

SEMESTER THIRD

Course Code: BTFT- 211-19

Course Title: Introduction to Biology and Microbiology

Hours per week:2+0+0

Credits: 2

RBT Level	Course Outcomes: After the completion of the course, the students will be able to:	
L1	CO1	Describe the basic organization of organisms and subsequent building to a living being.
L2	CO2	Explain the machinery of the cell functions that is ultimately responsible for various daily activities.
L3	CO3	Demonstrate the minimum nutritional requirements of microorganisms and the factor affecting their growth.
L4	CO4	Differentiate the mechanism of metabolism of various type of nutrients.
L5	CO5	Appraise the role of microorganisms in different fields.

UNIT-I

Basic Cell Biology: Introduction: Methods of Science-Living Organisms: Five kingdom classification, Cells and Cell theory, Cell Structure, Function and chemical constituents of living cell and cell division.

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, Nitrogen metabolism.

UNIT-III

The nutritional requirements and types of microorganisms (Carbon, Hydrogen, nitrogen, phosphorus, Oxygen and growth factors); Microbial Growth curve, Measurement of Growth; Factors effecting growth. Microbiology of carbon, nitrogen, phosphorus and sulphur transformations.

UNIT-IV

Role of microorganisms in organic matter degradation, maintenance of soil fertility and pest control; Microbiology of soil. Microbiology of air. Microbiology of water. Importance of bacteria, yeast, molds in food industry; Overview of Microorganisms associated with different fermented foods; Role of microorganisms in food borne infections and intoxications.

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 Outcome (CO) and Program Outcome (PO)

Course Code: BTFT 211-19		Course Title: Introduction to Biology and Microbiology															
(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak																	
	Program Outcome (PO)												PSO				
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
Course Outcome (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		1	1											2		2
	CO 5		1	2								1			1		3

Course Code: BTFT212-19

Course Title: Introduction to Biology and Microbiology lab

Hours per week:2+0+0

Credits: 2

RBT Level	Course Outcomes: After the completion of the course, the students will be able to:	
L1	CO1	Describe the preparation of standard solutions and buffers.
L2	CO2	Estimate the various components of cells using different techniques.
L3	CO3	Operate simple & micropipettes and microscope.
L4	CO4	Examine the cell structure using different instruments.
L5	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 Outcome (CO) and Program Outcome (PO)

Course Code: BTFT 212-19

Course Title: Introduction to Biology and Microbiology Lab

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

	Program Outcome (PO)												PSO				
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
Course Outcome (CO)	CO 1		2	1									1	2		3	3
	CO 2				1	1						1	2	1	2	3	2
	CO 3		2			2						1		1	2	1	1
	CO 4		1	1									2		2		2
	CO 5		1	2								1	1		1		3

Course Code: BTFT 213-19

Course Title: Food Composition and Analysis

Hours per week: 3+0+0

Credits: 3

RBT Level	Course Outcomes: After the completion of the course, the students will be able to:	
L1	CO1	Draw the chemical structure of carbohydrates, proteins and fats
L2	CO2	Explain the properties and functions of food macromolecules and some micronutrients.
L3	CO3	Employ different methods for quantitative and quantitative analysis of different food.
L4	CO4	Compare various enzymes with respect to their rate of action and site for working.
L5	CO5	Select the appropriate method for food analysis by applying food composition knowledge.

UNIT-I

Carbohydrates: Introduction, General Properties, Monosaccharides, Oligosaccharides, Polysaccharides, Nutritional Value of Carbohydrates, Commercial Sugar and Sugar Products, Qualitative Analysis and Quantitative Analysis.

UNIT-II

Lipids: Introduction, Simple Lipids and their Constituents, Compound Lipids, Derived Lipids, Nutritional Value of Fats and Fat Products, Commercial Fats and Fat Products, Deterioration of Fats, Analysis.

UNIT-III

Protein: Introduction, Amino Acid and the Peptide Bond, Classification Of Proteins, Structure of Proteins, Molecular Weight and Isoelectric Point of Proteins ,Analysis of Proteins; Vitamins and Minerals: Nomenclature, classification and analysis Introduction, Enzymes: Introduction, Nomenclature and Classification, Food Enzymes.

UNIT-IV

Weighing Devices, Visible and Ultraviolet Spectrophotometry, Thin-Layer Chromatography, pH, Sampling, Moisture, Crude Fat, Crude Protein, Crude Fiber.

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 Outcome (CO) and Program Outcome (PO)

Course Code: BTFT 213-19												Course Title: Food Composition and Analysis							
(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak																			
	Program Outcome (PO)												PSO						
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4		
Course Outcome (CO)	CO 1	2	1						2				1	2	1	2	2	3	
	CO 2		2										1	1	1	2	1	1	
	CO 3		1	2					1					2	1		1	2	2
	CO 4								1					2		2	1		
	CO 5	3	2												1			2	3

Course Code: BTFT 214-19

Course Title: Food Composition and Analysis Lab.

Hours per week: 0 + 0 +4

Credits: 2

RBT Level	Course Outcomes: After the completion of the course, the students will be able to:	
L1	CO1	Describe the different methods of food sampling.
L2	CO2	Explain the different methods used for food analysis.
L3	CO3	Apply the qualitative and quantitative methods of food analysis.
L4	CO4	Examine the results of food analysis and use it for further data analysis.
L5	CO5	Judge the composition of different food materials.

Methods of sampling for food analysis. Moisture analysis – oven drying method / moisture meter. Qualitative test for carbohydrates – Molisch test, Barfoed test, Benedict test. Determination of total carbohydrates, various types of starches, soluble sugars and reducing sugars. Methods of protein analysis – Kjeldahl method / Biuret method. Determination of total fats and oils – solvent extraction method. Determination of free fatty acids value, saponification value and iodine value in food samples. Mineral analysis by atomic absorption spectrophotometer and flame photometer. Chromatographic methods for separations and quantification of various vitamins. Determination of total phenols and tannins by colorimetric method. Some important chemical test and analysis for food additives and flavour components.

Mapping of Course Outcome (CO) and Program Outcome (PO)

Course Code: BTFT 214-19

Course Title: Food Composition and Analysis Lab.

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

	Program Outcome (PO)												PSO				
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
Course Outcome (CO)	CO 1	2	1						2			1	2	1	2	2	2
	CO 2			1		2						2	2	1	2	1	2
	CO 3		1	2				1				2	1	2		2	1
	CO 4					2		1				1		2	1		
	CO 5	3	2										1			2	3

Course Code: BTFT 215-19

Course Title: Nutrition and Health

Hours per week:2+0+0

Credits: 2

RBT Level	Course Outcomes: After the completion of the course, the students will be able to:	
L1	CO1	Define the terms and concepts related to food and nutrition.
L2	CO2	Explain and classify the requirement and source of nutrients essential for human health
L3	CO3	Discuss the role of nutrition in infections and diseases.
L5	CO4	Distinguish the role of nutrition education and different organizations for improving health of the masses nationwide.
L6	CO5	Design and formulate balanced diet plans for different vulnerable groups according to RDAs.

UNIT-I

Scope, concepts and importance of nutrition; definition of various terms related to nutrition, human digestive system, Malnutrition and its types, epidemiology of under nutrition and over nutrition, nutrition infection and immunity

UNIT-II

Nutrients: Classification, functions, sources, requirement and deficiency of proteins, carbohydrates, lipids, vitamins and minerals. Importance of dietary Fiber and water in human health, Energy - definition, units of measurement of energy, basal metabolic rate (BMR), specific dynamic action (SDA) of foods, factors affecting BMR and respiratory quotient (RQ)

UNIT-III

Recommended Dietary Allowance (RDA) for reference man and woman, concept of Balanced diets, diets for different age groups, Nutrition - role of nutrition in pregnancy and lactation, infant nutrition, childhood nutrition, geriatric nutrition; Nutrition of special groups: (space & sports)

UNIT-IV

Importance of Nutrition Education, Role of different national and international organizations in maintaining health and nutritional status, nutritional policies like food for work, mid-day meals, integrated child development services (ICDS) vitamin A and Iron, prophylaxis, measures; Existing food fads and fallacies & how to overcome

Recommended Readings:

1. Joshi S. A., (1992) *Nutrition and Dietetics* Tata Mc Grow- Hill publishing Company 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 Nutrition 3rd Ed.* Oxford University Press, 2007.
5. Khanna (1997) *Textbook of Nutrition and Dietetics*, Phoenix Publisher House Pvt. Ltd., New Delhi.
6. Eastwood M. S., (2003) *Principles of Human Nutrition 2 ed*, Blackwell Publishers.

Mapping of Course Outcome (CO) and Program Outcome (PO):

Course Code: BTFT 215-19													Course Title: Nutrition and Health				
(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak																	
	Program Outcome (PO)												PSO				
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
Course Outcome (CO)	CO 1	2	1						2			1	2	1	2	2	2
	CO 2			1		2						2	2	1	2	1	2
	CO 3		1	2				1				2	1	2		2	1
	CO 4					2		1				1		2	1		
	CO 5	3	2										1			2	3

Course Code: BTFT 216-19

Course Title: Engineering Properties of Foods

Hours per week:3+0+0

Credits: 3

RBT Level	Course Outcomes: After the completion of the course, the students will be able to:	
L1	CO1	Describe various physical and rheological properties of food and biomaterials.
L1	CO2	Describe thermal properties and flow behaviour of foods.
L2	CO3	Explain psychrometrics, dielectric, surface and colorimetric properties of foods.
L5	CO4	Judge the processing technique to be adopted for various foods according to their properties.
L6	CO5	Design the various equipments by considering the various properties of foods.

