2012), Food Processing Handbook, Wiley-VCH

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

Course Code: PCC-FT204-T		Course Title: Principles and Methods of Food Processing														
		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1	1			1		1							2	2	1
	CO 2			1			1		1						2	1
	CO 3	2	1	1										1	1	2
	CO 4	1	1	1			1		1					2	2	1
	CO 5	1	1				1		1	1					2	2

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

SEMESTER IV **Course Code: PCC-FT204-P** **Course Title: Principles and Methods of Food Processing Lab** **Hours per week: 0 + 0 + 4** **Credits: 2**	**Course Assessment Method: Max. Marks: 100 (Internal: 50; External: 50)** ***Evaluation:*** *There will be a 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 the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. 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 external examiner appointed by the Controller of Examination along with the internal examiner, preferably the laboratory course coordinator, appointed by the Chairperson of the Department.*

RBT Level	**Course Outcomes:** After the completion of the course, the students will be able to:	
L3: Apply	CO1	Use of basic instruments for food processing and analysis.
L4: Analyze	CO2	Identify various techniques for food preservation and food analysis.
L5: Evaluate	CO3	Assess of different pre- processing parameters for shelf-life enhancement of foods.
L6: Create	CO4	Formulate various methods and techniques of food processing.

Demonstration of various food processing equipment. Assessment of adequacy of blanching of food sample. Measurement of specific gravity of liquid sample. Identification of different food grains. Measurement of cooking quality of rice grains. Preparation of the sugar syrup of

different degree brix. Preservation of vegetable with the help of fermentation technique (Sauerkraut). Studies on the effect of boiling time on egg quality. Effects of various types of drying on food quality. Effect of edible coating processing on food quality. Adequacy tests for pasteurization and sterilization for different foods.

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

Course Code: PCC-FT204-P **Course Title: Principles and Methods of Food Processing Lab**

	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1	1					1			1				2	2	
	CO 2	1	1		1									2	1	
	CO 3		2	1	1										2	1
	CO 4	2	1	1			1			1				2	1	1

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

SEMESTER IV **Course Code: PCC-FT206-T** **Course Title: Food Engineering** **Hours per week: 3 + 1 + 0** **Credits: 4**	**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 the application basic science in food engineering.
L2: Understand	CO2	Demonstrate the working of different instruments.
L3: Apply	CO3	Solve numerical problems involved in different unit operations.
L4: Analyse	CO4	Identify suitable operating condition for a given process.
L5: Evaluate	CO5	Prescribe the operating conditions for any process to achieve desired goal.

UNIT – I

Introduction to Food Engineering: units and dimensions; Material and energy balance: basic principles, process flow diagrams, total mass balance, component mass balance, problems related to material balance, heat balance and energy balance.

UNIT - II

Fluid Flow Principles: fluid statics and fluid dynamics, Bernoulli equation; Newtonian and non-Newtonian fluids, streamline and turbulent flow, fluid flow applications, measurement of pressure and velocity; Liquid transport system, pipelines and pumps for food processing plants, types of pipelines, positive displacement pumps, air-lift pumps, propeller pumps, centrifugal pumps and jet pumps, pump selection.

UNIT - III

Thermal Process Calculations: commercially sterile concept, concept of D, F and Z values, reference F value, effect of temperature on thermal inactivation of microorganisms, thermal process calculation for canned foods, calculation of processing time in continuous flow systems.

UNIT - IV

Refrigeration: introduction, refrigeration cycle, components of refrigeration systems: compressor, condenser, and expansion valve, mechanical refrigeration system, freezing time calculations; Boiler design, working; Steam properties.

Recommended Readings:

1. Batty J. C. & Folkman S. L. (1983) *Food Engineering Fundamentals*, John Wiley and Sons.
2. Singh R. P. & Heldman D. R. (2014) *Introduction to Food Engineering*, Academic Press.
3. Loncin M. &Merson R. L. (1979) *Food Engineering Principles and Selected Applications,* Academic Press.
4. Toledo R. T. (2007) *Fundamentals of Food Process Engineering, 3rd edition*, Springer.
5. Ibarz A. & Gustavo Barbosa-Cánovas V. (2003) *Unit Operations in Food Engineering*, CRC Press.
6. Berk Z. (2009) *Food Process Engineering and Technology*, Academic Press.

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

Course Code: PCC-FT206-T												Course Title: Food Engineering			
	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1	1	1				1							2	2	1
	CO 2	1	1		1	1	1							3		1
	CO 3	2			2									2	2	1
	CO 4	3	1	1	2		1							3	3	2
	CO 5	2	3		2									3		2

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

SEMESTER IV **Course Code: PCC-FT208-T** **Course Title: Food Microbiology** **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	Describe the important pathogens and spoilage microorganisms in foods.
L2: Understand	CO2	Explain the microbiology of various food products.
L3: Apply	CO3	Classify the different types of food spoilage and food borne disease.
L4: Analyze	CO4	Identify different factors affecting the growth of microorganisms.
L6: Evaluate	CO5	Formulate suitable conditions both for growth and inactivation of microorganisms.

UNIT-I

Introduction, history and scope of food microbiology; Source and types of microorganism associated with food; Factors governing interaction between food and microorganisms; Importance of microorganism in food industry.

UNIT-II

Fermented foods from cereal and pulses meat (sausages, ham and bacon), fish, fruits (pickles), vegetables (sauerkraut, kimchi) and milk (Indian and western); Single cell protein (Processes and products); Fermented beverages - beer, vinegar and wine; Oriental foods, Mushrooms.

UNIT-III

Foods microbiology and public health - Types of food poisonings, important features and control; Overview of algal, fungal and viral food borne illnesses.

UNIT-IV

Microbial spoilage of milk, meats, fish and various plant products. Control of Microorganisms & Food Preservation methods, HACCP &Hurdle Technology and its applications

Recommended Readings:

1. James M. J. (2000) *Modern Food Microbiology, 5th Edition,* CBS Publishers.

2. Barnart G. J. (1997*) Basic Food Microbiology,* CBS Publishers.

3. Adam M. R. & Moss M. O. (1995) *Food Microbiology,* New Age International Pvt. Ltd. Publishers.

4. Bibek Ray (1996) *Fundamental Food Microbiology,* CRC Press.

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

Course Code: PCC-FT208-T													Course Title: Food Microbiology		
	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1	1	1	1			1							2	1	3
	CO 2	1	1	1			1						1	2	1	3
	CO 3	1	1		2	1							1	2	1	2
	CO 4	1	1		1								1	2	1	1
	CO 5	1	1	1		1							1	1	1	2

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

SEMESTER IV **Course Code: PCC-FT208-P** **Course Title: Food Microbiology Lab** **Hours per week: 0+0+4** **Credits: 2**	**Course Assessment Method: Max. Marks: 100 (Internal: 50; External: 50)** ***Evaluation:*** *There will be a 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 the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. 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 external examiner appointed by the Controller of Examination along with the internal examiner, preferably the laboratory course coordinator, appointed by the Chairperson of the Department.*

RBT Level	**Course Outcomes:** After the completion of the course, the students will be able to:	
L1: Remember	CO1	Describe the basic techniques of microbiological quality assessment.
L2: Understand	CO2	Demonstrate the working of different instruments used in microbiological examination of food.
L3: Apply	CO3	Use different methods of estimation, isolations and identification of microorganisms in food.
L4: Analyze	CO4	Separate bacteria through staining and biochemical testing.
L5: Evaluate	CO5	Determine the numbers of bacteria present in culture.

Study of a compound microscope. Gram Staining and Study of morphology of bacterial cells. Study of autoclave, Preparation and sterilization of nutrient broth and agar. Sub culturing of a bacterial strain in liquid and solid medium. Study of microbiological quality of milk by MBRT test. Preparation of synthetic medium for yeast and mould and inoculation with standard strains of yeasts and moulds. Dilution and Plating by spread –plate and pour –plate techniques. Isolation of pure culture. Estimation of microbial count of air.

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

Course Code: PCC-FT208-P													Course Title: Food Microbiology Lab		
	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1	1	1	1			1							2	1	2
	CO 2	1	1	1			1						1	2	1	2
	CO 3	1	1		2	1							1	1	1	2
	CO 4	1	1		1								1	2	1	1
	CO 5	1	1	1		1							1	1	1	2

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

SEMESTER IV **Course Code: ESC-FT202-T** **Course Title: Heat and Mass Transfer** **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	Describe the concept of various modes of heat transfer during processing of food.
L2: Understand	CO2	Explain the concept of mass transfer during processing operations.
L3: Apply	CO3	Use various analytical techniques for distillation and extraction for foods.
L5: Evaluate	CO4	Judge the processing technique to be adopted for various foods according to their heat and mass transfer properties.
L6: Create	CO5	Design equipment for food processing using heat and mass transfer equations.

UNIT-I

Heat transfer in food processing operations, mean temperature difference; Concept of heat conduction, Fourier's law of heat conduction, one dimensional steady state heat conduction equation for flat plate, hollow cylinder, hollow sphere; Thermal conductivity measurement, effect of temperature on thermal conductivity, conduction through liquids.

UNIT-II

Convection and Radiation: concept of heat transfer by convection, natural and forced convection, application of dimensional analysis for convection, equations for forced convection under laminar, transition and turbulent conditions, equations for natural convection; Concept of thermal radiations, black body concept, Stefan Boltsman's law, concept of grey body, radiation between surfaces.

UNIT-III

Heat Exchangers: parallel and counter flow heat exchangers, log mean temperature difference, single pass and multipass heat exchangers, plate heat exchangers, number of transfer unit; Diffusion and mass transfer coefficients: molecular and eddy diffusion in gases and liquids, steady state diffusion under stagnant and laminar flow conditions, diffusion in solids, concept of mass transfer coefficients.

UNIT-IV

Absorption and Distillation: equilibrium and operating line concept in absorption calculations, types of contactors, methods of distillation, extractive and azeotropic, low pressure distillation, steam distillation; Extraction and leaching: equilibrium in ternary systems; Differential contact extraction equipment - spray, packed and mechanically agitated contactors, pulsed extractors, centrifugal extractors, solid-liquid equilibria, leaching equipment-batch and continuous types.

Recommended Readings:

1. Binay K. Dutta (2001) *Heat Transfer Principles and Applications*, Prentice Hall of India.
2. Nag P. K. (2015) *Heat and mass transfer*, *3rd edition*, McGraw Hill Publishers.
3. Rudramoorthy R. & Mayilsamy K. (2011) *Heat and mass transfer*, *2nd edition,* Pearson Publication.
4. Barhr H. & Stephan K. (2011) *Heat and mass transfer*, *3rd edition*, Springer Publication.
5. Kamaraj G. & Raveendiran P. (2008) *Heat and mass transfer*, Scitech Publications.

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

Course Code: ESC-FT202-T													Course Title: Heat and Mass Transfer		
	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1	1	1	1			1							2	1	3
	CO 2	1	1	1			1						1	2	1	3
	CO 3	1	1		2	1							1	2	1	2
	CO 4	1	1		1								1	2	1	1
	CO 5	1	1	1		1							1	1	1	2

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

SEMESTER V **Course Code: FTIT-1** **Course Title: In-Plant Training-I** **Duration: 4-6 weeks** **Credits: 1**	**Course Assessment Method: Max. Marks: 100** **(Internal: 100)** ***Evaluation:*** *At the end of the training (during summer vacations following 4th semester) the seminar on training will be done in the beginning of 5th 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	Review the existing food processing set ups for their strengths and weaknesses.
L5: Evaluate	CO2	Assess the food industry problems and their implications.
L3: Apply	CO3	Select and apply modern engineering and IT tools to design, and solve industrial problems.
L5: Evaluate	CO4	Evaluate the unit setup with respect to the manufacturing process, plant layout, and other infrastructure and suggest viable improvements.
L6: Create	CO5	Organize the learned concepts and preparation of final report in an effective manner using technological tools.

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

Course Code: FTIT-1													Course Title: In-Plant Training-I		
	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1	1													3	2
	CO 2	1	2	2	1									1		2
	CO 3		2	2	2	3									1	3
	CO 4	1	2	2	3	2	1	1					1			3
	CO 5		2		1	1			1		3	1				2

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

SEMESTER V **Course Code: PCC-FT301-T** **Course Title: Processing of Grains** **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	Describe morphological and nutritional characteristics of cereals, millets and their processed products.
L2: Understand	CO2	Demonstrate working of machinery for valuable processed products.
L3: Apply	CO3	Examine functionalities of flour components in different food products.
L4: Analyse	CO4	Analyze effect of processing technologies on overall efficiency and product quality.
L6: Create	CO5	Design new approaches for providing solutions as per industry needs.