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, experimental approach to measure thermal properties; Thermodynamic properties of food: Thermodynamic food-water system, sorption energy, significance of thermal properties; Psychrometrics: Properties of dry air, composition of air, specific heat of dry air, enthalpy of dry air, properties of water-vapour, properties of air-vapour mixtures, psychrometric chart, application of psychrometric 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 Outcome (CO) and Program Outcome (PO)

Course Code: BTFT216-19		Course Title: Engineering Properties of Foods															
		(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak															
	Course Outcome (CO)	Program Outcome (PO)												PSO			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	CO 1	3	2			3	2	1			1	2	3	3	3	2	2
	CO 2	2	2			1	1	2	2				3	3	3	3	2
	CO 3	3	2	2	2		2	1	1	3	3	2	3	3	3	3	2
	CO 4	3	3		3	2	1	1			2	2	3	3	3	3	3
	CO 5	3	3	3	3	3	3	2	2		2	2	3	3	3	3	3

Course Code: BTFT 217-19

Course Title: Thermodynamics

Hours per week: 3 + 1 + 0

Credits: 4

RBT Level	Course Outcomes: After the completion of the course, the students will be able to:	
L1	CO1	Describe basic concepts of engineering thermodynamics and the practical application of thermodynamic laws.
L3	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	CO3	Use basic concepts of thermodynamics in problem solving.
L5	CO4	Evaluate the ideal thermodynamic air standard cycles and mathematical relationships between different thermodynamic properties.
L6	CO5	Construct the various 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, loss of available energy due to heat transfer through a finite temperature difference, 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, compressibility factor and law of corresponding states; Mixture of gases, mass, mole and volume fraction, Gibson Dalton's law, gas constant and specific heats, entropy for a mixture of non-reactive gases, problems; Thermodynamic relations: Maxwell relations, Clapyron equation, relations for changes in enthalpy and internal energy & entropy, specific heat capacity relations, Joule Thomson coefficient & inversion curve.

Reference 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 Outcome (CO) and Program Outcome (PO):

Course Code: Course Code: BTFT 217-19													Course Title: Thermodynamics				
(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak																	
	Program Outcome (PO)												PSO				
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
Course Outcome (CO)	CO 1	3	2	1	1		2	2		2	2	1	3	2	1	3	3
	CO 2	3	3	2	1		3	2	1	2	2	1	3	2	1	3	2
	CO 3	3	3	2	2		3	1	1	2	2		2	1	1	3	3
	CO 4	2	1	1	1		2			2	1		3	1	1	3	2
	CO 5	2	2	2	1		1			2	1		3	1	1	3	2

ENVIRONMENTAL STUDIES

Sl. No.	Category	Course Code	Course Title	Hours per week			Total contact hrs,	Credits
				Lecture	Tutorial	Practical		
1	Mandatory Non-credit Course	EVS101-18	Environmental Studies	2	0	0	21	0

*** 40 Hours are kept for various activities under the head of activities. There will be a final theory examination for the students of 50 marks but these marks will not be added to their final result as assessment will be satisfactory or non-satisfactory.**

Course Outcomes:

1. Students will enable to understand environmental problems at local and national level through literature and general awareness.
2. The students will gain practical knowledge by visiting wildlife areas, environmental institutes and various personalities who have done practical work on various environmental Issues.
3. The students will apply interdisciplinary approach to understand key environmental issues and critically analyze them to explore the possibilities to mitigate these problems.
4. Reflect critically about their roles and identities as citizens, consumers and environmental actors in a complex, interconnected world

Environmental Studies [L:2; T:0; P:0 (Credits-0)]

1. Environment Science (Mandatory non-credit course)

We as human being are not an entity separate from the environment around us rather we are a constituent seamlessly integrated and co-exist with the environment around us. We are not an entity so separate from the environment that we can think of mastering and controlling it rather we must understand that each and every action of ours reflects on the environment and vice versa. Ancient wisdom drawn from Vedas about environment and its sustenance reflects these ethos. There is a direct application of this wisdom even in modern times. Idea of an activity based course on environment protection is to sensitize the students.

Detailed Contents

Module 1 : Natural Resources :Renewable and non-renewable resources

Natural resources and associated problems.

- a) Forest resources : Use and over-exploitation, deforestation, case studies.
Timber extraction, mining, dams and their effects on forest and tribal people.
 - b) Water resources : Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.
 - c) Mineral resources : Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
 - d) Food resources : World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.
 - e) Energy resources : Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Case studies.
 - f) Land resources : Land as a resource, land degradation, man induced landslides, soil erosion and desertification.
- Role of an individual in conservation of natural resources.
 - Equitable use of resources for sustainable lifestyles.

Module 2 : Ecosystems

Concept of an ecosystem. Structure and function of an ecosystem.
Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of following ecosystems:

- a. Forest ecosystem
- b. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Module 3 : Biodiversity and its conservation

- Introduction – Definition : genetic, species and ecosystem diversity.
- Biodiversity at global, National and local levels.
- India as a mega-diversity nation
- Hot-spots of biodiversity.
- Threats to biodiversity : habitat loss, poaching of wildlife, man-wildlife conflicts.
- Endangered and endemic species of India
-

Module 4 : Social Issues and the Environment

- From Unsustainable to Sustainable development
- Resettlement and rehabilitation of people; its problems and concerns.
- Environmental ethics : Issues and possible solutions.
- Climate change, global warming, acid rain, ozone layer depletion, Nuclear accidents and holocaust. Case Studies.
- Public awareness.

***ACTIVITIES**

Nature club (bird watching, recognizing plants at institute/at home, recognizing local animals, appreciating biodiversity)

Impart knowledge and inculcate the habit of taking interest and understanding biodiversity in and around the college campus. The students should be encouraged to take interest in bird watching, recognizing local plants, herbs and local animals. The students should be encouraged to appreciate the difference in the local biodiversity in their hometown, in the place of their study and other places they visit for vacation/breaks etc.

Following activities must be included.

Identify a tree fruit flower peculiar to a place or having origin from the place.

Making high resolution big photographs of small creatures (bees, spiders, ants, mosquitos etc.) especially part of body so that people can recognize (games on recognizing animals/plants).

Videography/ photography/ information collections on specialties/unique features of different types of common creatures.

Search and explore patents and rights related to animals, trees etc. Studying miracles of mechanisms of different body systems.

1 (A) Awareness Activities:

- a) Small group meetings about water management, promotion of recycle use, generation of less waste, avoiding electricity waste
- b) Slogan making event
- c) Poster making event
- d) Cycle rally

- e) Lectures from experts
- f) Plantation
- g) Gifting a tree to see its full growth
- h) Cleanliness drive
- i) To live with some eminent environmentalist for a week or so to understand his work vi) To work in kitchen garden for mess
- j) To know about the different varieties of plants
- k) Shutting down the fans and ACs of the campus for an hour or so
- l) Visit to a local area to document environmental assets
river/forest/grassland/hill/mountain/lake/Estuary/Wetlands
- m) Visit to a local polluted site-Urban/Rural/Industrial/Agricultural
- n) Visit to a Wildlife sanctuary, Pushpa Gujral Science City, Kapurthala, National Park or Biosphere Reserve

Suggested Readings

1. Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
2. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad – 380 013, India, Email:mapin@icenet.net (R)
3. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p
4. Clark R.S., Marine Pollution, Clanderson Press Oxford (TB)
5. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumabai, 1196p
6. Hawkins R.E., Encyclopedia of Indian Natural History, Bombay Natural History Society, Bombay (R)
7. Heywood, V.H & Waston, R.T. 1995. Global Biodiversity Assessment. Cambridge Univ. Press 1140p.
8. Mhaskar A.K., Matter Hazardous, Techno-Science Publication (TB)
9. Miller T.G. Jr. Environmental Science, Wadsworth Publishing Co. (TB)
10. Odum, E.P. 1971. Fundamentals of Ecology. W.B. Saunders Co. USA, 574p

11. Townsend C., Harper J, and Michael Begon, Essentials of Ecology, Blackwell Science (TB)
12. Trivedi R.K., Handbook of Environmental Laws, Rules Guidelines, Compliances and Stadards, Vol I and II, Enviro Media (R)
13. Trivedi R. K. and P.K. Goel, Introduction to air pollution, Techno-Science Publication (TB)
14. Wanger K.D., 1998 Environmental Management. W.B. Saunders Co. Philadelphia, USA 499p

SEMESTER FOURTH

Course Code: BTFT 221-19

Course Title: Food Biochemistry

Hours per week: 3+0+0

Credits: 3

RBT Level	Course Outcomes: After the completion of the course, the students will be able to:	
L1	CO1	Define and describe terminology and basics of biochemistry of food
L2	CO2	Understand the concepts of water and energy balance.
L3	CO3	Classify various nutrients according to structures, sources and their functions.
L4	CO4	Explain and understand physico-chemical properties of various nutrients
L6	CO5	Illustrate metabolism processes of macro nutrients.

UNIT-I

Importance of food biochemistry, Functions of food; Basic food groups; nutrients supplied by food; Water in foods and its properties, water intake and losses, energy balance and basal metabolism

UNIT-II

Carbohydrate: Sources of food carbohydrates; Physico-chemical and functional properties; chemistry and structure of homo saccharides and hetero saccharide, introduction to carbohydrates metabolism, glycolysis, TCA cycle, Electron transport chain, oxidative and substrate level phosphorylation gluconeogenesis and glycogen metabolism. Functions, sources, digestion, absorption, assimilation, transport of proteins, transamination Deamination and decarboxylation fixation of nitrogen, Introduction to enzyme and characteristics, coenzymes, kinetics and mechanism of enzyme action. Importance of Hormones.

UNIT- III

Fats: Sources and physico chemical and functional properties; PUFA [Poly-unsaturated Fatty Acids] hydrogenation and rancidity; Saponification number, iodine value, Reichert-Meissl number, Polenske value; Lipids of biological importance like cholesterol and phospholipids. Introduction to lipid metabolism, β -oxidation of long chain fatty acids, Ketosis, breakdown of

phospholipids Biosynthesis of fatty acids, triglycerides, phospholipids, nucleotides and nucleic acids.

UNIT- IV

Minerals and Vitamins: Sources and structures of minerals & vitamins; Pro vitamins A & D; Vitamins as antioxidants. Minerals: Functions, sources, absorption, deficiency of macro-minerals, micro-minerals, and trace minerals. Vitamins: classification, Functions, sources, absorption, deficiency of water soluble and fat-soluble Vitamins.

Effect of processing on macro and micronutrients.

Reference 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. Lubert stryer, 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 Outcome (CO) and Program Outcome (PO)

Course Code: BTFT221-19		Course Title: Food Biochemistry																
(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak																		
	Program Outcome (PO)												PSO					
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	
Course Outcome (CO)	CO 1	2	1			1	2						3	1	2	3	2	
	CO 2	1	3		2	1							2		1	3	1	
	CO 3			1		2	1	3						2		1		
	CO 4		2		2									1		2	2	
	CO 5	3		3			2							2	2	1		3

Course Code: BTFT 222-19

Course Title: Principles and Methods of Food Processing

Hours per week:3+0+0

Credits: 3

RBT Level	Course Outcomes: After the completion of the course, the students will be able to:	
L1	CO1	Describe actions taken to maintain foods with the desired properties or nature for long as needed
L2	CO2	Identify quality loss mechanisms as biological, chemical and physical
L3	CO3	Employ preservation methods that make use of heat/cold, drying, acid, added chemicals, controlled air, pressure and high energy radiation
L5	CO4	Judge the best method of food preservation on the basis of various properties
L6	CO5	Develop food handling practices that reduce the potential for food borne illness

UNIT-I

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

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*, Wohead 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 Outcome (CO) and Program Outcome (PO)

Course Code: BTFT 222-19														Course Title: Principles and Methods of Food Processing			
(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak																	
	Program Outcome (PO)												PSO				
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
Course Outcome (CO)	CO 1					1	2						3	1		3	2
	CO 2		3		2	1										3	1
	CO 3	1		1		2	1	3						2			
	CO 4		3		2								1		2		
	CO 5			3			2						1				3

Course Code: BTFT 223-19

Course Title: Principles and Methods of Food Processing Lab. Hours per week: 0 + 0 + 4

Credits: 2

RBT Level	Course Outcomes: After the completion of the course, the students will be able to:	
L1	CO1	Describe the basic principles of equipments used during food processing.
L2	CO2	Understand the use of different processing techniques.
L4	CO3	Test the adequacy of different processing treatments.
L5	CO4	Evaluate the effects of preservation techniques on food quality.
L6	CO5	Develop different processing parameters on the basis of food properties.

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 Outcome (CO) and Program Outcome (PO)

Course Code: BTFT 223-19		Course Title: Principles and Methods of Food Processing Lab.															
(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak																	
Course Outcome (CO)	Program Outcome (PO)													PSO			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	CO 1	1				2				3				1	2		3
	CO 2	2	1		3									3	1	2	
	CO 3		3		2	1										1	
	CO 4	2			3	1										2	3
CO 5						2			1			3	2		3	1	

Course Code: BTFT 224-19

Course Title: Food Engineering

Hours per week: 3 + 1 + 0

Credits: 4

RBT Level	Course Outcomes: After the completion of the course, the students will be able to:	
L1	CO1	Describe the construction and operating principles of food and beverage processing, handling and packaging systems using engineering terminology
L2	CO2	Explain Newtonian and non-Newtonian behaviour of fluids and their relevance to food rheology principles and related food processing methods.
L3	CO3	Apply the principles of mass and energy balance to food processing systems.
L5	CO4	Evaluate heat loads and heat losses in heating and cooling food process systems
L6	CO5	Design a general food plant layout and improve on existing plant layout.

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 Outcome (CO) and Program Outcome (PO)

Course Code: BTFT 224-19													Course Title: Food Engineering				
(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak																	
	Program Outcome (PO)												PSO				
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
Course Outcome (CO)	CO 1	3	2			3	2	1			1	2	3	3	3	2	2
	CO 2	2	2			1	1	2	2		2		3	3	3	3	2
	CO 3	3	2	2	2		2	1	1	3	3	2	3	2	3	2	2
	CO 4	3	3		3	2	1	1			2	2	3	3	3	3	3
	CO 5	3	3	3	3	3	3	2	3	2		2	2	3	3	3	3

Course Code: BTFT 225-19

Course Title: Food Microbiology

Hours per week:3+0+0

Credits: 3

RBT Level	Course Outcomes: After the completion of the course, the students will be able to:	
L1	CO1	Describe the microbiology of various food products
L2	CO2	Identify the important pathogens and spoilage microorganisms in foods.
L3	CO3	Demonstrate understanding of how microorganisms enter and grow in food or can be used to make food and processes to identify and control foodborne disease and food spoilage and understand of the basis of food safety regulations that governing these processes.
L4	CO4	Compare the role and significance of microbial inactivation, adaptation and environmental factors (i.e., aw, pH, temperature) on growth and response of microorganisms in various environments.
L6	CO5	Formulate different microorganisms for different industrial applications.

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, meat, fish, fruits, vegetables and milk; Single cell protein; Fermented beverages - beer, vinegar and wine; Oriental foods.

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. Microbiology of spices. Control of Microorganisms & Food Preservation methods, HACCP & Hurdle Technology and its applications

Recommended Reading:

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 Outcome (CO) and Program Outcome (PO)

Course Code: BTFT 225-19						Course Title: Food Microbiology											
(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak																	
	Program Outcome (PO)												PSO				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	
Course Outcome (CO)	CO 1	2	1	2		1	2						3	1	2	3	2
CO 2	1	3		2	1								2		1	3	1
CO 3			2		2	1	3						3			1	
CO 4		2		1									1		3	2	
CO 5	3		3			2							2	2	1		3

Course Code: BTFT226-19

Course Title: Food Microbiology Lab.

Hours per week:0+0+4

Credits: 2

RBT Level	Course Outcomes: After the completion of the course, the students will be able to:	
L1	CO1	Describe different culturing techniques for microorganisms.
L2	CO2	Identify bacteria through staining and biochemical testing.
L3	CO3	Demonstrate the use of microscope in identifying various bacterial, protozoa, and fungal species.
L4	CO4	Examine the effectiveness of various antiseptics, disinfectants, and antibiotics in preventing bacterial growth.
L5	CO5	Evaluate 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 growth of E. coli by a spectrophotometer. 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. Isolation of starch-hydrolyzing organism from soil. Dilution and Plating by spread – plate and pour – plate techniques. Isolation of pure culture. Estimation of microbial count of air.

Mapping of Course Outcome (CO) and Program Outcome (PO)

Course Code: BTFT226-19														Course Title: Food Microbiology Lab.			
(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak																	
	Program Outcome (PO)												PSO				
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
Course Outcome (CO)	CO 1	2	1	1		1	2						3	1	2	3	2
	CO 2	1	3		2	1							2		2	3	1
	CO 3			1		2	1	3						2		1	2
	CO 4		2	1	1								1	3	2	2	3
	CO 5	3		3			2						2	2	1		3

Course Code: BTFT227-19

Course Title: Heat and Mass Transfer

Hours per week:3+0+0

Credits: 3

RBT Level	Course Outcomes: After the completion of the course, the students will be able to:	
L1	CO1	Describe the concept of various modes of heat transfer during processing of food.
L2	CO2	Explain the concept of mass transfer during processing operations.
L3	CO3	Use various analytical techniques for distillation and extraction for foods.
L5	CO4	Judge the processing technique to be adopted for various foods according to their heat and mass transfer properties.
L6	CO5	Design equipment's 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 Boltzman'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 Outcome (CO) and Program Outcome (PO)

Course Code: BTFT227-19												Course Title: Heat and Mass Transfer					
(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak																	
	Program Outcome (PO)												PSO				
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
Course Outcome (CO)	CO 1	3	2	2	2		3	2	1		2		3	3	3	2	2
	CO 2	3	2	2	2		3	2	1		2		3	3	3	2	2
	CO 3	3	3	2	3		1	1		1	2		3	2	1	2	2
	CO 4	3	3	2	3			1		1	2		3	2	1	2	1
	CO 5	3	2	3	2		2			1	2		3	1	1	2	2

SEMESTER FIFTH

RBT Level	Course Outcomes: After the completion of the course, the students will be able to:	
L1	CO1	Describe the morphology, composition, nutritive value and properties of cereals, millets and their processed products and by-products.
L2	CO2	Understand the importance, working and problems associated with the processing of grains like dehulling/threshing, milling etc. for improving their utilization.
L3	CO3	Apply theoretical knowledge of grains at the industrial level to broaden applications.
L5	CO4	Evaluate the changes resulted from various treatments and select the best suitable condition to minimize loss and improve quality.
L6	CO5	Create problem solving strategies according to the current and future prospects of grain processing sector.

UNIT-I

Present status and future prospects of major cereals and millets in India and world, Morphology, composition, nutritive value and properties of various food grains including cereals, pseudo-cereals, millets and other coarse grains.

UNIT-II

Wheat- 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 functionality in bakery products, Extruded wheat products, pasta products.

UNIT-III

Paddy- threshing, drying and storage, parboiling processes- drying, milling operations, pre-cleaners, shellers and hullers, separators, polishers, rice mill yields and losses at different stages of milling, processed rice products.

UNIT-IV

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, 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.