UNIT-I

Scope of Grain processing industry, Wheat- morphology, composition, varieties and quality characteristics, milling process- conditioning and tempering, equipments in wheat milling- disc mill, hammer mill, roller mill, Functionality of wheat flour components- composition and classification of proteins, lipids and starch.

UNIT-II

Paddy- threshing, drying and storage, parboiling processes- drying, milling operations, pre-cleaners, shellers and hullers, separators, polishers, rice milling yield and factors affecting milling yield, by-products of rice milling, processed rice products, Storage Practices.

UNIT-III

Corn- types and dry and wet milling, manufacture of value-added products, Barley- structure, composition, nutritive value and quality characteristics, malting process and industrial applications of barley malt, Oats- structure, composition, nutritive value, milling and food uses.

UNIT-IV

Sorghum- structure, composition, nutritive value, threshing, de-hulling and milling, sorghum-based products, Millets- structure, composition, nutritive value and types of millet, importance of millets, Pseudocereal- Structure, composition, and Processing.

Recommended Readings:

1.Matz, S.A. (1970) "Cereal Technology", AVI Publishing Co.

2.Kulp K. (2000) *Handbook of Cereal Science and Technology, Second Edition*. CRC Press.

3.Dendy D. A. V. & Dobraszczyk B. J., (2001) *Cereal and Cereal Products*. Aspen

4.Kent, N.L., *Technology of Cereals*, CBS Publisher

5.Tanley A. Watson and Paul E. Ramstad: *Corn Chemistry and Technology*, ADCC, USA.

Julliano, B.O., *Rice Chemistry and Technology*, AACC, USA.

6.Wheat, rice, corn, oat, barley and sorghum processing handbook, Asia pacific business press, New Delhi.

7.Pomeranz Y. (1988) *Wheat: chemistry and technology*, American Association of cereal chemists, Minnesota.

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

Course Code: PCC-FT301-T													Course Title: Processing of Grains		
	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1	1												3		3
	CO 2	3				3								3	3	
	CO 3	3	1			2										
	CO 4	1	2	1		3								3	2	
	CO 5	3	2	3	3	3								3	3	3

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

SEMESTER V **Course Code: PCC-FT301-P** **Course Title: Processing of Grains Lab** **Hours per week: 0+0+4** **Credits: 2**	**Course Assessment Method: Max. Marks: 100 (Internal: 50; External: 50)** ***Evaluation:*** *There will be a 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 the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. 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 external examiner appointed by the Controller of Examination along with the internal examiner, preferably the laboratory course coordinator, appointed by the Chairperson of the Department.*

RBT Level	**Course Outcomes:** After the completion of the course, the students will be able to:	
L2: Understand	CO1	Estimate different physicochemical properties of grains.
L3: Apply	CO2	Classify cereal grains on the basis of the different quality parameters.
L4: Analyse	CO3	Compare output of milling operations of cereals and other grains.
L5: Evaluate	CO4	Assess nutritional and functional characteristics of grains and flour.
L6: Create	CO5	Formulate cereal based new products with improved quality and technology.

Orientation to different grain processing equipments, their functions and uses, Determination of adulterants in wheat and wheat flour, study the morphological and physical properties of different grains, experimental milling of wheat and paddy, proximate analysis of grains and grain products, estimation of dry and wet gluten of wheat flour, parboiling and cooking properties of different varieties of rice, determination of sedimentation value of the whole/refined wheat flour, estimation of alcoholic acidity of wheat flour, determination of water absorption capacity of wheat flour, storage studies of various grains having different moisture levels, preparation of expanded & puffed rice from raw and parboiled materials and assessment of quality of products including expansion in volume, determination of foaming and dough raising capacities of flour, determination of diastatic activity and maltose value, preparation of bread, cake and cookie and analyzing their quality parameters, visit to a rice mill, flour mill and FCI godown.

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

Course Code: PCC-FT301-P **Course Title: Processing of Grains Lab**

		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1	2												1		2
	CO 2	3												2	3	
	CO 3	3	3											3	2	3
	CO 4	3	2	3										3	2	1

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

SEMESTER V **Course Code: PCC-FT303-T** **Course Title: Fruits and Vegetables 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 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	Describe fruits and vegetables structure, composition, nutritive value and factors affecting pre and post-harvest quality of fruits and vegetables.
L2: Understand	CO2	Explain maturity determination methods and various storage conditions fo attaining quality products.
L3: Apply	CO3	Use of pre-processing unit operations and equipments for processing and preservation of fruits and vegetables products.
L4: Analyze	CO4	Identify various physicochemical and microbial changes of processed products along with shelf-life evaluation.
L5: Evaluate	CO5	Appraise problem solving strategies and methods of waste utilization for value addition of fruits and vegetables.

UNIT-I

Scope of fruit and vegetable processing industry in India- present status, constraints and prospects. Fruits and vegetables- classification, types, structure and composition of fruits and vegetables- chemical composition and nutritive value and importance in our diet, Post-harvest

technology and its significance, pre-harvest factors affecting post-harvest quality of fruits and vegetables.

UNIT-II

Physiological development – fruit ripening, respiration, role of ethylene, fruit maturity-definition, methods of maturity determination, maturity indices for selected fruits and vegetables, chemical changes during maturation. Methods of storage- controlled atmospheric storage (CAS), modified atmospheric storage (MAS) and hypobaric.

UNIT-III

Pre-processing treatment and operations: equipments, cleaning methods, sorting, grading, peeling and blanching, methods of pre-cooling, minimal processing of fruits and vegetables, packaging of fruits and vegetables.

UNIT-IV

Processing technology of jam, jelly and marmalades, fruit preserves and candied fruits, chutneys, pickles, pickling with vinegar and fermentation- sauerkraut, sauces and ketchups, Processing technology of fruit products- unit operations involved in preparation of fruit beverage, types of beverages, juice, ready to serve (RTS), nectar, cordial, squash, crush, processing of syrups, fruit juice concentrate, fruit juice powder, carbonated beverages, fruit cheese, fruit leather, FPO specifications, Machineries involved in fruit processing.

Recommended Readings:

1.Giridharlal, Siddappa and Tandon., *Preservation of fruits and vegetables*. ICAR, New Delhi.

2.Srivastava. P., R., and Sanjeev Kumar. *Fruit and vegetable preservation - 3rd Edition*.

3.International Publishers, Delhi.

4.Thompson, A.K., (2003). *Fruits and vegetables; Harvesting, handling and storage*. Blackwell Publishing.

5.Norman. N. Potter *Food Science*.CBS publishers and distributors, New Delhi.

6.Hui, Y. H., (2006). *Handbook of fruits and fruit processing*. Blackwell Publishing.

7.Arthey, David, Arhurst, Philip, R., (2005). *Fruit processing- Nutrition, products and quality management*, 2nd edition. Springer.

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

Course Code: PCC-FT303-T													Course Title: Fruits and Vegetables Processing		
	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1		1					1						2		1
	CO 2	1	1	1				1		1				2	2	1
	CO 3	2	1	1		1				1				1	2	
	CO 4		2		2				1					2		1
	CO 5		2	1	1				1					1	2	3

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

SEMESTER V **Course Code: PCC-FT303-P** **Course Title: Fruits and Vegetables Processing Lab** **Hours per week: 0+0+4** **Credits: 2**	**Course Assessment Method: Max. Marks: 100 (Internal: 50; External: 50)** ***Evaluation:*** *There will be a 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 the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. 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 external examiner appointed by the Controller of Examination along with the internal examiner, preferably the laboratory course coordinator, appointed by the Chairperson of the Department.*

RBT Level	**Course Outcomes:** After the completion of the course, the students will be able to:	
L3: Apply	CO1	Use the principles of food processing for preparation of various fruits and vegetables products.
L4: Analyze	CO2	Identify various processing techniques and equipments for product development.
L5: Evaluate	CO3	Determine quality changes and evaluation of analytical parameters.
L6: Create	CO4	Develop new products and techniques for value addition.

Orientation to different fruit processing equipments, their functions and uses, determination of pectin, moisture, total solids, vitamin C, lycopene, titratable acidity, TSS of fruit and vegetable

products, preparation of fruit juices, squashes and cordial, enzymatic classification of fruit pulp, preservation and processing of certain vegetables by drying, preparation of tomato ketchup, puree and paste and their preservation, preparation of pickles and chutneys, preparation of jam, jelly and marmalade and their storage study, blanching of the given sample and assessment of its adequacy, enzymatic browning of fruits and vegetables and its control, preparation of preserve and dried fruit products (papad, bars, candy), freezing of fruits and vegetables, determination of reducing and total sugars, visit to local fruit and vegetables processing industries.

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

Course Code: PCC-FT303-P								Course Title: Fruits and Vegetables Processing Lab							
	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1	1		1		1				1				1	2	
	CO 2	1	1	2			1							1	2	
	CO 3		1						1					3	1	1
	CO 4	1	1	1			1	1						1	2	2

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

SEMESTER V **Course Code: PCC-FT305-T** **Course Title: Food Safety, Quality and Regulations** **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	Describe concept of laws, standards and systems related to food quality and safety.
L2: Understand	CO2	Explain principles and mechanism related to food safety and quality management systems.
L3: Apply	CO3	Use various regulations as per the requirement of dynamic food sector.
L5: Evaluate	CO4	Assess various factors that affect food quality and safety for obtaining good quality and safe foods.
L6: Create	CO5	Prescribe improvement in existing regulations and management systems for food industries.

UNIT-I

Introduction, concept of food safety and standards, food safety strategies; Food hazards and contaminations - biological (bacteria, viruses and parasites), chemical (toxic constituents/ hazardous materials from pesticide residues/environmental pollution/chemicals) and physical factors, Food borne disease causing agents, Water borne diseases, sources of contaminations and their effects

UNIT-II

Food safety aspects, working mechanism and applications of novel methods of food processing such as pulsed electric field (PEF), high pressure processing (HPP), irradiation and other thermal and non-thermal processing; GAP, GHP, GMP, HACCP system for food safety: Principles and its applications

UNIT-III

Fundamentals of quality management principles, FSMS, QMS, TQM, systems and requirements, Guidelines of performance improvements; ISO: Fundamental, requirement and guidelines, Halal Certification

UNIT-IV

Food Safety and Standard act 2006 and Regulations 2011: General Act, Important Definitions, Licensing and Registration, Packaging and Labelling, Food Recall Procedure, SPS and TBT agreements, Codex Alimentarius Commission, Food and drug administration (FDA), BIS (Bureau of Indian standards)

Recommended Readings:

1. Singh, S. P. (2009). *Food Safety, Quality Assurance and Global Trade: Concerns and Strategies:* International Book Distributing Co. Lucknow.
2. Alli, I. (2004). *Food Quality Assurance: Principles and Practices:* CRC Press.
3. Rekha, S. &Pushpa, R. (1997). *Handbook of Indian Food Quality and authenticity:* Woodhead Publishing Ltd., London
4. Julie, Miller & Jones (1998) *Food safety,* Association of official analytical chemist USA.
5. Michael M. & Cramera (2006) *Food plant Sanitation (GMP),* CRC Press, Taylor & Francis Group.

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

Course Code: PCC-FT305-T		Course Title: Food Safety, Quality and Regulations														
	Programme Outcomes (PO)													Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1	1	2											1		2
	CO 2			2											2	1
	CO 3			1										1	2	3
	CO 4		3											3		1
	CO 5	2												2		2

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

SEMESTER V **Course Code: PCC-FT307-T** **Course Title: Food Refrigeration and Cold Storage Construction** **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	Outline terminology associated with refrigeration system and cold storage design.
L2: Understand	CO2	Explain basic refrigeration systems and identify methods for performance improvement.
L3: Apply	CO3	Classify different refrigeration technique for different food.
L4: Analyse	CO4	Compare the quality of frozen food preserved using refrigeration technique.
L5: Evaluate	CO5	Assess the cold storage structure as per different commodity requirement.