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.
6. Julliano, B.O., *Rice Chemistry and Technology*, AACC, USA.
7. *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 Outcome (CO) and Program Outcome (PO)

Course Code: BTFT 311-19													Course Title: Processing of Grains				
(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak																	
	Program Outcome (PO)												PSO				
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
Course Outcome (CO)	CO 1	1	1	2	2	1	2	2	1	1	1		2	2	3	2	3
	CO 2	2	2	2	1	2	2	1	2	2	2		2	2	3	3	3
	CO 3	2	3	3	3	3	2	1	2	2	2		1	3	3	2	3
	CO 4	2	3	3	3	3	2	2	2	2	2		2	3	3	3	2
	CO 5	2	3	3	3	2	2	2	2	2	2		2	3	3	3	3

Course Title: Processing of Grains Lab

Hours per week:0+0+4

Credits: 2

RBT Level	Course Outcomes: After the completion of the course, the students will be able to:	
L1	CO1	Define principles and procedures of grain processing and qualitative and quantitative analysis of grains and their products.
L2	CO2	Understand the importance of formulating and analyzing processed products of cereals and other grains.
L3	CO3	Operate and maintain various equipments of grain processing and analysis.
L5	CO4	Evaluate the problems related to grain processing and analysis.
L6	CO5	Design cereal based new products having good nutrition and safety for human health.

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 Outcome (CO) and Program Outcome (PO)

Course Code: BTFT 312-19													Course Title: Processing of Grains Lab.				
(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak																	
	Program Outcome (PO)												PSO				
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
Course Outcome (CO)	CO 1	2	1	3	1	2	3	1	1			1		3	3	3	2
	CO 2	1	2	2	1	1	2				2			3	3	3	3
	CO 3	3	2	3	1	2	3	1				1	1	3	3	3	3
	CO 4	2	2	2	2	1	1	1			2	2	2	3	3	3	3
	CO 5	3	3	3	1	2	3	2		1	2	3	2	3	3	3	3

RBT Level	Course Outcomes: After the completion of the course, the students will be able to:	
L1	CO1	Define the harvesting factors, structure, composition, nutritive value and storage conditions of fruits and vegetables and specifications related to their processed products.
L2	CO2	Select best suitable maturity and operating conditions for attaining quality products.
L3	CO3	Apply theoretical knowledge of fruits and vegetables at the industrial level to broader applications by producing value added products.
L5	CO4	Evaluate the changes resulted from various processing techniques.
L6	CO5	Create problem solving strategies and methods in accordance with the current and future prospects 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 Outcome (CO) and Program Outcome (PO)

Course Code: BTFT 313-19													Course Title: Fruits and Vegetables Processing				
(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak																	
	Program Outcome (PO)												PSO				
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
Course Outcome (CO)	CO 1	2	1				3	1	1			1		3	3	3	2
	CO 2	1	2											1	1	2	3
	CO 3	3	2									1	1	2		2	2
	CO 4	2	2	2	2	1						2	2	1	1	1	1
	CO 5	3	3	3	1	2						3	2	3	3	3	3

Course Code: BTFT 314-19

Course Title: Fruits and Vegetables Processing Lab

Hours per week:0+0+4

Credits: 2

RBT Level	Course Outcomes: After the completion of the course, the students will be able to:	
L1	CO1	Remember principles and procedures of processing and qualitative and quantitative analysis of fruits and vegetables.
L2	CO2	Understand importance of preparation and analysis of processed products of fruits and vegetables.
L3	CO3	Operate and maintain various equipments of processing and analysis in fruits and vegetables sector.
L5	CO4	Evaluate the changes and problems related to the processing of fruits and vegetables.
L6	CO5	Create new products and methods 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 Outcome (CO) and Program Outcome (PO):

Course Code: BTFT 314-19													Course Title: Fruits and Vegetables Processing Lab.				
(1/2/3 indicates strength of the correlation) 1-Strong, 2-Medium, 3-Weak																	
	Program Outcome (PO)												PSO				
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
Course Outcome (CO)	CO 1	2	1				3	1	1			1		3	3	3	2
	CO 2	1	2											1	1	2	3
	CO 3	1		1		1	2		2			1	1	2		2	2
	CO 4	2	1	2		2	1		1			2	2	1	1	1	1
	CO 5	3	2	1								3	2	3	3	3	3

Course Code: BTFT 315-19

Course Title: Food Safety, Quality and Regulations

Hours per week:3+0+0

Credits: 3

RBT Level	Course Outcomes: After the completion of the course, the students will be able to:	
L1	CO1	Remember the concepts of all laws, standards and systems related to food quality and safety.
L2	CO2	Differentiate and compare various food safety management systems and laws according to their applications in various food sectors.
L3	CO3	Deploy the specifications of food quality and safety improvement laws in the manufacturing and storage sector.
L5	CO4	Evaluate and control various factors that affect food quality and safety for obtaining good quality and safe foods.
L6	CO5	Formulate new laws and specifications required by dynamic food sector.

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 inspection services (FSIS) and their applications, Food safety aspects of novel methods of food processing such as pulsed electric field (PEF), high pressure processing (HPP), irradiation and other thermal and non-thermal processing, Environmental protection agency (EPA) and its role in food safety system.

UNIT-III

Fundamentals of quality management principles, FSMS, QMS, TQM, systems and requirements, Guidelines of performance improvements; GMP, GAP, GHP; ISO: Fundamental, requirement and guidelines.

UNIT-IV

BIS (Bureau of Indian standards), Food Safety and Standard act 2006, Food Authority of India and scientific panels, Codex Alimentarius Commission, HACCP system of food protection-Principles and its applications, HACCP system for food safety, Food and drug administration (FDA).

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 Outcome (CO) and Program Outcome (PO)

Course Code: BTFT 315-19		Course Title: Food Safety, Quality and Regulations															
(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak																	
		Program Outcome (PO)												PSO			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
Course Outcome (CO)	CO 1	1	2				1				1			1		2	
	CO 2			2			1						1		2	1	1
	CO 3			1			2				2			1	2	3	1
	CO 4		3				1						1	3		1	
	CO 5	2					2						2	2		2	3

Course Code: BTFT 316-19

Course Title: Food Refrigeration and cold Storage

Hours per week:3+0+0

Credits: 3

RBT Level	Course Outcomes: After the completion of the course, the students will be able to:	
L1	CO1	Familiarize with the terminology associated with refrigeration system and cold storage design.
L2	CO2	Understand basic refrigeration systems and identify methods for performance improvement.
L3	CO3	Apply the knowledge of different refrigeration technique for different food.
L5	CO4	Evaluate the quality of frozen food preserved using refrigeration technique.
L6	CO5	Design the cold storage structure as per different commodity requirement.

UNIT- I

Principles of Refrigeration Refrigeration cycles, Vapour Compression and Vapour Absorption cycles, Refrigerants, characteristics of different refrigerants, Ozone Depletion Potentials, Green house Potential Refrigerants, use of non polluting refrigerants, net refrigerating effect, ton of refrigeration - Components of a Refrigeration system: Compressor, condenser, Evaporator, Expansion valves piping and different controls. Atmospheric air and its properties, Psychometrics, Energy considerations

UNIT-II

Cold Storage Design and Construction Small and large commercial storages, Insulation, properties of insulating materials, air diffusion equipment, Doors and other openings. Cold load estimation; prefabricated systems, walk-in-coolers, and Refrigerated container trucks: Freezer Storages, Freezer room Temperatures, insulation of freezer rooms: Pre-cooling and pre freezing. Cold Storage practice, Stacking and handling of material in and around cold rooms, Optimum temperatures of storage for different food materials-meat and poultry products, marine products, fruits and vegetables, spices and food grains.

UNIT-III

Operation and maintenance - Controlled atmosphere and modified atmosphere storages Controlled atmosphere and Modified atmosphere storages Principles and basics of their construction, Chilling of Foods Chilling equipment for liquid foods, Secondary refrigerants and direct expansion techniques in chilling, Chilled foods transport and display cabinets - Basics of Chilled foods microbiology, Packaging of Chilled foods - Hygienic design considerations for chillers and chilled Storages. 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 of texture and quality of foods, Freezer types, Individual quick freezing. Cryogenic Freezing, Freezing practice as applied to marine foods, meat and poultry, fruits and vegetables.

Recommended Readings:

1. Raymond R.Gunther: Refrigeration, Air conditioning and Cold Storage Chiltan 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. Aurel Gobaneu and Gabriela Laseha 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 Outcome (CO) and Program Outcome (PO)

<p align="center">Course Code: BTFT 316-19 Course Title: Food Refrigeration and cold Storage</p> <p align="center">(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak</p>																	
	Program Outcome (PO)												PSO				
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
Course Outcome (CO)	CO1	3	2	2	2		3	2	1		2		3	3	3	2	2
	CO2	3	2	2	2		3	2	1		2		3	3	3	2	2
	CO3	3	3	2	3		1	1		1	2		3	2	1	2	2
	CO4	3	3	2	3			1		1	2		3	2	1	2	1
	CO5	3	2	3	2		2			1	2		3	1	1	2	2

RBT Level	Course Outcomes: After the completion of the course, the students will be able to:	
L1	CO1	Outline the historical background of modern industry and the production function.
L2	CO2	Understand the influence of various environmental factors on Food Industries and business operations.
L4	CO3	Analyze the process of starting a new venture and create their business plan.
L5	CO4	Judge the process of entrepreneurship and the institutional facilities available to an entrepreneur in India.
L6	CO5	Develop the knowledge on legal aspects and government policy relating to entrepreneurship.

Evaluation:

At the end of the training (during summer vacations following 4th semester) the seminar on training will be done in the 5th semester

Mapping of Course Outcome (CO) and Program Outcome (PO)

Course Code: BTFT 317-19												Course Title: In-Plant Training					
Training																	
(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak																	
	Program Outcome (PO)												PSO				
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
Course Outcome (CO)	CO1	2	1	3	2	2				2	2	3	3	3	2	3	
	CO2		2	1	3									3	2	3	2
	CO3			2	1	3								2	3	2	3
	CO4	2	1	3	2	2				2	2	3	3	3	2	3	2
	CO5	1	2		3	2						2	1	2	3	3	3

Course Title: Open Elective-I (for the students of other teaching department)

Processing and Preservation of Foods

Hours per week:3+0+0

Credits: 3

RBT Level	Course Outcomes: After the completion of the course, the students will be able to:	
L1	CO1	Outline the different preservation techniques related to food processing.
L2	CO2	Discuss the role of preservation in eliminating all the factors that increases chances of contamination in foods.
L3	CO3	Employ the different preservation techniques to extend the shelf life of various food products.
L5	CO4	Evaluate the effects of different preservation techniques on nutritional and qualitative properties of foods.
L6	CO5	Develop better preservation technologies based on the concept of hurdle technology.