UNIT- I

Principles of Refrigeration cycles used in food Industries, Vapour Compression and Vapour Absorption cycles, Refrigerants, characteristics of different refrigerants, Ozone Depletion Potentials, Green house Potential Refrigerants, net refrigerating effect, tonnage of refrigeration - Components of a Refrigeration system: Compressor, condenser, Evaporator, Expansion valves

UNIT-II

Cold Storage Design and Construction Small and large commercial storages, Insulation, properties of insulating materials, air diffusion equipment, Doors and other openings. Cooling load estimation; insulation of freezer rooms: Pre-cooling and pre freezing; Stacking and handling of material in and around cold rooms

UNIT-III

Operation and maintenance - Controlled atmosphere and modified atmosphere storages, Chilling of Foods Chilling equipment for liquid foods, Secondary refrigerants and direct expansion techniques in chilling, Effect of chilling on food quality, Cool storages and their applications. Evaporative cooling and its applications

UNIT-IV

Freezing of foods Freezing equipment, Freezing rates, growth rate of ice crystals, crystal size and its effect on texture and quality of foods, Freezer types, Individual quick freezing. Cryogenic Freezing and its applications

Recommended Readings:

1. Raymond R.Gunther: Refrigeration, Air conditioning and Cold Storage Chilten Company, Philadelphia, USA 1957

2. Clive D.J.Dellino: Cold and Chilled Storage Technology Publisher: Kluwer Academic Publishers (1997)

3. S. Domkundwar and Subhash Arora: A Course in refrigeration and Air Conditioning: Dhanpat Rai and sons, Publishers, New Delhi (1994)

4. Andrew D Althouse and others: Refrigeration and air Conditioning Goodheart – Willcox Company Inc. 1982

5. E.R.Hollowell: Cold Storage and Freezer Storage Manual AVI Publishing Co. (1980)

6. Ed. C.P.Mallet: Frozen Food Technology Balckie Academic and Professional, (1993)

7. AurelGobaneu and GabrialaLaseha and others (1976) Cooling Technology in the Food Industry: Abacus Press, Tunbridge Wells, U.K.

8. Colin Dennis and Michael Stringer: Chilled Foods – A Comprehensive Guide Ellis Horwood Publishing, New york (1992)

9. D.K.Tressler and C.F.Evers: The Freezing Preservation of Foods (Vol.1&2) AVI Publishing Company Inc. USA (1965)

10. J.S. Pruthi: Quick Freezing Preservation of Foods (2 Volumes) Allied Publishers, Mumbai (1999)

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

Course Code: PCC-FT307 Course Title: Food Refrigeration and Cold Storage Construction																
	Programme Outcomes (PO)													Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1	1	1				1							2	2	2
	CO 2	1	1		1	1	1							3	2	
	CO 3	2			2									2	2	
	CO 4	3	1	1	2		1							3	3	2
	CO 5	2	3		2									3		2

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

SEMESTER VI **Course Code: BSC-FT302-T** **Course Title: Statistics for Food Technologists** **Hours per week: 2+1+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 basic concepts related to application of statistical methods.
L2: Understand	CO2	Describe qualitative and quantitative statistical techniques.
L3: Apply	CO3	Solve the problems regarding descriptive and inferential statistics in the domain of food.
L4: Analyse	CO4	Apply statistical techniques for data exploration, visualization and analysis.
L5: Evaluate	CO5	Compare different statistical techniques and sampling distributions.
L6: Design	CO6	Design of experiments to solve problems related to food processing.

UNIT-I

Statistical terms and notations, frequency distribution, frequency curve, measures of central tendency and dispersion, Binomial and poission distribution; Introduction to sampling.

UNIT-II

Statistical Methods: normal distribution, test of significance, null hypothesis, types of error, level of significance and degree of freedom, steps involved in testing of hypothesis, z-test, t-test for testing sample mean and difference between two means, paired t- test, chi-square test for testing goodness of fit and independence of attributes in 2×2 contigency table, yates correction, F-test.

UNIT-III

Statistical quality control: Introduction, advantages and limitations; Techniques of statistical quality control, control charts for variations, $\bar{x}$ and R chart, control chart for attribution, c chart, p chart, np chart; consumer risk, producer risk; Acceptance quality level (AQL); Lot tolerance percentage quality level (LTPD), process average fraction defective. Operative characteristic curve, simple and double sampling plans for prepackaged foods.

UNIT-IV

Correlation and regression, Analysis of variance, How to use excel; Computer aided statistical tools designs.

Recommended Readings:

1.Chesson. A. "Industrial Statistic", Duncan. D.B.Taraporevate Sons & Co. Bombay.

2.Nath, Pran "Statistics and Reliability for Engineering", Tara Printing works Varanasi.

3.Hald A., "Statistical theory with Engineering applications" John and Sons. Inc.

4.Savage. Leonard, "Foundation of Statistics" John Willey & Sons. Inc.

5.Rangana (1995) *Food Quality Assurance*.

6.Hubbard M. R. (2005) *Statistical quality control for food industry*, Springer Publishers.

7.Gupta S. P. (2006) *Statistical Methods*.

8.Gupta S. C. & Kapoor V. K. *Statistical Methods*.

9.Gupta S. C. & Kapoor V. K. *Fundamentals of Applied Statistics*.

10.Sharma J. K. (2005) *Business Statistics*.

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

Course Code: BSC-FT302-T													Course Title: Statistics for Food Technologists		
	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1	1														3
	CO 2	2	1	1		2										3
	CO 3	3	2	2	1	3										3
	CO 4	3	2	2	1	3										3
	CO 5	3	2	2	2	3										3
	CO6	3	3	3	3	3										3

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

SEMESTER VI **Course Code: PCC-FT302-T** **Course Title: Technology of Milk and Milk 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 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	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

Current status of Indian dairy sector**:** production, utilization and per capita consumption of milk, SWOT analysis; Milk: definition, types of milk, composition, nutritive value of milk and milk products; Physico-chemical properties of milk, Milk processing: reception, pasteurization (LTLT, HTST), homogenization, sterilization, UHT processing and aseptic packaging.

UNIT-II

Cream separation and related equipments; Butter: definition, butter-making process, overrun, defects in cream & butter; Technology of ice-cream: composition of ice-cream, methods of preparation; Evaporated and concentrated milks: methods of manufacture and defects, Dried milks**:** dried whole milk/WMP, dried non-fat milk/SMP; milk drying system (film, roller, drum, spray, foam spray drying).

UNIT-III

Cultured milk and milk products: types and manufacturing process; Cheese: technology of different varieties of cheese manufacturing (cheddar & mozzarella), changes during ripening; manufacture of processed cheese, defects in cheese; Introduction to traditional dairy products**:** rabri, kulfi, srikhand, khoa, channa, paneer, ghee.

UNIT-IV

By-products utilization: caseinates, co-precipitates, whey protein concentrate, cleaning and disinfection in a dairy industry: terms, definitions, cleaning and disinfection agents and processes; cleaning in place (CIP) and cleaning out of place (COP)**.**

Recommended Readings:

1. Ahmed, Tufail (1997) "Dairy Plant Engineering and Management", Kitab Mahal, Allahabad.

2. Kessler, H.G. (1981) "Food Engineering and Dairy Technology", V.A. Kessler, Frcising., Germany.

3. Vaclavik V. A. & Christian E. W. (2003) *Essentials of food science*. 2nd edition, Springer International.

4. Spreer E. (1998) *Milk and dairy product technology*, Marcel Dekker Inc.

5. Smit G. (2003) *Dairy processing - improving quality,* Woodhead Publishing.

6. Hohnson M. & Alford (1987) *Fundamentals of dairy chemistry.* 2nd edition, CBS Publishers.

7. Rajagopal, Roy, S.K. (2014) *Milk & milk products technology,* BS Publishers.

8. Early R. (2010) *Technology of dairy product,* Springer Publishers.

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

Course Code: PCC-FT302-T													Course Title: Technology of Milk and Milk Products		
	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1	1											1	1	2	3
	CO 2	1												2	1	
	CO 3													3	3	1
	CO 4													2	1	2
	CO 5	1	1		1								3	3	2	1

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

SEMESTER VI **Course Code: PCC-FT302-P** **Course Title: Technology of Milk and Milk Products Lab** **Hours per week: 0+0+4** **Credits: 2**	**Course Assessment Method: Max. Marks: 100 (Internal: 50; External: 50)** ***Evaluation:*** *There will be a 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 the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. 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 external examiner appointed by the Controller of Examination along with the internal examiner, preferably the laboratory course coordinator, appointed by the Chairperson of the Department.*

RBT Level	**Course Outcomes:** After the completion of the course, the students will be able to:	
L2: Understand	CO1	Demonstrate procedures and analytical techniques for milk and milk product testing.
L3: Apply	CO2	Judge quality of milk and milk products as prescribed by legal authorities.
L4: Analyse	CO3	Detect the presence of inferior quality material in milk and milk products.
L5: Evaluate	CO4	Assess method for quality assurance of milk and milk products.
L6: Create	CO5	Formulate new milk products with enhanced quality characteristics and nutritional value.

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 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, separation of cream using cream separator, Development of some indigenous dairy products- Standardization and preparation of khoa/ice cream/Rasogulla, visit to a dairy plant

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

Course Code: PCC-FT302-P		Course Title: Technology of Milk and Milk Products Lab														
	Programme Outcomes (PO)													Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1	1												3	2	1
	CO 2	1												2	3	1
	CO 3			1											1	
	CO 4													1	1	
	CO 5	1												1	2	2

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

SEMESTER VI **Course Code: PCC-FT304-T** **Course Title: Fermentation 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 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	Outline the scope and importance of fermentation technology in food industry.
L2: Understand	CO2	Indicate fermenter's parts, design features and measurements of fermentation parameters.
L3: Apply	CO3	Classify fermentation systems and products of fermentation.
L5: Evaluate	CO4	Assess the applications of fermentation technology for value-addition.
L6: Create	CO5	Prescribe problem solving methods regarding manufacturing of fermented foods.

UNIT-I

Introduction, history, scope and principle components of fermentation; Types of fermentation. Growth kinetics during fermentation; Isolation & screening of microorganisms used in fermentation; Media for industrial fermentation, criteria used in media formulation, sterilization, raw materials.

UNIT-II

Fermenter Design: bioreactor configuration, design features, criteria in Fermenter design, requirement for aeration and mixing, energy transfer; Other fermenter designs- tube reactors, packed bed reactors, fluidized bed reactors, cyclone reactors, trickle flow reactors; Measurement and control of fermentation parameters.

UNIT-III

Fermentation Systems: Batch and Continuous system, Fed batch culture, solid substrate fermentation; Production and recovery of primary and secondary metabolites: Methods of separation, purification and formulation of metabolites.

UNIT-IV

Fermented Products: Production and recovery of Industrial alcohol, citric acid, acetic acid, lactic acid, acetone- butanol fermentation, amino acids- lysine & glutamic acid production, enzymes, antibiotics (penicillin and tetracycline); oriental fermented foods; Applications of fermentation technology for value-addition.

Recommended Readings:

1. Godfrey T., and West S., (1996) *Industrial enzymology*, Stockholon Press, New York.
2. Pandey A., (1994) *Solid state fermentation*, New Age, Publishers. New Delhi.
3. Cruger W., and Kruger (2002), *Biotechnology –A Textbook of Industrial Microbiology, 2ndEdition*, Panima Publishing Corporation, New Delhi
4. Ward O. P., (1999), *Fermentation Biotechnology – Principles, Process and Products*. Prentice Hall Publishing, New Jersey.

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

Course Code: PCC-FT304-T													Course Title: Fermentation Technology		
	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1			1			1				1			2		2
	CO 2	2		2		1	1			1		1		1		2
	CO 3	1	1	1		1				1		1		2	2	3
	CO 4	1	1	1	1	1			1					2	3	2
	CO 5		2		1		1							2	2	3

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

SEMESTER VI **Course Code: PCC-FT304-P** **Course Title: Fermentation Technology Lab** **Hours per week: 0+0+2** **Credits: 1**	**Course Assessment Method: Max. Marks: 100 (Internal: 50; External: 50)** ***Evaluation:*** *There will be a 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 the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. 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 external examiner appointed by the Controller of Examination along with the internal examiner, preferably the laboratory course coordinator, appointed by the Chairperson of the Department.*

RBT Level	**Course Outcomes:** After the completion of the course, the students will be able to:	
L3: Apply	CO1	Sketch different types of fermenters with demonstration.
L4: Analyse	CO2	Distinguish working of various types of fermenters.
L5: Evaluate	CO3	Appraise production methods and control tests for various types of fermented products.
L6: Create	CO4	Formulate various methods of analysis for fermented foods.

Study of fermenter/bioreactor accessory, Demonstration of different type of fermenters, Inoculation, Isolation & screening of culture, Production, recovery and control tests for the following fermented products such as Alcohol, Baker's yeast, Citric acid, Amylases, Pectinase, Yoghurt, Wine, Cider, Sauerkraut etc., production of polysaccharides, production of traditional fermented foods such as rabri, bhatura, dahi, dhokla, kanji etc.

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

Course Code: PCC-FT304-P													Course Title: Fermentation Technology Lab		
	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1	1	1	1			1			1				2	1	
	CO 2	1	1	1											2	2
	CO 3				1		1		1						2	2
	CO 4		1	1			1			1				2		2

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

Professional Elective – I

SEMESTER VI **Course Code: PEC-FT302-T(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 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	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
L5: Evaluate	CO4	Identify the various unit operations involved in bioprocessing.
L6: Design	CO5	Plan the production of industrially important metabolites

UNIT-I

Kinetics of microbial growth and death: definition, fermentation kinetics rate of cell synthesis, product formation and effect of environment, types of kinetics, batch and continuous type, control measures, instrumentation and fermentation economics.

UNIT-II

Simple enzyme kinetics: simple kinetics model for enzyme substrate interaction. Derive the equation of Michelin Menton for reaction rate, product formation and calculation of Km and V max values; complex enzyme kinetics: oxidation – reduction form of enzymes, observed apparent rate constant, factors affecting the inhibition, competitive, non-competitive inhibition, substrate interaction; kinetics pattern of various fermentations: classification of kinetics pattern, as per different scientists, simple, simultaneous, consecutive, stepwise, complex reactions and their examples.

UNIT-III

Air sterilization, aeration and agitation: definition, thermal death time, media heat sterilization, advantages of continuous sterilization. aeration and agitation: oxygen requirement of industrial fermentations, determination of K La Value, factors affecting K La value. Fermenter: design, operation and their problems during Scale up, management of cellular process.

UNIT-IV

Downstream processing and product recovery: separation techniques like adsorption, chromatography, precipitation, ultra-filtration etc., purification techniques: spray drying, fluidized bed drying etc, Product formation for value added products using bioconversions techniques, production of antibiotics, economic process, utilization of byproducts through bioconversion, present mode of utilization and their nutritional value.

Recommended Readings:

1.Kumar, H. D. "A Textbook on Biotechnology" 2nd Ed.,1998

2.Prescott and Dunn., "Industrial Microbiology"

3.Shuichi Alba, Arthur E., Humphrey and Nancy F., Millis Biochemical *Engineering*

4.Baily J.E., and Ollis D.F., (1997) *Biochemical Engineering Fundamentals*, McGraw Hill Book Co.

5.Shuler M. L., and Kargi F., (2002) *Bioprocess Engineering – Basic Concepts* Second Edition, Prentice Hall

6.Lee J. M., *Fundamentals of biochemical engineering*

7.Ghose T.K., (1990), *Bioprocess Computations in Biotechnology* Ellis Harwood Ltd.

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

Course Code: PEC-FT302-T(i)													Course Title: Bioprocess Engineering		
	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1	2											1	2	2	1
	CO 2	3	1											2	2	2
	CO 3	1		3										1	2	3
	CO 4	3			1									2	3	2
	CO 5	2	2	3	1		1							2	2	3

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

SEMESTER VI **Course Code: PEC-FT302-T(ii)** **Course Title: Technology of Beverages** **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	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- classification and scope of beverage industries in India and world; Water for beverage industry, Technology of alcoholic and non-alcoholic beverages and their manufacturing; Important aspects of unit operations for beverage processing.

UNIT-II

Technology of alcoholic beverages; Malt preparation and Beer production, wine and its classification, processing of grape wine, perry, cider, toddy. Distilled alcoholic beverages; whisky, rum, vodka etc.

UNIT-III

Fruit beverages and soft drinks; Various ingredients and additives, Technology of fruit beverages like fruit juice, squash, cordial, crush, syrup, nectar, carbonated beverages, RTS (Ready to serve), mocktails and cocktails.

UNIT-IV

Coffee: production practices and structure of coffee/cherry, Coffee processing- roasting, grinding, brewing extraction, dehydration, instant coffee; Tea: tea leaf processing, black, green, red, yellow, oolong, instant tea; Effective applications of quality controls- sanitation and hygiene in beverage industry, Technology of cocoa beverage, Technology of dairy beverages; whey, flavored milk.

Recommended Readings:

1.Choudhury, M.R. (1978) "Tea Industry and India".

2.Ashurst P. R. (2005) *Chemistry and technology of Soft drink and fruit juices, 2nd edition*, Blackwell Publishing Ltd.

3.Steen D. P. &Ashurst P. R. (2000) *Carbonated soft drinks – Formulation and manufacture*, Blackwell Publishing Ltd.

4.Manay S. N. & Shadakdharaswamy M (2000) *Foods – Facts and Principles*, *3rd edition* New, Age International Pvt. Ltd.

5.Bamforth C. W. (2005) *Food, fermentation and microorganisms*, Blackwell Science Publishing Ltd.

6.Bamforth C.W. (2006) *Brewing New Technology*, CRC Press, Woodhead Publishers.

7.Hui Y. H. (2012) *Handbook of Plant Based fermented technology & Beverages,* Taylor & Francis Group.

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

Course Code: PEC-FT302-T(ii)													Course Title: Technology of Beverages		
	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1			1				1	1						2	2
	CO 2	1	1		1	1				1				2	2	
	CO 3							1	1						1	1
	CO 4							1	1						1	1
	CO 5	1	1	1										2	1	2

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

SEMESTER VI **Course Code: PEC-FT302-T(iii)** **Course Title: Specialty 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 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	Outline the classification of specialty foods based on processes and sources.
L2: Understand	CO2	Discuss the scope of specialty foods along with nutritional and therapeutic benefits.
L3: Apply	CO3	Generalize the effectiveness of different specialty foods for consumer-specific needs.
L5: Evaluate	CO4	Justify the formulation of specialty foods tailored according to consumer requirements.
L6: Create	CO5	Prescribe the food business operators regarding marketing and regulations pertaining to specialty foods.

UNIT-I

Introduction and classification of specialty foods, Need and scope of specialty foods, Specialty foods based on sources; cereals and millets, legumes and pulses, fruits and vegetables, animal food sources, by-product based.

UNIT-II

Specialty foods based innovative process technology, food additives, bioactive components, packaging techniques, growing conditions: organic and inorganic.

UNIT-III

Specialty foods for different disorders- cardiovascular diseases, diabetes, stress, obesity, cancer, joint disorders and malnutrition.

UNIT-IV

Specialty foods based on specific consumer-oriented foods: army personnel, space/astronaut, high altitude mountain climbers, athletes.

Recommended Readings:

1. Gibson GR & William CM. 2000. Functional Foods - Concept to Product.
2. Robert EC. 2006. Handbook of Nutraceuticals and Functional Foods. 2nd Ed. Wildman.
3. Manson P.2001. Dietary Supplements. 2nd Ed. Pharmaceutical Press.
4. Bamji MS, Rao NP & Reddy V. 2003. Textbook of Human Nutrition. Oxford & IBH.

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

Course Code: PEC-FT302-T(iii) **Course Title: Specialty Foods**

		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1			1										2		2
	CO 2	1	2	3	1									2	3	1
	CO 3	1		2			3							2	2	3
	CO 4	1	2	2			1	1							3	2
	CO 5	1	2	2	2	1	1							1	1	2

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

Professional Elective – II

SEMESTER VI **Course Code: PEC-FT304-T(i)** **Course Title: Technology of Pulses and Oilseeds** **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 morphological and nutritional characteristics of major pulses and oilseeds.
L2: Understand	CO2	Demonstrate working of machinery for valuable processed products from pulses and oilseeds.
L3: Apply	CO3	Judge different techniques for oil extraction and food applications of deoiled cake.
L5: Evaluate	CO4	Assess suitable processes and storage practices for obtaining best quality products with minimum losses.
L6: Create	CO5	Plan new applications and processes of pulses and oilseeds for their proper utilization in national and international market.

UNIT-I

Major pulses and oilseeds grown in the country and their food applications, Present status of pulse milling industry in India; Chemical composition and nutritional value; Anti-nutritional factors and methods of their removal.

UNIT-II

Processing of pulses: Home scale, cottage scale and commercial methods of de-hulling; Modern techniques in dal mills; Processing of red gram, bengal gram, green gram, black gram; Dal milling: principle, methods, equipments and effects on quality; Dry and wet milling of pulses; Soaking- Principles & Methods of soaking- sprouting, puffing, roasting & parboiling of legumes; Physical and biochemical changes during these processes; Cooking quality of dhal-methods, factors affecting cooking quality; Quick cooked dhal, Instant dhal

UNIT-III

Introduction to chemical composition and characters of oil seed and oils, post-harvest technology of oil seeds- handling, drying, storage, grading, pre-treatment, cleaning, dehulling, size reduction and flaking; Oil extraction: ghani, power ghanis, solvent extraction process: principle, pretreatments i.e. breaking, cracking and flaking, desolventization.

UNIT-IV

Refining of oils: degumming, neutralization, bleaching, filtration, deodorization; New technologies in oil seed processing, Utilization of oil seed meals for different food uses; High protein products, like protein concentrates and isolates.

Recommended Readings:

1.SalunkheD. K., Kadam S. S., Chavan J. K. (1985) *Post-Harvest Biotechnology of Legumes*, CRC Press.

2.Chakraborth A. (2008) *Post-Harvest Technology of Cereals, Pulses and Oil seeds, 3rd edition,* oxford &lbh Publishing Co. Pvt. Ltd.

3.Smartt J. &Nwokolo E. (1996) *Food and Feed from legumes and oilseed,* Chapman and Hall Publishers.

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

Course Code: PEC-FT304-T(i)													Course Title: Technology of Pulses and Oilseeds		
	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1	1												3		3
	CO 2	3	2											3	3	
	CO 3	3	1											2	3	
	CO 4	1	2	1										3	2	1
	CO 5	3		3	3									3	3	3

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

# SEMESTER VI **Course Code: PEC-FT304-T(ii)** **Course Title: Technology of Spices and Herbs** **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	Outline the classification, types, role and uses of spices and herbs.
L2: Understand	CO2	Illustrate the nutritional and medicinal properties of major Indian spices and herbs.
L3: Apply	CO3	Use of various processing and packaging techniques/machineries for value addition of spices and herbs.
L4: Analyse	CO4	Identify effects of using spices, herbs, spice extractives and blends on human health.
L6: Create	CO5	Develop improved methods for manufacturing various value-added spice products of National and International standards.

UNIT-I

Introduction: Importance and role of spices and herbs in food processing, classification and properties of spices, scope of spice and herb processing in India and world.

UNIT-II

Spices and culinary herbs: Types, spice qualities and specifications, uses and physiological effects, components, antimicrobial and antioxidant properties of spices and herbs, important spices and medicinal herbs added in food products and their processing.

UNIT-III

Spice processing: Processing and manufacturing of major Indian spices and herbs: Pepper, cinnamon, cardamom, nutmeg, saffron, turmeric and ginger; Minor spices- cloves, leafy spices, bay oregano, seed spices; Common herbs; their composition and processing.

UNIT-IV

Medicinal values of herbs; Condiments and spice products, Spice blends and extractives, manufacturing steps, essential oils, salad dressings, seasonings, oleoresins, technique of encapsulation, Spice processing and Packaging machineries, uses and limitations.

Recommended Readings:

1.Farrell K. T. (1985) *Spices, condiments and seasonings*. The AVI Publications.

2.Purseglove J. W., Brown E. G., Green C. L. & Robbins S. R. J. (1981) *Spices*, Longman Publications.

3.HirasaK. & Takemasa M. (1998) *Spice Science and Technology*, Marcel Dekker Inc.

4.Pruthi J. S. (1996) *Quality assurance in spices and spice products (Modern methods of analysis)*, Allied Publishers Limited.

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

Course Code: PEC-FT304-T(ii)													Course Title: Technology of Spices and Herbs		
	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1	1					1	1						2	2	1
	CO 2			1	1			1			1			2	2	2
	CO 3	1	1	1		2		1						2	3	2
	CO 4				1	1									2	2
	CO 5			2	1	1	2								2	2

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

SEMESTER VI **Course Code: PEC-FT304-T(iii)** **Course Title: Dairy Process 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 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	Describe principle, working and application of equipments used in dairy processing.
L2: Understand	CO2	Illustrate mechanisms and calculations associated with dairy operations for achieving efficient production.
L3: Apply	CO3	Use manufacturing equipments of milk processing considering their efficient utilization.
L5: Evaluate	CO4	Determine the effects of various unit operations on the properties of milk and milk products.
L6: Create	CO5	Formulate various processing condition for equipments on the basis of different product requirements.