UNIT-I

Sources of foods, scope and benefit of industrial food preservation, perishable, non perishable foods, causes of food spoilage, Microbial growth curve and general principle of preservation, Preservation factors.

UNIT-II

Thermal processing methods of preservation- principle and equipments: Canning, blanching, pasteurization, sterilization, evaporation, Use of low temperature- principal, equipment and effects on quality, Chilling, cold storage, freezing.

UNIT-III

Preservation by drying/dehydration and concentration- principle, methods, equipments and effect on quality- difference, importance of drying & dehydration over other methods of drying and dehydration, equipments and machineries, Physical and chemical changes in food during drying and dehydration, Need and Principle of concentration, methods of concentration- Thermal concentration, freeze concentration, membrane concentration, changes in food quality by concentration.

UNIT-IV

Preservation by radiation, chemicals & preservatives, Definition and methods of irradiation, Direct & Indirect effect, measurement of radiation dose, dose distribution, effect on microorganisms, Deterioration of Irradiated foods-physical, chemical and biological effects on quality of foods, Presentation of foods by chemicals, antioxidants, mould inhibitors, antibodies, acidulates etc. Preservation by salt & sugar- principle, method, equipments and effects on food quality, Recent methods in preservation- Pulsed electric field processing, High pressure processing, Processing using ultrasound, dielectric, ohmic and infrared heating. Theory, equipments and effect on food quality.

Suggested Readings:

1. Norman N. Potter, Joseph H. Hotchkiss , Food Science – 5th ed. Springer, 1998 - Technology & Engineering - 608 pages
2. Giridhari Lal, G.S. Siddappa and G. L. Tandon, Preservation of Fruits and Vegetables; CFTRI, ICAR , New Delhi -12
3. Mircea Enachescu Dauthy, ‘Fruit and vegetable processing’, FAO Agricultural Services Bulletin 119; International Book Distributing Co.
4. B J B Wood, Microbiology of Fermented Foods, Vol. I; Elsevier Applied Science Publishers.
5. Diane M Barrett, Laszlo Somogyi, Hoshahalli Ramaswamy, Processing Fruits, Science and Technology; CRC Press.
6. Marcus Karel, Owen R Fernnema, Physical principles Food Science, Part I and II; Marcel Dekker inc

Mapping of Course Outcome (CO) and Program Outcome (PO):

Course Code: BTFT 318-19		Course Title: Processing and Preservation of Foods															
(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak																	
	Program Outcome (PO)												PSO				
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
Course Outcome (CO)	CO 1						2	1					3	2	3	3	
	CO 2												3	3	3	3	
	CO 3												3	3	3	3	
	CO 4				3	2	1					1	3	3	3	3	
	CO 5											1	3	3	1	1	1

SEMESTER SIXTH

Course Title: Statistics for Food Technologists

Hours per week:2+1+0

Credits: 3

RBT Level	Course Outcomes: After the completion of the course, the students will be able to:	
L1	CO1	Define basic concept and ideas of Statistical quality control and different Statistical methods.
L2	CO2	Understand basics of control chart for variables and for attributes with its application, concept of Process Capability Analysis (PCA).
L3	CO3	Solve the problems regarding measures of central tendency and measures of dispersion and problems related to chi square test, analysis of variance, regression analysis.
L5	CO4	Evaluate different concept of sampling, sampling distribution and its application.
L6	CO5	Design different types of statistical methods for fast and easy calculations.

UNIT-I

Statistical terms and notations, frequency distribution, frequency curve, measures of central tendency and dispersion, Binomial and poisson 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 contingency 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; Overview of Computer aided statistical tools.

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 Outcome (CO) and Program Outcome (PO)

Course Code: BTFT 320-19													Course Title: Statistics for Food Technologists				
(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak																	
	Program Outcome (PO)												PSO				
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
Course Outcome (CO)	CO 1	2	1								1	2	3		1	2	
	CO 2	1	3		2									2	3		1
	CO 3	1	2	3										2	1	3	
	CO 4		1		3	2								1	3	2	
	CO 5	1	1	3	2								1	1		3	2

RBT Level	Course Outcomes: After the completion of the course, the students will be able to:	
L1	CO1	Define all concepts related to the composition, properties, processing and utilization of various types of milk and milk products.
L2	CO2	Understand the current scenario and future prospective of dairy sector for broadening applications.
L3	CO3	Employ and interpret the technology of processing treatments for value addition in milk sector.
L5	CO4	Judge the quality characteristics of various dairy products.
L6	CO5	Design the various technologies related to dairy sector.

UNIT-I

Current status of Indian dairy sector: production, utilization and per capita consumption of milk; Milk: definition, types of milk, composition, nutritive value of milk and milk products; Milk properties: physical, chemical and thermal properties like density, acidity, redox potential, specific gravity, thermal conductivity etc.; Milk processing: reception, pasteurization (LTLT, HTST), homogenization, sterilization, 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: water and solid balance, boiling point elevation; Dried milks: dried whole milk, 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, mawa, channa, paneer, ghee.

UNIT-IV

Value addition and by-products utilization: fortified milk and milk products such as minerals and vitamins fortified milk; Low fat, low lactose and low cholesterol milk products; Utilization of whey, caseinates etc; Cleaning and disinfections 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 Outcome (CO) and Program Outcome (PO)

Course Code: BTFT 321-19														Course Title: Technology of Milk and Milk Products			
(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak																	
	Program Outcome (PO)												PSO				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	
Course Outcome (CO)	CO 1	3	3					2			3	2	1	2	3	2	
	CO 2	2	3		3	2		3					2	1		3	
	CO 3	3	2	1				3	3	3			3	3	1		
	CO 4		2		3	2							2	1	2		
	CO 5	2	3	1	2							3	3	2	1	2	

RBT Level	Course Outcomes: After the completion of the course, the students will be able to:	
L1	CO1	Describe all procedures and their mechanism related to dairy sector.
L2	CO2	Understand the use of different manufacturing and analytical techniques for value addition.
L5	CO3	Judge the adequacy of different processing treatments.
L5	CO4	Evaluate the effects of preservation techniques on nutritional and quality parameter of milk and milk products.
L6	CO5	Develop new methods for proper utilization under hygienic conditions.

Orientation to different milk processing equipments, their functions and uses, sampling of milk and milk products, platform tests of milk, determination of proximate composition, adequacy of pasteurization of milk, separation of cream using cream separator, standardization of milk, detection of common adulterants in milk, bulk properties of dairy powders, estimation of salt in butter, preparation of reconstituted milk/rehydrated milk, *khoa*, *channa*, *paneer*, ice-cream, curd/yoghurt, butter, ghee and flavored dairy products, visit to a dairy plant.

Mapping of Course Outcome (CO) and Program Outcome (PO)

Course Code: BTFT 322-19													Course Title: Technology of Milk and Milk Products Lab.				
(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak																	
		Program Outcome (PO)											PSO				
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
Course Outcome (CO)	CO1	2	2						2			1	2	3	2	1	2
	CO2	2	1		1	2		1						2	3	2	1
	CO3	1	3	3				1	2	2				1	1	2	
	CO4		2		1	2								2	3	2	3
	CO5	2	1	3	2								1	1	2	3	2

Course Title: Fermentation Technology

Hours per week:3+0+0

Credits: 3

RBT Level	Course Outcomes: After the completion of the course, the students will be able to:	
L1	CO1	Define the scope of fermentation technology in food industry.
L2	CO2	Understand about parts, design and working of fermenters.
L3	CO3	Use of cultivation techniques of industrial microorganisms.
L5	CO4	Judge production of primary and secondary metabolites.
L6	CO5	Create problem solving methods according to current and future prospects 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: 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.

UNIT-IV

Methods of separation, purification and formulation of metabolites; Principle of over-production of primary and secondary metabolites with relevant examples; Application of fermentations for value-addition; Waste product types and utilization for production of useful products; Waste treatment systems, aerobic and anaerobic systems for wastes from industry.

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 Outcome (CO) and Program Outcome (PO)

Course Code: BTFT 323-19		Course Title: Fermentation Technology															
(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak																	
	Program Outcome (PO)												PSO				
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
Course Outcome (CO)	CO 1	1						1				1	2	3	3	2	
	CO 2											1	3		2		
	CO 3	1	1	1		2		1					1	2	2	2	
	CO 4			1		2							1	2	2		
	CO 5												2	2	2	1	1

Course Title: Fermentation Technology Lab.

Hours per week:0+0+2

Credits: 1

Study of fermenter/bioreactor accessory, Demonstration of different type of fermenters,

RBT Level	Course Outcomes: After the completion of the course, the students will be able to:	
L1	CO1	Define the scope of fermentation technology in food industry.
L2	CO2	Understand about parts, design and working of fermenters.
L3	CO3	Use of cultivation techniques of industrial microorganisms.
L5	CO4	Judge production of primary and secondary metabolites.
L6	CO5	Create problem solving methods according to current and future prospects of fermented foods.