UNIT-I

Evaporation: basic principles of evaporators, construction and operation, different types of evaporators used in dairy industry, calculation of heat transfer area and water requirement of

condensers, basic concepts of multiple effect evaporators, operations and various feeding systems, thermo processor and MVR system, care and maintenance of evaporators.

UNIT-II

Drying: Introduction to principle of drying, Equilibrium moisture constant, bound and unbound moisture, Rate of drying- constant and falling rate, Effect of Shrinkage, Classification of dryers- spray and drum dryers, spray drying, etc., air heating systems, Atomization and feeding systems. Factors affecting bulk density of power, spray dryer controls, Theory of solid gas separation, cyclone separators, Bag Filters, Care and Maintenance of drum and spray dryers.

UNIT-III

Fluidization: Mechanisms of fluidization characteristics of gas-fluidization systems, Minimum Porosity, Bed Weight, Pressure drop in fluidized bed, Application of fluidization in drying, Batch fluidization, Fluidized bed dryers. Mechanization and equipment used in manufacture of indigenous dairy products.

UNIT-IV

Membrane Processing: Ultra filtration, Reverse Osmosis and electro dialysis, Materials for membrane construction, Ultra filtration of milk, Effect of milk constituents on operation, membranes for electro- dialysis.

Recommended Readings:

1. Smit ,G. (2003) Dairy processing- improving quality. Woodhead Publishing.
2. Walstra P., Geuits T.J., Noomen A., Jellema A. and Van Boekel M.A.J.S. (1999) Dairy technology- priciples of milk properties and processes. Marcel Dekker Inc.
3. Johnson W. and Alford (1987) Fundamentals of dairy chemistry. 2nd edition, CBS Publishers.
4. Wong N.P, Jenners R., Keeney M.and Marth E.H. (1998) Fundamentals of dairy chemistry. 3rd edition, CBS Publishers.
5. Atherton H.V.andNewlander J.A. (1987) Chemistry and testing of dairy products. 4th edition, CBS Publishers.
6. Spreer E. (1998) Milk and dairy product technology. Marcel Dekker Inc.

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

Course Code: PEC-FT304-T(iii)													Course Title: Dairy Process Engineering		
	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1	2	1	1										2	3	
	CO 2	1	2			1	1							3	2	1
	CO 3	1	1			2	1							2	2	2
	CO 4	2	1	2		1								3		2
	CO 5	1	2	1			2							2	1	2

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

SEMESTER VII **Course Code: FTIT-2** **Course Title: In-Plant Training-II** **Duration: 4-6 weeks** **Credits: 4**	**Course Assessment Method: Max. Marks: 100** **(Internal: 100)** ***Evaluation:*** *At the end of the training (during summer vacations following 6th semester) the evaluation will be done in the beginning of 7th semester by a three-member 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	Review the existing food processing set ups for their strengths and weaknesses
L5: Evaluate	CO2	Assess the food industry problems and their implications.
L3: Apply	CO3	Select and apply modern engineering and IT tools to design, and solve industrial problems
L5: Evaluate	CO4	Evaluate the unit setup with respect to the manufacturing process, plant layout, and other infrastructure and suggest viable improvements
L6: Create	CO5	Organize the learned concepts and publish final report in an effective manner using technological tools

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

Course Code: FTIT-2													Course Title: In-Plant Training-II		
	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1	1													3	2
	CO 2	1	2	2	1									1		2
	CO 3		2	2	2	3									1	3
	CO 4	1	2	2	3	2	1	1					1			3
	CO 5		2		1	1			1		3	1				2

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

SEMESTER VII	Course Assessment Method: Max. Marks: 100
Course Code: PCC-FT401-T	**(Internal: 30; External: 70)**
Course Title: Instrumental Analysis of Foods	***Note for Paper Setter:***
Hours per week: 2 + 0 + 0	*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.*
Credits: 2	

RBT Level	**Course Outcomes:** After the completion of the course, the students will be able to:	
L1: Remember	CO1	List instrumental techniques used for qualitative and quantitative parameters of food.
L2: Understand	CO2	Illustrate principle and working of instrument related to physical, chemical and microbiological analysis.
L3: Apply	CO3	Judge operational conditions and preciseness of different techniques.
L4: Analyse	CO4	Compare different methods used in instrumental quality evaluation.
L6: Create	CO5	Propose an appropriate instrumental process and interpretation of obtained parameters.

UNIT-I

Methods of analysis, introduction and scope of various analytical methods for food samples such as food colour, pH value and turbidity; Importance, methods and types of sampling; Uses and roles of various grinding instruments/ machines for preparation of samples for analysis; Expression of results; Methods of moisture analysis in food – drying methods; Near infrared (NIR) techniques, isothermic technique; Analysis of principal food constituents such as carbohydrates, proteins, fat, vitamins and minerals by various methods.

UNIT-II

Methods for separation, identification and quantification of various food components; Separation methods – filtration, centrifugation, sedimentation; Electrophoresis: gel electrophoresis, paper electrophoresis, high voltage electrophoresis, starch gel electrophoresis; Basic principles of spectroscopy: UV, visible and fluorescence spectroscopy.

UNIT-III

Refractometric techniques (refractive index) and instruments for various food components including flavour component and food additives; Methods for measuring textural properties of foods– Instron food tester, penetrometer, texture analyser; Methods for measuring rheological properties of foods – viscoamylograph, extensograph, alveograph, farinograph and mixograph etc.

UNIT-IV

High performance liquid chromatography (HPLC)– types of columns and their applications, high pressure pumps, various types of detectors for HPLC; Gas chromatograph (GC) and gas liquid chromatography (GLC); mass spectrophotometer and their applications in food.

Recommended Readings:

1. Nielson S. S. (2003) *Food analysis*, Kluwer Academic Press.
2. Pomeranz Y. J. (2000) *Food Analysis,* Springer Publications.
3. Srivastava (2000) *Instrumental Approach to chemical analysis,* S. Chand Publishers.
4. Winton A. L. (1999) *Techniques of food analysis, Allied Science, Official methods of analysis*, Association of official analytical chemist USA.
5. Das H. (2005) *Food processing operations analysis,* Asian Books private ltd.
6. James CS (1998). Analytical chemistry of foods, BlackicAcad, UK.
7. Winton, AL (1999). Techniques of food analysis, Allied Science Publication, New Delhi.
8. Song, DWS (1996) Mechanism and theory in food chemistry Champasian and Hall Inc. New York.

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

Course Code: PCC-FT401-T													Course Title: Instrumental Analysis of Foods		
	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1	1	1											2	1	
	CO 2	3	2	1										3		
	CO 3	3	3	1										3	2	
	CO 4	3	3	2	1									2	3	
	CO 5	3	3	3	2									3	3	3

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

SEMESTER VII	Course Assessment Method: Max. Marks: 100
Course Code: PCC-FT401-P	**(Internal: 50; External: 50)**
Course Title: Instrumental Analysis of Foods Lab	***Evaluation:***
Hours per week: 0 + 0 + 2	*There will be a 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 the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. 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 external examiner appointed by the Controller of Examination along with the internal examiner, preferably the laboratory course coordinator, appointed by the Chairperson of the Department.*
Credits: 1	

RBT Level	**Course Outcomes:** After the completion of the course, the students will be able to:	
L2: Understand	CO1	Estimate different physical and chemical parameters of food.
L3: Apply	CO2	Illustrate principle and working of instrument related to physical, chemical and microbiological analysis.
L4: Analyse	CO3	Infer the dehydration profile of different food samples.
L5: Evaluate	CO4	Assess different methods used in instrumental quality evaluation.
L6: Create	CO5	Propose an appropriate instrumental process and interpretation of obtained parameters.

Sampling plan; Sample collection and preparation for analysis; Qualitative and quantitative evaluation of food materials; pH, turbidity, viscosity, texture, colour, etc. Spectrophotometric analysis of foods, Study of germination in various grains, millets, pulses and other pseudocerals

using seed germinator, Quality of milk using ultrasonic milk analyzer, Dehydration of foods of different categories like fruits, vegetables, herbs etc., Working/demonstration of HPLC, GC, DSC, farinograph, viscoamylograph, FTIR, bomb calorimeter and NIR.

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

Course Code: PCC-FT401-P		Course Title: Instrumental Analysis of Foods Lab														
	Programme Outcomes (PO)													Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1	1												2	1	
	CO 2	3	2	2										3		
	CO 3	3	2	1										3	2	
	CO 4	3	3	2	3									2	3	3
	CO 5	3	3	3	2									3	3	3

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

SEMESTER VII	Course Assessment Method: Max. Marks: 100
Course Code: PCC-FT403-T	**(Internal: 30; External: 70)**
Course Title: Waste Management and Effluent Treatment	***Note for Paper Setter:***
Hours per week:2+0+0	*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.*
Credits: 2	

RBT Level	**Course Outcomes:** After the completion of the course, the students will be able to:	
L1: Remember	CO1	Define food waste management and effluent treatment.
L2: Understand	CO2	Interpret physicochemical and microbial quality of food industry waste.
L3: Apply	CO3	Use different approaches for waste management and effluent treatment.
L5: Evaluate	CO4	Assess effect of food waste on environment.
L6: Create	CO5	Propose appropriate approach for waste treatment and management as per safety guidelines.

UNIT-I

Waste generation in food processing industries; concept, scope, health and environmental concern in waste management and effluent treatment; Physicochemical quality of wastewater from different food processing industries- temperature, pH, dissolved oxygen, biological oxygen demand, chemical oxygen demand; Grease content, metal content, forms of phosphorus and sulphur in waste waters and other ingredients like insecticide, herbicides and fungicides residues.

UNIT-II

Physicochemical unit operations- screening, grit chamber, equalization, sedimentation, floatation, coagulation, flocculation, filtration, disinfection; Adsorption and ion exchange; Aeration and gas transfer; Membrane separation processes.

UNIT-III

Biological treatment/Secondary treatment: aerobic and anaerobic biological treatment processes, combined aerobic and anaerobic treatment processes; Suspended growth and attached growth biological treatment; Oxidation ditches; Activated sludge process; Biological oxidation- trickling filters; Bio- towers; Rotating biological contractors, aerated lagoons; Anaerobic sludge blanket processes.

UNIT-IV

Tertiary treatments: advanced wastewater treatment process- sand, coal and activated carbon filters, phosphorus, Sulphur, nitrogen and heavy metals removal; Environmental protection act and specifications for effluent of different food industries, treatment, reuse and disposal of solids and biosolids.

Recommended Readings:

1. Metcalf & Eddy (2013) *Wastewater Engineering treatment and Resource recovery*, 5th edition, McGraw Hill.
2. Marriott N. G. (2006) *Principles of Food Sanitation*, 5th edition, CBS Publication.
3. Lawrence K. W., Howard H. Y. &Yapijakis C. (2005) *Waste Treatment in the Food Processing Industry*, CRC Press.
4. Wang & Lo H. (2006) *Waste treatment in the food processing industry,* CRC Press, Taylor & Francis Group.
5. Loannis & Arvanitoyannis S. (2008) *Waste management for the food industries, Elsevier* publishers.

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

Course Code: PCC-FT403-T		Course Title: Waste Management and Effluent Treatment														
	Programme Outcomes (PO)													Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1			1			1	1						1	3	1
	CO 2			1			1	1						1	2	2
	CO 3	1	1	1	1										3	2
	CO 4	1	2	1	1		2	1							3	2
	CO 5	2	2	2			2	3							2	1

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

SEMESTER VII **Course Code: PCC-FT403-P** **Course Title: Waste Management and Effluent Treatment Lab** **Hours per week: 0+0+2** **Credits: 1**	**Course Assessment Method: Max. Marks: 100** **(Internal: 50; External: 50)** ***Evaluation:*** *There will be a 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 the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. 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 external examiner appointed by the Controller of Examination along with the internal examiner, preferably the laboratory course coordinator, appointed by the Chairperson of the Department.*

RBT Level	**Course Outcomes:** After the completion of the course, the students will be able to:	
L2: Understand	CO1	Estimate different physical and chemical characteristics in food waste.
L3: Apply	CO2	Examine food waste and its utilisation.
L4: Analyse	CO3	Identify various methods employed for the treatment of industrial wastes.
L5: Evaluate	CO4	Compare different waste produced in the industries.
L6: Create	CO5	Propose methods of waste and disposal on environment.