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 Outcome (CO) and Program Outcome (PO):

Course Code: BTFT 324-19										Course Title: Fermentation Technology Lab.								
(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak																		
		Program Outcome (PO)												PSO				
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	
Course Outcome (CO)	CO1	1							1				2		2		2	
	CO2												3	2	3	1	3	
	CO3	1	1	1		2		1					2		2		2	
	CO4			1		2								2	3		3	1
	CO5													3	3	3	2	3

Professional Elective – I**Course Code: BTFT 325.1-19****Course Title: Bioprocess Engineering****Hours per week:3+0+0****Credits: 3**

RBT Level	Course Outcomes: After the completion of the course, the students will be able to:	
L1	CO1	Describe the kinetics of microbial growth and enzymes, sterilization, aeration, agitation and downstream processing.
L2	CO2	Select the best appropriate conditions and instrumentation for favorable growth kinetics.
L3	CO3	Operate and manage fermenters economically and beneficially.
L5	CO4	Evaluate the changes caused by various factors affecting aeration, agitation and kinetic processes.
L6	CO5	Create problem solving strategies, methods and models in accordance with the current and future prospects in bioprocess engineering.

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 K_m 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 $K_L a$ Value, factors affecting $K_L a$ 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 Outcome (CO) and Program Outcome (PO):

Course Code: BTFT 325.1-19													Course Title: Bioprocess Engineering				
(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak																	
	Program Outcome (PO)												PSO				
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
Course Outcome (CO)	CO 1	2	1						2			1	2	3	2	1	2
	CO 2	3	2		1	2		2						2	3		1
	CO 3	1	1	3				2	1	1				1	1	3	3
	CO 4		2		2	1								2	3	2	1
	CO 5	2	1	3	2								1	1	2	3	2

Course Code: BTFT 325.2-19

Course Title: Technology of Beverages

Hours per week:3+0+0

Credits: 3

RBT Level	Course Outcomes: After the completion of the course, the students will be able to:	
L1	CO1	Define the technology, manufacturing, quality control and specifications of beverages.
L2	CO2	Select the best favorable additives, processing methods, equipments and other conditions for attaining good quality beverages.
L3	CO3	Apply theoretical and practical skills of various beverages and their raw materials at the industrial level by producing value added products.
L5	CO4	Evaluate the changes resulted from various processing techniques.
L6	CO5	Create problem solving methods and treatments according to the current and future prospects of beverage industries in India and world.

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, Changes during malting, brewing, hopping, fermentation, ageing, maturation & packaging.

UNIT-II

Technology of alcoholic beverages; 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 Outcome (CO) and Program Outcome (PO):

Course Code: BTFT 325.2-19													Course Title: Technology of Beverages			
(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak																
	Program Outcome (PO)												PSO			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
Course Outcome (CO)	CO 1	1	2		1								2	1	1	3
	CO 2	2		1	1	2							2	1	2	2
	CO 3		1	2	2		1						2	2	3	3
	CO 4		2			1							1	1	1	1
	CO 5		2	1			1					1	1	1	3	3

Course Title: Specialty Foods

Hours per week:3+0+0

Credits: 3

RBT Level	Course Outcomes: After the completion of the course, the students will be able to:	
L1	CO1	Outline the classification of specialty foods based on process and different sources.
L2	CO2	Discuss the scope of specialty foods in day today life along with its Nutritional and medical benefits.
L3	CO3	Apply the use of different techniques to create specific consumer foods.
L4	CO4	Evaluate the effectiveness of different specialty foods on consumer health.
L6	CO5	Formulate new specialty foods based on different bio active components.

UNIT I

Need and scope of specialty foods, Nutritional status, Health care and medical benefits, Specialty foods based on sources; cereals and millets, legumes and pulses, fruits and vegetables, animal food sources, by-product based, Non-conventional foods.

UNIT II

Specialty foods based on process; Innovative process technology, Food additives, Bioactive components, Novel nutraceutical based, Packaging techniques, Adaptable technology basis, Fast and PET foods, Growing conditions: organic and inorganic.

UNIT III

Specialty foods based on genetics; Genetically modified foods, Transgenic foods, Biotechnological aspects of detoxification, Proprietary foods, Supplementary foods.

UNIT IV

Therapeutic foods; Modification of diets as per disorders/disease related to different organs: digestive tract, liver, cardiovascular system, kidney, metabolic disorders, allergy, endocrine

disorders. Specific consumer oriented foods: army personnel, space/astronaut, high altitude mountain climbers, Foods for disaster situation.

Reference Books

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 Outcome (CO) and Program Outcome (PO)

Course Code: BTFT 325.3-19														Course Title: Specialty Foods			
(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak																	
	Program Outcome (PO)												PSO				
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
Course Outcome (CO)	CO 1	3				2			3				2	1	1	2	1
	CO 2												3	2		3	2
	CO 3	3	3	3			3	2					2		3	2	1
	CO 4			3			2	3							2	2	2
	CO 5												1	2	1		1

Professional Elective – II**Course Code: BTFT 326.1-19****Course Title: Technology of Pulses and Oilseeds****Hours per week:3+0+0****Credits: 3**

RBT Level	Course Outcomes: After the completion of the course, the students will be able to:	
L1	CO1	Define importance, composition, nutritive value, properties and processing of major pulses and oilseeds and their products and by-products.
L2	CO2	Compare pulses and oilseeds in terms of their nutritional and anti-nutritional properties.
L3	CO3	Demonstrate instrumentation used for oil extraction of oilseeds and other value addition techniques in pulses and oilseeds processing.
L5	CO4	Select suitable processes/treatments and their time-temperature combinations for obtaining best quality products with minimum losses.
L6	CO5	Develop 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.Salunkhe D. K., Kadam S. S., Chavan J. K. (1985) *Post Harvest Biotechnology of Legumes*, CRC Press.
- 2.Chakraborty A. (2008) *Post Harvest Technology of Cereals, Pulses and Oil seeds, 3rd edition*, oxford & Ibh Publishing Co. Pvt. Ltd.
- 3.Smartt J. & Nwokolo E. (1996) *Food and Feed from legumes and oilseed*, Chapman and Hall Publishers.

Mapping of Course Outcome (CO) and Program Outcome (PO)

Course Code: BTFT 326.1-19		Course Title: Technology of Pulses and Oilseeds															
		(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak															
	Course Outcome (CO)	Program Outcome (PO)												PSO			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	CO 1	1						1					1	2	3	3	2
	CO 2												1	3		2	
	CO 3	1	1	1		2		1					1	2	2	2	
	CO 4			1		2							1	2	2		
	CO 5												2	2	2	1	1

Course Code: BTFT 326.2-19

Course Title: Technology of Spices and Herbs

Hours per week:3+0+0

Credits: 3

RBT Level	Course Outcomes: After the completion of the course, the students will be able to:	
L1	CO1	Describe the role, classification, properties, quality, specifications and processing of spices and herbs.
L2	CO2	Illustrate importance, working and problem associated with processing of spices and herbs.
L3	CO3	Operate and maintain various processing machines used for value addition.
L5	CO4	Judge effects of spices and herbs on the food products and human health and thereby selecting best blends of spices and herbs.
L6	CO5	Develop improved procedures for use of spices and herbs and their processing knowing the current and future prospects in national and international markets.

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- brahmi, tulsi, mint, thyme, curry leaves, lemon grass their composition , processed products.

UNIT-IV

Medicinal values of herbs; Condiments and spice products, Spice blends and extractives, their types, manufacturing steps, essential and encapsulated oils, salad dressings and seasonings, oleoresins, uses in processed foods, spice processing machineries; Packaging of spices and herbs: handling, 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. Hirasa K. & 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 Outcome (CO) and Program Outcome (PO)

Course Code: BTFT 326.2-19														Course Title: Technology of Spices and Herbs			
(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak																	
	Program Outcome (PO)												PSO				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	
Course Outcome (CO)	CO 1	1	2	1				1				1	2	3	3	2	
	CO 2		1	2								1	3		2	3	
	CO 3	1	2	1		2		1				2	2	3	2	2	
	CO 4			1		2						1	2	2		2	
	CO 5	3	2	1		1	2					2	2	2	1	1	

Course Title: Dairy Process Engineering

Hours per week:3+0+0

Credits: 3

RBT Level	Course Outcomes: After the completion of the course, the students will be able to:	
L1	CO1	Describe principle, working and applications of equipments used in dairy processing.
L2	CO2	Illustrate mechanisms and calculations associated with dairy operations for achieving efficient production.
L3	CO3	Operate and maintain manufacturing equipments of milk processing considering their efficient utilization.
L5	CO4	Evaluate the effects of operations like evaporation, concentration etc on the properties of milk and milk products.
L6	CO5	Design the various equipments on the basis of various process parameters.

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, Economy of operation, 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 powder, 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, Butter and Ghee making machine, Ice-cream and Cheese making equipments. Packaging machines for milk & milk 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.and Newlander 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 Outcome (CO) and Program Outcome (PO)

Course Code: BTFT 326.3-19													Course Title: Dairy Process Engineering				
(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak																	
	Program Outcome (PO)												PSO				
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
Course Outcome (CO)	CO 1	2	1	2				2	1				1	2	3	3	2
	CO 2												1	3	2	2	2
	CO 3	2	1	2		2		1	2				1	2	3	2	1
	CO 4	2		1		2							1	2	2	1	3
	CO 5		1										2	2	1	1	3

Course Title: Open Elective-II (for the students of other teaching department)

Food Safety, Quality and Regulations

Hours per week:3+0+0

Credits: 3

RBT Level	Course Outcomes: After the completion of the course, the students will be able to:	
L1	CO1	Remember the concepts of all laws, standards and systems related to food quality and safety.
L2	CO2	Differentiate and compare various food safety management systems and laws according to their applications in various food sectors.
L3	CO3	Deploy the specifications of food quality and safety improvement laws in the manufacturing and storage sector.
L5	CO4	Evaluate and control various factors that affect food quality and safety for obtaining good quality and safe foods.
L6	CO5	Formulate new laws and specifications required by dynamic food sector.

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 inspection services (FSIS) and their applications, Food safety aspects of novel methods of food processing such as pulsed electric field PEF, high pressure processing HPP, irradiation and other thermal and non-thermal processing, Environmental protection agency (EPA) and its role in food safety system.

UNIT-III

Fundamentals of quality management principles, systems and requirements, Guidelines of performance improvements; GMP, GAP, GHP; ISO: Fundamental, requirement and guidelines.

UNIT-IV

BIS (Bureau of Indian standards), Food Safety and Standard act 2006, Food Authority of India and scientific panels, Codex Alimentarius Commission, HACCP system of food protection: Principles and its applications, HACCP system for food safety; Food and drug administration (FDA).

Recommended Readings:

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

Mapping of Course Outcome (CO) and Program Outcome (PO):

Course Code: BTFT 327-19													Course Title: Food Safety, Quality and Regulations				
(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak																	
	Program Outcome (PO)												PSO				
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
Course Outcome (CO)	CO 1	2							1				1	2	3	3	2
	CO 2	1	2							1			1	3	2	2	2
	CO 3	2	1	1	2	1		1	1	2			1	2	1	3	3
	CO 4			1		2							1	2	2		2
	CO 5	1	2						2	1			2	2	2	1	3

SEMESTER SEVENTH

Course Code: BTFT 411-19

Course Title: Instrumental Analysis of Foods

Hours per week: 2 + 0 + 0

Credits: 2

RBT Level	Course Outcomes: After the completion of the course, the students will be able to:	
L1	CO1	Remember and define all concept related to qualitative and quantitative estimation of foods using various instruments.
L2	CO2	Illustrate the principle and working of instrument related to physical, chemical and microbiological analysis.
L3	CO3	Operate and maintain favorable conditions during analysis for achieving preciseness.
L4	CO4	Examine advantages and disadvantages of one method of food analysis versus another.
L6	CO6	Develop the appropriate instrumental procedure and course of action for a food analysis problem.

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 column 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*, Blackic Acad, 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 Outcome (CO) and Program Outcome (PO)**Course Code: BTFT 411-19****Course Title: Instrumental Analysis of Foods****(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak**

	Program Outcome (PO)												PSO				
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
Course Outcome (CO)	CO 1	3	3	2	3	3		2	1					3	2	3	3
	CO 2	2	3	2	2	2								3	2	3	3
	CO 3	3	3	3	3	2									3	3	
	CO 4		3	2		1							2	3	3	3	
	CO 5	3	1	3	2	2							1	3		3	3

Course Code: BTFT 412-19

Course Title: Instrumental Analysis of Foods Lab.

Hours per week: 0 + 0 + 2

Credits: 1

RBT Level	Course Outcomes: After the completion of the course, the students will be able to:	
L1	CO1	Remember and define all procedures related to qualitative and quantitative estimation of foods.
L2	CO2	Illustrate the principle and working of instruments related to food analysis.
L3	CO3	Operate and maintain analytical instruments for their maximum efficiency with good preciseness.
L4	CO4	Select best convenient method of food analysis according to the available conditions and instruments in food industries.
L6	CO6	Improve and develop the existing and new innovative instrumental methods.

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 pseudocereals 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 Outcome (CO) and Program Outcome (PO)

Course Code: BTFT 412-19		Course Title: Instrumental Analysis of Foods Lab															
(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak																	
	Program Outcome (PO)												PSO				
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
Course Outcome (CO)	CO 1	3	3	3		3	3						1	3	3	3	3
	CO 2		2	2	3									2	2	1	3
	CO 3	2	2	3	2	1						2	2	2		2	2
	CO 4		3	2		2								3		2	3
	CO 5		2	3	2			2						3	3	2	3

RBT Level	Course Outcomes: After the completion of the course, the students will be able to:	
L1	CO1	Define waste management and effluent treatment.
L2	CO2	Classify and describe content of the waste and its application in food industry.
L3	CO3	Using various methods employed for the treatment of industrial wastes.
L4	CO4	Examine the different waste produced in the industries.
L6	CO6	Evaluate and judge the effect of waste and disposal on environment produced from food industries.

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; Disinfection processes- theory, characteristics of disinfectants, mechanism and factors influencing disinfection; 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 Outcome (CO) and Program Outcome (PO)

Course Code: BTFT 413-19		Course Title: Waste Management and Effluent Treatment															
		(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak															
		Program Outcome (PO)												PSO			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
Course Outcome (CO)	CO 1	3	1		1	2	3	3	2		1	1	3	2	1	3	2
	CO 2		2		1	2							3	2	2	1	
	CO 3					2	2					2	3	1	1	2	
	CO 4		1		1		2	1				2	3	1		2	3
	CO 5											2	3	2	2	3	3

Course Title: Waste Management and Effluent Treatment Lab. Hours per week:0+0+2

Credits: 1

RBT Level	Course Outcomes: After the completion of the course, the students will be able to:	
L1	CO1	Outline waste management and effluent treatment.
L2	CO2	Classify and describe content of the waste and its application in food industry.
L3	CO3	Apply and use various methods employed for the treatment of industrial wastes.
L4	CO4	Compare and examine the different waste produced in the industries.
L6	CO6	Develop and improve the existing and new innovative methods of waste and disposal on environment produced from food industries.

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 wate, 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 Outcome (CO) and Program Outcome (PO)

Course Code: BTFT 414-19		Course Title: Waste Management and Effluent Treatment Lab.															
(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak																	
	Program Outcome (PO)												PSO				
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
Course Outcome (CO)	CO 1	3	1		1	2	3	3	2		1	1	3	2	1	3	2
	CO 2		2		1	2							3	2	3		2
	CO 3					2	2					2	3		2	2	
	CO 4		1		1		2	1				2	3				3
	CO 5											2	3	2	2	3	3

Professional Elective- III**Course Code: BTFT 415.1-19****Course Title: Food Plant Design and Layout****Hours per week:3+0+0****Credits: 3**

RBT Level	Course Outcomes: After the completion of the course, the students will be able to:	
L1	CO1	Describe all requirements related to food plant design, its documentation maintenance and improvement.
L2	CO2	Select the most suited location for plant on the basis of various availabilities.
L3	CO3	Apply the knowledge to formulate and maintain economic and efficient conditions within the plant.
L4	CO4	Evaluate the plant thoroughly with respect to product quality, documentation, hygiene and cost.
L6	CO6	Generate problem solving conditions according to the current and future prospects of food sector.

UNIT-I

Overview of Food Process and Plant Design: Food process design, Food plant design, Food plant utilities, Food plant economics; Economic and technical context of food plant design; Optimization of food plant processes.

UNIT-II

Documentation of Food Plant Design: Preliminary studies of food products and raw materials, Laboratory studies, Pilot plant studies, Food plant preliminary and final projects, Information handling in flow chat form; Processing system alternatives: Process synthesis; Food processing system alternatives analysis.

UNIT-III

Experimentation in pilot plant: Pilot plant Size and structure, types, application and design; Materials for construction of food equipment; Hygienic design of processing system and auxiliary system: Basic principles for hygienic design of food equipment and auxiliary systems in contact with foods, external design of processing equipment and auxiliary systems, CIP system design. Process Engineering Economics: Money flow in food business enterprise, Capital cost, Manufacturing cost, Cash flow analysis, Plant profitability, Sensitivity analysis.

UNIT-IV

Operating cost of food plant; Project analysis of food preservative plants (like Tomato paste plant, Orange juice concentrate plant, Sterilized milk plant, Fruit canning plant, Vegetable freezing plant, Vegetable dehydration plant); Food manufacturing plants (like Bread manufacturing plant, Yogurt manufacturing plant); Food ingredients plants (like Beet sugar plant and other additives plant)

Books Recommended

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 Outcome (CO) and Program Outcome (PO)

Course Code: BTFT 415.1-19		Course Title: Food Plant Design and Layout															
(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak																	
	Program Outcome (PO)												PSO				
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
Course Outcome (CO)	CO 1		1				3	3	2		1	1	3				
	CO 2				1	1							3	2	2	1	
	CO 3					2	2					2	3	1	1		
	CO 4		1		1		2	1				2	3	1		2	3
	CO 5											2	3	2	2	3	3

Course Title: Food and Agri-Business Management

Hours per week:3+0+0

Credits: 3

RBT Level	Course Outcomes: After the completion of the course, the students will be able to:	
L1	CO1	Understand the basic knowledge of WTA and Agri-business management.
L2	CO2	Describe all policies and responsibilities related to food business management.
L3	CO3	Demonstrate EDPs and surveys wrt current and future perspective.
L4	CO4	Examine the role of various type of management in agri business.
L6	CO6	Evaluate risks associated with market, product, personnel behavior.

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 Outcome (CO) and Program Outcome (PO)

Course Code: BTFT 415.2-19		Course Title: Food and Agri-Business Management															
		(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak															
		Program Outcome (PO)												PSO			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
Course Outcome (CO)	CO 1		1				3	3	2		1	1	3				
	CO 2				1	1							3	2	2	1	
	CO 3					2	2					2	3	1	1		
	CO 4		1		1		2	1				2	3	1		2	3
	CO 5											2	3	2	2	3	3

Course Title: Food Flavors and Colours

Hours per week:3+0+0

Credits: 3

RBT Level	Course Outcomes: After the completion of the course, the students will be able to:	
L1	CO1	Define various food flavours, their types and characteristics.
L2	CO2	Understand different methods of production and extraction of food flavours & colors.
L3	CO3	Use flavor, colour extract and natural pigments in different kind of food products.
L4	CO4	Compare various physicochemical properties of colours and flavous for their best use.
L5	CO5	Select best lakes and dyes with their maximum permissible limits in food processing industries.

UNIT-I

Introduction to food flavours: Definition, classification and types, volatile and non-volatile flavouring compounds and their sensory characteristics; Natural food flavouring: Fruit, vegetables, spices, beverage, meat, fat, cooked flavours, uses in foods and importance of natural flavours.