Demonstration of different sewage, water and effluent treatment plant in various industries, Determination of pH of different samples by pH meter. (Electrometric Method), Determination of total solids in waste sample, Determination of total dissolved solids in waste water sample by Gravimetric Method, Determination of total suspended solids in waste water sample,

Determination of fixed & volatile solids in waste water sample, Determination of total organic matter in a given waste water, To evaluate effectiveness of coagulants & flocculants foe water treatment using jar test method, Determination of BOD of waste water sample, Determination of COD of waste water sample, Determination of Total Organic Carbon of waste water sample.

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

Course Code: PCC-FT403-P	Course Title: Waste Management and Effluent Treatment Lab														
	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1			1			1	1					1	1	3	1
	CO 2			1			1	1						1	2	2
	CO 3	1		1	1								2		3	2
	CO 4	1	2		1		2	1							3	2
	CO 5	2	2	2			2	2					2		2	1

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

SEMESTER VII **Course Code: PROJ-FT1** **Course Title: Project-1** **Hours per week: 0+0+8** **Credits: 4**	**Course Assessment Method: Max. Marks: 100** **(Internal: 100)** ***Evaluation:*** *At the end of the project-1 (during 7th semester) the evaluation will be done at the end of 7th 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:	
L5: Evaluate	CO1	Assessment of current research problems on the basis of literature review.
L6: Create	CO2	Planning of research problems pertaining to food science and engineering.
L4: Analyze	CO3	Identify the relevant methodology and conduct the research effectively.
L6: Create	CO4	Organize the research findings and publish the report ethically.
L6: Create	CO5	Invent procedures, methodologies and possible solutions to cater to the needs of all the stakeholders.

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

Course Code: PROJ-FT1													Course Title: Project-1		
	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1	1												1		
	CO 2	1	1	1	1										2	2
	CO 3	1	3	2	3	1			1						3	2
	CO 4		2		2	3			2	1						2
	CO 5	1	2	2		1	1						1		1	1

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

Professional Elective- III

SEMESTER VII **Course Code: PEC-FT401-T(i)** **Course Title: Food Plant Design and Layout** **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	Describe all requirements related to food plant design, its documentation maintenance and improvement.
L2: Understand	CO2	Sketch the most suited location for plant setup.
L3: Apply	CO3	Prepare an efficient and economic system for plant design.
L4: Analyse	CO4	Assess the plant thoroughly with respect to product quality, documentation, hygiene and cost.
L6: Create	CO5	Propose an effective plant layout design for food processing as per requirement of the stakeholders and industry.

UNIT-I

Food Plant design: Importance and economics of plant design, Legal and commercial aspects of plant design, General consideration, specification, Food plant design process, Feasibility

study and analysis, Preliminary studies of food products and raw materials, Location and site selection for food plants, Factors involved in plant location decision.

UNIT-II

Food Plant Layout: Objectives and advantages, types of layout, factors effecting design layout size, utilities and services, Types of Layout design procedure, symbols. Experimentation in pilot plant: Pilot plant Size and structure, types, application and design; Materials for construction of food equipment; Building materials and construction.

UNIT-III

Basic principles for hygienic design of food equipment and auxiliary systems in contact with foods, Process scheduling and operation, Project analysis of food processing plants (like Bakery plant, Confectionery plant, Dairy processing plant, Fruit and vegetable processing, Alcoholic and non-alcoholic beverage).

UNIT-IV

Food processing enterprise economics: Total revenue function, Total cost function, Break-even and shutdown Points, Economics of mass production, Engineering economics, Operating cost of food plant.

Recommended Readings:

1. Food Plant Design, by Antonio Lopez-Geomez and Gustavo V. Barbosa-Canovas, CRC press, Taylor & Francis, New York
2. Food Plant Economics, by Zacharias B. Maroulis and George D. Saravacos, CRC press, Taylor & Francis, New York
3. Plant Design and Economics for Chemical Engineers by Peter, M.S. and Timmerhaus, K.D. McGraw Hill

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

Course Code: PEC-FT401-T(i)		Course Title: Food Plant Design and Layout														
	Programme Outcomes (PO)													Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1	1												3	1	
	CO 2	2	2	3										3	3	
	CO 3	3	3	3										3	2	
	CO 4	3	3	3	3									3	3	
	CO 5	3	3	3	3		2		1					3	3	3

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

SEMESTER VII **Course Code: PEC-FT401-T(ii)** **Course Title: Introduction to Agri-Business Management** **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	Describe basic concept about WTA and Agri-business management.
L2: Understand	CO2	Explain all policies and responsibilities related to agribusiness with food business management.
L3: Apply	CO3	Generalize different approaches for entrepreneurship and market research.
L5: Evaluate	CO4	Evaluate risks associated with market, product and consumer behavior.
L6: Create	CO5	Plan to set up start up and food business.

UNIT-I

Introduction, definition, history, objectives, importance with respect to Indian economy and globalization. Agricultural and food policy, rural management. Management of agri-business. New product development: introduction, development and value analysis.

UNIT-II

Entrepreneurship Development Programs (EDP): introduction, importance, characteristics and functions of an entrepreneur, SWOT analysis of new industries and products. Government schemes and incentives for promotion of entrepreneurship. Financing and risk management in agri-business.

UNIT-III

Marketing management: role of management in agri-business, attributes and responsibility of manager. Marketing of agricultural produce. Market research for agri-business. Different types of management in agri-business: production, retail and supply chain and inventory management (introduction, need, attributes and function).

UNIT-IV

World trade agreements related with food business, export and prospects of food products in India. Consumer behaviour towards food consumption, consumer surveys by various institutes and agencies.

Recommended readings:

1. Kottler (1994). Marketing Management: Prentice Hall of India, New Delhi.
2. Baker, G. A., Grunewald, O. & Gorman, W. D. (2002). Introduction to food and agribusiness management: Prentice Hall of India, New Delhi.
3. Khanks, S. S. (1999). Entrepreneurial Development: Chand and company, New Delhi.
4. Jakobsen, G. &Torp, J. E. (2001). Understanding business systems in developing countries.
5. Ahmad, S. M. (2000). Management Info Guide.

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

Course Code: PEC-FT401-T(ii)		Course Title: Introduction to Agri-Business Management														
	Programme Outcomes (PO)													Programme Specifi Outcomes (PSO)		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1	1							1	1				2		
	CO 2	2	1									1		2		1
	CO 3	3	2		1							2		3		2
	CO 4								2	2		3		3		3
	CO 5			3			2			3	3			3		3

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

SEMESTER VII **Course Code: PCC-FT401-T(iii)** **Course Title: Food Flavours and Colours** **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	Recognize various terms related to food flavours, colours and their classification.
L2: Understand	CO2	Explain different methods of extraction and production of food flavours and colours.
L3: Apply	CO3	Use of flavoring components and pigments in processed foods.
L4: Analyse	CO4	Identify various physicochemical properties of food colours and flavours along with their limitations.
L6: Create	CO5	Assess the quality parameters of certified flavors, dyes, lakes and their uses in food industries.

UNIT-I

Introduction to food flavours: Definition, classification and types, volatile and non-volatile flavouring compounds and their characteristics; Natural food flavouring compounds: Fruit, vegetables, beverage, meat, fat, fish and cooked flavours, Importance and applications

UNIT-II

Flavours in processed foods: Development of flavours in processed foods, role of microbes, thermal reactions, off flavours in foods; Synthetic flavouring compounds, flavour extraction and production methods, compounded flavours, flavor encapsulation, flavour enhancers, functional uses and applications.

UNIT-III

Food colorants: Natural pigments from plant, animal and microbial sources, colour stability, need of colour addition, colour loss during thermal processing, applications of natural colorants, Synthetic colorants, types, uses and applications, Colour analyzing techniques and equipments.

UNIT-IV

Certified colours: Colorants subject to certification, certified F, D and C colorants, Primary certified food colours, blending of colours, lakes and dyes, properties and uses of certified dyes and their regulatory aspects; Microbial colours: Methods of production, advantages and disadvantages, maximum permissible limits of food colours, standards for use in processed foods.

Recommended Readings:

1. Fennema O. R. (1996) *Food Chemistry 3rd edition*, Marcel Dekker Inc.
2. Fisher C. & Scott T. R. (1997) *Food flavours- Biology and Chemistry*, The Royal Society of Chemistry.
3. Branen A. L., Davidson P. M. &Salminen S. (1980) *Food Additives 2nd edition*, Marcel Dekker Inc.
4. A.O.A.C. (1997) *Official methods of analysis. 16th edition, Vol. II*. AOAC International Publication.

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

Course Code: PCC-FT401-T(iii)													Course Title: Food Flavours and Colours		
	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1	1					1	1						2	2	1
	CO 2			1	1			1			1			2	2	2
	CO 3	1	1	1		2		1						2	3	2
	CO 4				1	1									2	2
	CO 5			2	1	1	2								2	2

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

Professional Elective-IV

SEMESTER VII **Course Code: PEC-FT403-T(i)** **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 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	Recognize the freezing mechanism of foods and types of freezing methods.
L2: Understand	CO2	Interpret properties of frozen food and calculation of freezing time.
L3: Apply	CO3	Examine sensory and shelf-life characteristics of frozen foods.
L4: Analyse	CO4	Identify various packaging materials and machine for manufacturing of frozen products
L6: Create	CO5	Generate ideas regarding improved technologies for development of value-added frozen foods and management of suitable cold chain facilities in India.

UNIT-I

Current status of frozen food industry in India, freezing process: mechanism of freezing, freezing curve, factors affecting freezing rate, glass transition temperature, thermo-physical properties of frozen foods, freezing load, freezing time calculations.

UNIT-II

Freezing methods and equipment, convective (air freezing, brine freezing, cryogenic freezing) and conductive processes (contact and scraped freezers) of freezing, Individual Quick Freezing (IQF), Innovation in freezing process: freeze concentration, dehydro freezing, freeze drying, cryogenic freezing, changes during frozen storage, thawing techniques and microbial quality of thawed foods.

UNIT-III

Quality and safety of frozen foods: changes during freezing, quality and safety of frozen meat, fish, poultry and their products, quality and safety of frozen vegetables, fruits, dairy products, ready to eat meals, bakery products, eggs and eggs products; sensory analysis and shelf-life evaluation of frozen foods.

UNIT-IV

Packaging of frozen foods: Introduction to frozen food packaging, different materials used for packaging, packaging machinery, cold store design, transportation of frozen foods, retail display equipment, household refrigerators and freezers, monitoring and control of cold chain.

Recommended Readings:

1. Hui Y. H., Legarretta I. G., Lim M. H., Murrell K.D. & Nip W. (2004) *Handbook of Frozen Foods*, CRC Press.

2. Sun D. (2011) *Handbook of Frozen Food Processing and Packaging, Second Edition*, CRC Press.

3. Evans J. A. (2011) *Frozen Food Science and Technology*, Wiley-Blackwell.

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

Course Code: PEC-FT403-T(i)													Course Title: Technology of Frozen Foods		
	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1	1	1				1							2	2	1
	CO 2	1	1	1								1		2	1	1
	CO 3	1	1					1	1					2	1	2
	CO 4	1	1	1		1	1			1				2	2	3
	CO 5	1	1	2		1	1	1		1				1	2	2

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

SEMESTER VII **Course Code: PEC-FT403-T(ii)** **Course Title: Meat, Fish and Poultry 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 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	Describe the composition, structure and properties of meat.
L2: Understand	CO2	Explain various preservation techniques of meat, poultry and fish.
L3: Apply	CO3	Examine the safety and quality aspects of meat, fish and poultry products.
L4: Analyse	CO4	Infer the need for utilization of by-products of the meat, fish and poultry industry.
L6: Create	CO5	Prescribe suitable processing conditions and quality assessment for foods of animal origin.

UNIT-I

Status and scope of meat and poultry industry in India, Muscle- structure, chemical composition and physicochemical properties of meat muscle, nutritive value, conversion of muscle into meat. Slaughtering of animals and poultry, Factors affecting post-mortem changes, properties, and shelf life of meat. Meat tenderization - natural and artificial methods.

UNIT-II

Preservation of meat- application of various methods for meat preservation, Manufacturing of meat products – uncooked, comminuted, restructured meat products, sausages, meat emulsions, intermediate moisture meats, ready to eat (RTE) meat products. Meat plant sanitation and waste disposal.

UNIT-III

Poultry products: types, chemical composition and nutritive value of poultry meat; Egg: structure, composition and nutritive value, storage, grading of eggs and preservation, Quality evaluation of eggs, Egg products: egg powder, liquid egg products, value added egg products. Packaging of egg and egg products.

UNIT-IV

Fish processing: fresh fish handling, quality evaluation and storage. Fish products - fish meal, fish protein concentrate, fish liver oil, fish paste, fish sauce and other important fishery by-products. Utilization of by-products and wastes of meat and poultry industry

Recommended Readings:

1.Govindan, T.K. (1985) "Fish Processing Technology". Oxford and IBH.

2.Wheaton, F.W. and Lawson, T.R (1985) "Processing of Aquatic Food Products". John Wiley and Sons.

3.Hall, G.M. "Fish Processing Technology"(1992). London Blackie Academic and Professional Publication.

4.Gerasimov, G.V. and Antonova, MT. (1979) "Techno-Chemical Control of fish Processing Industry". Amerind Publishing Co. Pvt. Ltd.

5.Borgess, G.H.O., Cutting, C.L., Lovern, J.A. and Waterman, U. (1967) "Fish Handling and Processing". Chemical Publishing Co.

6.Mead G. (2004) *Poultry Meat Processing and Quality,* Woodhead Publishers.

7.Panda P. C. (1992) *Text Book on Egg and Poultry Technology*, Vikas Publishers.

8.Sahoo J. & Chatli M. K. (2016) *Textbook on Meat, Poultry and Fish Technology,* Daya Publishing House.

9.Kerry J. P. (2012) *Advances in Meat, Poultry and Seafood Packaging,* Woodhead Publishing Limited.

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

Course Code: PEC-FT403-T(ii)													Course Title: Meat, Fish and Poultry Processing		
	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1			1										2		2
	CO 2	1	2	3	1									2	3	1
	CO 3	1		2			3							2	2	3
	CO 4	1	2	2			1	1							3	2
	CO 5	1	2	2	2	1	1							1	1	2

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

SEMESTER VII	Course Assessment Method: Max. Marks: 100 (Internal: 30; External: 70)
Course Code: PEC-FT403-T(iii) **Course Title: Food Product Development and Sensory Evaluation** **Hours per week: 3+0+0** **Credits: 3**	***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	Outline different aspect related to NPD.
L2: Understand	CO2	Discuss market need for new food product.
L3: Apply	CO3	Use different sensory methods and their applications in NPD.
L4: Analyse	CO4	Assess the viability and market acceptability of developed product.
L6: Create	CO6	Develop the new food product as per market, consumer and legal aspects.

UNIT-I

New Proprietary Food Products: Sources for R&D initiative, Definition, Classification, Characterization, Factors shaping new product development- Social concerns, health concerns, impact of technology. Product integrity and conformance to standard.

UNIT-II

Market and market place influence on new product development, Market Survey, Consumer survey to identify new products in terms of Line Extension Repositioning Existing Products

New form/Reformulation. New packaging of existing products, Innovative products, Creative Products. Tapping traditional foods and unconventional sources of foods.

UNIT-III

Identification of concept and product for development, Market research for the concept and selected product, Identification of products, selection of one product and its standardization improving success. Costing the product and determining the sales price, Advertising and test marketing the product, Report preparation.

UNIT-IV

Shelf-life testing of new product (testing for appropriate quality parameters-chemical, microbiological and nutrient content, acceptability studies), Overview of sensory principles and practices: General consideration in sensory testing, Selection and screening of panel: Types of panel (Trained panel, discriminative and communicative panel). Methodology for sensory evaluation: Discriminative test, Descriptive test & Affective Tests. Maintaining suitable environmental conditions for sensory evaluation

Recommended Readings:

1. Earle R, Earle R & Anderson A. 2001. Food Product Development. Woodhead Publ.
2. Lyon, D.H.; Francombe, M.A.; Hasdell, T.A.; Lawson, K. (eds), Guidelines for Sensory Analysis in Food Product Development and Quality Control, Chapman and Hall, London.
3. Amerine, M.A.; Pangborn, R.M.; Roessler, E.B., Principles of Sensory Evaluation, Academic Press, NY
4. Kapsalis, J.G, Objective Methods in Food Quality Assessment, CRC Press, Florida.
5. Martens, M.; Dalen, G.A.; Russwurm, H. (eds), Flavour Science and Technology, John Wiley and Sons, Chichester.
6. Moskowitz, H.R. (eds), Food Texture: Instrumental and Sensory Measurement, Marcel Dekker Inc., New York.
7. Earle R, Earle R & Anderson A. 2001. Food Product Development. Woodhead Publ.
8. Fuller 2004. New Food Product Development - from Concept to Market Place. CRC.
9. Moskowitz, Howard R. 2009. An Integrated Approach to New Food Product Development. CRC Press.

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

Course Code: PEC-FT403-T(iii) Course Title: Food Product Development & Sensory Evaluation																
	Programme Outcomes (PO)													Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1	1												1		1
	CO 2		2	2										2	1	3
	CO 3	3	2	2	2									3	3	1
	CO 4	3	3	3	2									2		3
	CO 5	3	3	3	3									3		3

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

SEMESTER VIII **Course Code: PCC-FT402-T** **Course Title: 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	Describe packaging terminologies, its type and functions.
L2: Understand	CO2	Explain the manufacturing of packaging materials based on paper, glass, metal and plastic.
L3: Apply	CO3	Classify the traditional and modern types of food packaging.
L4: Analyse	CO4	Identify suitable packaging materials for given food items.
L6: Evaluate	CO5	Assessment of different packaging materials for different foods

UNIT-I

Introduction to food packaging: definitions, packaging terminology, functions of packaging, package environments; package selection: characteristics of food packaging material, shelf life of packaged food stuff.

UNIT-II

Different type of packaging materials: Advantages and disadvantages. Paper and paper-based packaging materials: types and properties. Metal packaging materials: manufacture of tin plate,

electrolytic chromium coated steel (ECCS), aluminium and container making process. Corrosion and corrosiveness of foods and lacquers; Glass packaging materials: composition, properties, manufacture and closures; Plastic polymer as packaging materials: processing, classification and properties of polymers. Additives in plastics.

UNIT –III

Edible and bio-based food packaging materials: edible films and coatings of different types, their barrier and mechanical properties, modified atmospheric packaging (MAP), active and intelligent packaging. Importance of labeling in food packaging.

UNIT -IV

Packaging requirements of foods: fresh–fruits and vegetables, meat, fish, poultry, dairy products, cereals and snack foods, beverages, frozen and microwave foods, edible oils and spice products, Recycling of packaging materials, Packaging standards and regulations and packaging equipments.

Recommended Readings:

1. Robertson G. L., (2006) Food Packaging: Principles and Practice. 2nd edition, Taylor and Francis Group.

2. Mattsson B., and Sonesson U., (2000) Environmentally-friendly food processing Woodhead Publishing Ltd.

3. Ahvenainen R., (2003) Novel food packaging techniques. Woodhead Publishing Ltd.

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

Course Code: PCC-FT402-T													Course Title: Food Packaging		
	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1	2					2								2	3
	CO 2	2	1	2										2	2	
	CO 3		1												3	
	CO 4		1	2				2	1					1	3	2
	CO 5			2				2	2						2	2

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

SEMESTER VIII **Course Code: PCC-FT402-P** **Course Title: Food Packaging Lab** **Hours per week: 2 + 0 + 0** **Credits: 1**	**Course Assessment Method: Max. Marks: 100 (Internal: 50; External: 50)** ***Evaluation:*** *There will be a 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 the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. 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 external examiner appointed by the Controller of Examination along with the internal examiner, preferably the laboratory course coordinator, appointed by the Chairperson of the Department.*

RBT Level	**Course Outcomes:** After the completion of the course, the students will be able to:	
L1: Remember	CO1	Describe various analytical procedure related to the food packaging.
L2: Understand	CO2	Classify different types of packaging materials.
L3: Apply	CO3	Choose the best packaging material as per the product requirement in consideration with environmental concerns.
L4: Analyse	CO4	Evaluate shelf life of packaged foods.
L6: Evaluate	CO5	Examine the role and effectiveness of various packaging systems with respect to specific foods.

Testing of properties of different packaging materials (paper, plastic, glass and metal), study of symbols and labels used on food packages, identification of various types of plastic packaging material, vacuum packaging, form-fill-seal packaging, determination of changes in packed foods, food packaging under different packaging conditions, preparation and applications of edible packaging, comparative evaluation of different packages for some specific foods like spongy, crispy texture foods etc. shelf life studies of foods under different packaging and environmental conditions.

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

Course Code: PCC-FT402-P													Course Title: Food Packaging Lab			
	Programme Outcomes (PO)													Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1		3			1							2	3		3
	CO 2		2		1								2	2	1	2
	CO 3		1		2	1						1	2	2		2
	CO 4					2				2						2
	CO 5									2	2			3		2

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

Professional Elective –V

SEMESTER VIII **Course Code: PEC-FT402-T(i)** **Course Title: Baking and Confectionary 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 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	Describe various raw materials used for preparation of bakery and confectionary products.
L2: Understand	CO2	Demonstrate unit operations and working of equipment's involved in bakery and confectionary.
L3: Apply	CO3	Examine functionalities of different ingredients used in bakery and confectionary industry.
L5: Evaluate	CO4	Assess different processes used in product preparation and product quality.
L6: Create	CO6	Develop new bakery and confectionary products.

UNIT-I

Status of bakery and confectionery industries in India; Raw materials for bakery and confectionery products- essential and optional ingredients; Functionality of bakery ingredients; Rheological characteristics of flour, FSSAI specification of raw materials; Bakery equipments: Mixer, divider, sheeter, rounder, proofer, moulder, oven, slicer.

UNIT-II

Technology of bread making, bread making process and methods, Types of bread, quality evaluation of bread, Technology of biscuit making process, Quality evaluation of biscuits

UNIT-III

Technology of cake preparation, Types, methods of preparation, Quality evaluation of cakes, cake faults and remedies; Preparation process of other bakery products: rusks, crackers, buns, muffins and pizza

UNIT-IV

Confectionery- Raw materials, types, process and machinery; Types of candies: boiled sweets, hard candy, brittle; chocolates: manufacturing process, quality consideration and parameters; Manufacturing process of toffees, caramels, lozenges, chewing gum, bars; Sugar free confectionary.

Recommended Readings:

1. Khatkar B. S. (2011) *Baking Science and Technology*, Arihant Publication.
2. AmendolaJ. & Rees N. (2003) *Understanding Baking: The Art and Science of Baking*, Wiley.
3. Dubey S. C. (2002) *Basic Baking,* The Society of Indian Bakers.
4. Manley D. (2000) *Technology of Biscuits, Crackers & Cookies*. *2nd Edition,* CRC Press.
5. NPCS Board of Food Technologists (2014) *Confectionery Products Handbook (Chocolate, Toffees, Chewing Gum & Sugar Free Confectionery)*, Asia Pacific Business Press Inc.
6. Edwards W.P. (2007) *The Science of bakery products,* RSC Publications.
7. Mohos F. (2010) *Confectionery & chocolate engineering, principles & applications,* Wiley Blackwell Publishing Ltd.

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

Course Code: PEC-FT402-T(i)													Course Title: Baking and Confectionary Technology		
	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1	1												3		
	CO 2	1												2	3	
	CO 3	1	2		1									3		
	CO 4	3	2	2										3	2	
	CO 5	3	3	3	3									2	2	3

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

SEMESTER VIII **Course Code: PEC-FT402-T(ii)** **Course Title: Technology of Fats and Oils** **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	Describe sources, types and physicochemical properties of fats and oils.
L2: Understand	CO2	Explain method for production and of various fat and oil products.
L3: Apply	CO3	Judge the effect of processing and other environmental conditions on the quality of fats and oils.
L4: Analyze	CO4	Distinguish between various fats and oils on the basis of their origin and use.
L5: Evaluate	CO6	Assess various quality parameters in controlling the quality of fats and oils.

UNIT-I

Current status and scope of fat and oil industry, importance of fats and oils in foods; Sources, chemical composition and properties of fats and oils, introduction to concept of polymorphism and crystallization in fats and oils and lipid oxidation; reversion and rancidity of fats and oils, causes and prevention, effect of thermal processing on quality of oils and fats

UNIT-II

Storage of oilseeds, extraction of oils: cold pressing and hot pressing, solvent extraction, rendering, removal and recovery of solvent form miscella, removal and recovery of solvent from extracted residue; Refining of oil; neutralization, degumming, bleaching, alkali refining, deodorization, winterization of oil, hardening of oil, filtration of hardened oil; Production of palm oil –rice bran oil, soybean oil, modifications of the properties of oils and fats including chemical and biotechnological processes, toxicity of frying oil, detection of adulteration.

UNIT-III

Animal fats: lards, tallow and its industrial application, physical nature, production and storage; Fish oils and oil from microbial sources, production of margarine, confectionery plastic fat, application of plastic fat in bakery, confectionary (including cocoa butter replacers), shortening processing.

UNIT-IV

Preparation of various products including salad dressing and mayonnaise, imitation dairy products, low calorie spreads; By-products of fat/oil processing industries – oil seed protein isolates; quality standards of edible oils and fats; vegetable oils as biodiesel, RUCO initiative

Recommended Readings:

1. Gillies, M.T. (1974) "Shortenings, Margarine and Food Oils". Noyes Data Corporation.

2. Desrosiar, N.W. (1977) "Elements of Food Technology", AVI Publishing Co.

3. Williams, K.A. (1986) "Oils, Fats and Fatty Foods". J. and A. Churchil Ltd. London.

4. Swern D., (1982), *Bailey's Industrial Oil and Fat Products, Vol 1 & 2*, *4th ed*, John Wiley & Sons.

5. Devine J., & Williams P.N., (1961), *The Chemistry & Technology of Edible Oils and Fats*, Pergamon Press.

6. Weiss T. J., (1983) *Food Oils and their Uses*, AVI.

7. Kirschentiuer, H.G., (1944), *Fats and Oils*, Reinhold Publishing Corporation, New York.

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

Course Code: PEC-FT402-T(ii)													Course Title: Technology of Fats and Oils		
	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1			2	1									1		1
	CO 2				1									1	1	3
	CO 3			1										1	1	2
	CO 4				1									1	1	1
	CO 5		1	1		1								1	1	2

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

SEMESTER VIII **Course Code: PEC-FT402-T(iii)** **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 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	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.
L5: Evaluate	CO4	Assess the changes due to various factors in snack food processing.
L6: Create	CO6	Design economical, nutritionally adequate and organoleptically acceptable snack foods.

UNIT-I

Snack foods- Definition, classification, importance and need. Concept of junk & fried foods and their impact on human health. Technology for grain-based snacks: Breakfast cereals: Introduction and classification (flaked cereals, oven puffed cereals, gun puffed cereals, shredded products). Breakfast cereal-manufacturing processes (traditional and modern

methods), High shear cooking process and steam cookers. Whole grains snack technology-roasted, toasted, puffed, popped, flaked.

UNIT-II

Technology for fruit and vegetable-based snacks: chips, wafers. Frying technology: applications of frying in snack food preparation, frying chemistry, changes in food due to frying, Coated grains and nuts- salted, spiced and sweetened; *chikkies.* instant premixes of traditional Indian snack foods.

UNIT-III

Extrusion: Introduction to extruders and their principles, types of extruders-their design and functioning, Pre-conditioning of raw materials used in extrusion process: operations and benefits, Chemical and nutritional changes in food during extrusion, post-extrusion processes- colouring, flavouring and packaging of extruded snack foods.

UNIT-IV

Texturized vegetable protein: definition, processing techniques. Direct expanded (DX) and third generation (3G) snacks: types, Equipments for frying, baking, drying, toasting, roasting, flaking, popping, blending, coating and chipping. Recent advances in Snack Foods

Recommended Readings:

1. Booth, R. G. (1997). Snack Food: CBS, New Delhi.
2. Raymond, W. L. & Rooney, L. W. (2001). Snack Foods Processing: CRC. London.
3. Lusas, E. W. & 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: PEC-FT402-T(iii)													Course Title: Snack Food Technology		
	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1	1		1	1		1							2	1	1
	CO 2	2		2	1		1						1	1	2	3
	CO 3	2		2	1	2	1							3	3	1
	CO 4		2	2	1		1							3	1	2
	CO 5	1	1	3	3	2	3							2	1	3

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

SEMESTER VIII **Course Code: PEC-FT404-T(i)** **Course Title: Introduction to Food Additives** **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	Describe chemistry and functionality of different food additives
L2: Understand	CO2	Illustrate significance of food additives in food processing industries.
L3: Apply	CO3	Examine uses of additives as per product specifications.
L5: Evaluate	CO4	Assess impact of various food additives on shelf life of food products and human health.
L6: Create	CO5	Prescribe food additives doses as per National and International standards.

UNIT - I

Food Additives: definitions, classification and applications, food preservatives- classification, antimicrobial agents, types and their action, regulatory issues in India, international legal issues; Antioxidants (synthetic and natural, mechanism of oxidation inhibition), anti-browning agent (types and mode of action, application); Chelating agents: types, uses and mode of action; Coloring agents: applications and natural colorants, sources of natural color, color extraction techniques, color stabilization.

UNIT - II

Flavoring Agents: flavors (natural and synthetic flavors), flavor enhancers, flavor stabilization, flavor encapsulation; Flour improvers: leavening agents, humectants and sequestrant, hydrocolloids, acidulants, anticaking agents.

UNIT - III

Sweeteners: natural and artificial sweeteners, nutritive and non-nutritive sweeteners, their properties and uses, Emulsifiers: types, selection of emulsifiers, emulsion stability, functions and mechanism of action.

UNIT - IV

Nutrient supplements & thickeners: polysaccharides, bulking agents, antifoaming agents, synergists, antagonists; permitted dosages, indirect food additives; harmful effects/side effects associated with various additives (various diseases) and safety concerns.

Recommended Readings:

1. Branen A. L., Davidson P. M., and Salminen S. (2001) *Food Additives*. 2nd Ed. Marcel Dekker.
2. Gerorge A. B., (1996) *Encyclopedia of Food and Color Additives. Vol. III*. CRC Press.
3. Gerorge A. B., (2004) *Fenaroli's Handbook of Flavor Ingredients5th Ed*. CRC Press.
4. Morton I. D., and Macleod A. J., (1990) *Food Flavours. Part A, B & C*. Elsevier.
5. Stephen A. M., (2006) *Food Polysaccharides and Their Applications*. Marcel Dekker.

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

Course Code: PEC-FT404-T(i)													Course Title: Introduction to Food Additives		
	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1	1												3	3	2
	CO 2	1												1	3	3
	CO 3		1	2	2				2					2	2	2
	CO 4			3	1		2		2					1	2	3
	CO 5		2	2	2		2	2	2					2	3	3

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

# SEMESTER VIII **Course Code: PEC-FT404-T(ii)** **Course Title: Technology of Traditional 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 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	Outline the basic concepts of different traditional foods.
L2: Understand	CO2	Explain the processing technologies used to manufacture different categories of traditional foods.
L3: Apply	CO3	Apply various methods of food processing while retaining the traditional essence.
L4: Evaluate	CO4	Distinguish the needs of modern society to make safe and healthy ready-to-use traditional Indian formulations.
L6: Create	CO5	Judge the knowledge of bioactive components of traditional foods for specific health needs.

UNIT-I

Introduction to Traditional Indian foods. Eating styles and its variation with season and occasion in different regions of India. Traditional Indian cooking practices, processes, and equipments. Traditional methods of food preservation

UNIT-II

Traditional methods of milling of different categories of food grains (cereals, millets, pulses, oilseeds), traditional processing techniques of meat, fish and poultry

UNIT-III

Regional foods (Breakfast foods, snack foods, fermented foods, street foods, beverages, desserts) that have gone Pan India/Global, Commercial production of traditional foods, IPR issues pertaining to traditional foods

UNIT-IV

Traditional foods with specialized health uses. Food safety and security aspects with regard to traditional foods. Future prospects of traditional foods

Recommended Readings:

1. Sen, Colleen Taylor *"Food Culture in India"* Greenwood Press, 2005.
2. Davidar, Ruth N. *"Indian Food Science: A Health and Nutrition Guide to Traditional Recipes:* East-West Books, 2001.

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

Course Code: PEC-FT404-T(ii)													Course Title: Technology of Traditional Foods		
	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1	1		1		1	1							2	2	
	CO 2	1		1											2	1
	CO 3	2	2	2			1							1	2	3
	CO 4		1	3			3							1	2	3
	CO 5			2		2	3						1		1	3

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

SEMESTER VIII **Course Code: PEC-FT404-T(iii)** **Course Title: Functional Foods and Nutraceuticals** **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	Outline the concepts of nutraceuticals and functional foods.
L2: Understand	CO2	Illustrate the health applications of functional foods from different sources.
L3: Apply	CO3	Examine the stability of various functional components under different processing conditions.
L4: Analyze	CO4	Identify the potential and efficacy of different nutraceuticals in health management.
L6: Create	CO5	Formulate a functional food specific to particular health condition.

UNIT-I

Introduction to nutraceuticals and functional foods: Definition, classification (based on origin), chemical structure, health benefits and mechanism of action of nutraceuticals of different categories.

UNIT-II

Functional cereals & oilseeds, functional fruits and vegetables, spices and herbs. Dairy based functional foods. Meat, fish and poultry based functional foods.

UNIT-III

Extraction / purification of bioactive ingredients/nutraceuticals and stability during processing, Stages in development of functional food. Marketing, regulatory and labeling issues.

UNIT-IV

Nutritional significance: Role of nutraceutical/ functional foods in cardiovascular health, diabetes, obesity, immunity, neuromuscular, joints and bone related disorders, stress\]. Dosage levels; adverse effects and toxicity of nutraceuticals.

Recommended readings:

1. Mazza, G (1988). Functional foods – biochemical and processing aspects, Technomic Publ. Lancaster, USA.
2. Kirk, RS (1999). Pearson's composition and analysis of foods. Wesley Longman Inc. California, USA.
3. Wildman, REC (2007) Handbook of nutraceuticals and functional foods.
4. Official Methods of Analysis (2003). Association of official analytical chemists, USA.

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

Course Code: PEC-FT404-T(iii)													Course Title: Functional Foods and Nutraceuticals		
	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1													2		1
	CO 2	1	2	1	2									2		1
	CO 3	1	1	1		1								2	2	2
	CO 4	1	2	2	1	2									2	2
	CO 5	2	2		3	2			1					2		3

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

SEMESTER VIII **Course Code: PROJ-FT2** **Course Title: Project-2** **Hours per week: 0+0+12** **Credits: 6**	**Course Assessment Method: Max. Marks: 100** **(External: 100)** ***Evaluation:*** *At the end of the project-2 (during 8th semester) the evaluation will be done at the end of 8th semester by a committee comprising an external expert, supervisor and chairperson of the department.*

RBT Level	**Course Outcomes:** After the completion of the course, the students will be able to:	
L5: Evaluate	CO1	Assessment of current research problems on the basis of literature review
L6: Create	CO2	Planning of research problems pertaining to food science and engineering.
L4: Analyze	CO3	Identify the relevant methodology and conduct the research effectively
L6: Create	CO4	Organize the research findings and publish the report ethically
L6: Create	CO5	Invent procedures, methodologies and possible solutions to cater to the needs of all the stakeholders

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

Course Code: PROJ-FT2 **Course Title: Project-2**

		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1	1												1		
	CO 2	1	1	1	1										2	2
	CO 3	1	3	2	3	1			1						3	2
	CO 4		2		2	3			2	1						2
	CO 5	1	2	2		1	1						1		1	1

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

OR

SEMESTER VIII **Course Code: FTIT-3** **Course Title: In-Plant Training-III** **Duration: 4-6 months** **Credits: 10**	***Evaluation:*** *Evaluation will be done as per evaluation guidelines for training/internship during 8th semester issued vide letter no. Acad./AC-III/Fac-1/2022/346-354 dated 20/01/2022.* .

RBT Level	**Course Outcomes:** After the completion of the course, the students will be able to:	
L4: Analyse	CO1	Review the existing food processing set ups for their strengths and weaknesses.
L5: Evaluate	CO2	Assess the food industry problems and their implications.
L3: Apply	CO3	Select and apply modern engineering and IT tools to design, and solve industrial problems.
L5: Evaluate	CO4	Evaluate the unit setup with respect to the manufacturing process, plant layout, and other infrastructure and suggest viable improvements.
L6: Create	CO5	Organize the learned concepts and publish final report in an effective manner using technological tools.

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

Course Code: FTIT-3 **Course Title: In-Plant Training-III**

		Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Course Outcomes (CO)	CO 1	1													3	2
	CO 2	1	2	2	1									1		2
	CO 3		2	2	2	3									1	3
	CO 4	1	2	2	3	2	1	1					1			3
	CO 5		2		1	1			1		3	1				2

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