UNIT-II

Flavours in processed foods: Development of flavours in processed foods, role of microbes, thermal reactions, off flavours in foods; Synthetic flavourings: Flavouring materials, terminology, flavour extraction and production methods, compounding of flavours, flavour encapsulation, functional uses and applications in food products, flavour enhancers, functions and stability in foods.

UNIT-III

Food colorants: Natural pigments from plant and microbial sources, colour stability, need of colour addition, colour loss during thermal processing, applications of natural colorants, types of colours, uses of synthetic colorants. Colour analyzing technique and equipment.

UNIT-IV

Certified colours: Colorants subject to certification, colour effects in certified foods, 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 Outcome (CO) and Program Outcome (PO)

Course Code: BTFT 415.3-19		Course Title: Food Flavours and Colours																
		(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak																
		Program Outcome (PO)												PSO				
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	
Course Outcome (CO)	CO 1						2	3						1	2	1	1	
	CO 2													1	1	1	1	
	CO 3													1	1	1	1	
	CO 4				1	2	3						3	1	1	1	1	
	CO 5											3	1	1	3	3	3	1

Professional Elective-IV**Course Code: BTFT 416.1-19****Course Title: Technology of Frozen Foods****Hours per week:3+0+0****Credits: 3**

RBT Level	Course Outcomes: After the completion of the course, the students will be able to:	
L1	CO1	Describe the physical aspects and innovations in freezing and quality, safety and packaging of frozen products.
L2	CO2	Select the most suited freezing method with good monitoring and control systems.
L3	CO3	Apply theoretical and numerical abilities of freezing at the commercial level for reducing losses caused by improper storage.
L4	CO4	Judge the sensory and shelf life characteristics of frozen foods.
L6	CO6	Generate problem solving conditions according to the current and future prospects of cold chains in India and world.

UNIT-I

Current status of frozen food industry in India, physical aspect of freezing process: heat transfer during freezing, freezing time, convective (air freezing, brine freezing, cryogenic freezing) and conductive processes (contact and scraped freezers) of freezing, changes during freezing, glass transitions, thermophysical properties of frozen foods, freezing load, Individual Quick Freezing (IQF); freezing time calculations.

UNIT-II

Innovation in freezing process, freeze concentration, dehydrofreezing, freeze drying, cryogenic freezing, freeze damage, changes during frozen storage, thawing techniques and microbial quality of thawed foods; Freezing methods and equipment, cold store design, transportation of frozen

foods, retail display equipments, household refrigerators and freezers, monitoring and control of the cold chain.

UNIT-III

Quality and safety of frozen foods: 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; Recent trends in frozen food packaging: active packaging, intelligent packaging, vacuum packaging and application of edible films on frozen foods.

Recommended Books:

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 Outcome (CO) and Program Outcome (PO)

Course Code: BTFT 416.1-19													Course Title: Technology of Frozen Foods				
(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak																	
	Program Outcome (PO)												PSO				
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
Course Outcome (CO)	CO 1	2	2	2		2	1						2	3	3	3	2
	CO 2					2							2	3	3	3	2
	CO 3	2	2	1	1	2	2						1		2	2	2
	CO 4												1	3		2	1
	CO 5			1	1								2			1	1

Course Title: Meat, Fish and Poultry Processing

Hours per week:3+0+0

Credits: 3

RBT Level	Course Outcomes: After the completion of the course, the students will be able to:	
L1	CO1	Describe the composition, structure and properties of muscle meats.
L2	CO2	Explain the various preservation techniques of meat, poultry and fish products.
L3	CO3	Evaluate the need and means of utilization meat, fish and poultry industry by products.
L4	CO4	Examine safety and quality aspects of meat, fish and poultry products.
L6	CO6	Maintain and develop hygienic condition with maximum utilization within the meat industry.

UNIT-I

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

UNIT-II

Processing and preservation of meat - mechanical deboning, aging or chilling, freezing, pickling, curing, cooking and smoking of meat; Thermal processing- canning of meat, retort pouch, dehydration and irradiation; Meat Products - uncooked comminuted and restructured meat products, sausages, meat emulsions, dried meats, intermediate moisture meats and meat extracts, ready to eat (RTE) meat products. Meat plant sanitation and waste disposal.

UNIT-III

Poultry products: types, chemical and nutritive value of poultry meat; Poultry handling and dressing: inspection of birds, poultry slaughter and dressing, factors affecting quality of poultry; Egg: structure, composition and nutritive value of eggs, changes in egg due to aging; Quality evaluation of eggs, candling, albumen index, haugh unit, yolk index; Egg preservation: grading of eggs, whole egg preservation, pasteurization, dehydration, freezing; Egg products: egg powder, value added egg products (Meringues and Foams etc.), packaging of egg and egg products.

UNIT-IV

Fish products - production of fish meal, fish protein concentrate, fish liver oil, fish paste and fish sauce and other important by products; Quality control of processed fish; Fish processing; By-product utilization: By-products and wastes from meat and poultry industry; HACCP in meat 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 Outcome (CO) and Program Outcome (PO)

Course Code: BTFT 416.2-19														Course Title: Meat, Fish and Poultry Processing			
(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak																	
	Program Outcome (PO)												PSO				
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
Course Outcome (CO)	CO 1	1	2	2	1	1	1	1					1	3	3	3	3
	CO 2	1	1	2	2	1		1			2	2	2	3	2	3	3
	CO 3		2		2			2					3	2	3	2	
	CO 4	1		1		2		3			1	1	1	2	3		3
	CO 5	3			2						2	1			2	3	3

RBT Level	Course Outcomes: After the completion of the course, the students will be able to:	
L1	CO1	Outline the different aspect related to NPD.
L2	CO2	Identify the market need for new product of foods considering the various concern related to it.
L3	CO3	Evaluate the product characteristics and perform its different type of sensory tests.
L4	CO4	Test the new food products in the market and check it viability.
L6	CO6	Create and develop the new food products as per market and consumer requirement.

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

Suggested 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 Outcome (CO) and Program Outcome (PO)

Course Code: BTFT 416.3-19 Course Title: Food Product Development & Sensory Evaluation																	
(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak																	
	Program Outcome (PO)												PSO				
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
Course Outcome (CO)	CO 1		1	2			1						1	1	1	2	3
	CO 2		2		2		1						2	3	2	1	1
	CO 3	1					2						1	2		1	3
	CO 4	2					1						1	1	2	3	
	CO 5		3				2								2	2	3

Course Title: In-Plant Training

Duration: 6-8 weeks

Credits: 4

RBT Level	Course Outcomes: After the completion of the course, the students will be able to:	
L1	CO1	Outline the historical background of modern industry and the production function.
L2	CO2	Understand the influence of various environmental factors on Food Industries and business operations.
L4	CO3	Analyze the process of starting a new venture and create their business plan.
L5	CO4	Judge the process of entrepreneurship and the institutional facilities available to an entrepreneur in India.
L6	CO5	Develop the knowledge on legal aspects and government policy relating to entrepreneurship.

Mapping of Course Outcome (CO) and Program Outcome (PO)

Course Code: BTFT 417-19										Course Title: In-Plant Training							
(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak																	
		Program Outcome (PO)												PSO			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
Course Outcome (CO)	CO1	2	1	3	2	2				2	2	3	3	3	2	3	3
	CO2	2	3	1		3				1	1	1	2	1	3		3
	CO3			2	3	2				2	2	1	2	3	1	3	2
	CO4									3	2		1		3	1	2
	CO5	1	2		3	2				1		2	1	2	3	3	3

Course Title: Open Elective –III (for the students of other teaching department)

Instrumental Analysis of Foods

Hours per week: 3 + 0 + 0

Credits: 3

RBT Level	Course Outcomes: After the completion of the course, the students will be able to:	
L1	CO1	Remember and define all concept related to qualitative and quantitative estimation of foods using various instruments.
L2	CO2	Illustrate the principle and working of instrument related to physical, chemical and microbiological analysis.
L3	CO3	Operate and maintain favorable conditions during analysis for achieving preciseness.
L4	CO4	Examine advantages and disadvantages of one method of food analysis versus another.
L6	CO6	Develop the appropriate instrumental procedure and course of action for a food analysis problem.

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 column 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:

9. Nielson S. S. (2003) *Food analysis*, Kluwer Academic Press.
10. Pomeranz Y. J. (2000) *Food Analysis*, Springer Publications.
11. Srivastava (2000) *Instrumental Approach to chemical analysis*, S. Chand Publishers.
12. Winton A. L. (1999) *Techniques of food analysis, Allied Science, Official methods of analysis*, Association of official analytical chemist USA.
13. Das H. (2005) *Food processing operations analysis*, Asian Books private ltd.
14. James CS (1998). *Analytical chemistry of foods*, Blackic Acad, UK.
15. Winton, AL (1999). *Techniques of food analysis*, Allied Science Publication, New Delhi.
16. Song, DWS (1996) *Mechanism and theory in food chemistry* Champasian and Hall Inc. New York.

Mapping of Course Outcome (CO) and Program Outcome (PO)

Course Code: BTFT 418-19														Course Title: Instrumental Analysis of			
Foods																	
(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak																	
	Program Outcome (PO)												PSO				
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
Course Outcome (CO)	CO 1	3	3	2	3	3		2	1					3	2	3	3
	CO 2	2	3	2	2	2								3	2	3	3
	CO 3	3	3	3	3	2									3	3	
	CO 4		3	2		1								3	3	3	
	CO 5	3	1	3	2	2								3		3	3

SEMESTER EIGHTH

Course Code: BTFT 421-19

Course Title: Food Packaging

Hours per week: 3 + 0 + 0

Credits: 3

RBT Level	Course Outcomes: After the completion of the course, the students will be able to:	
L1	CO1	Describe the objectives, functions, packaging and recycling of materials use for packaging.
L2	CO2	Understand and compare different types and characteristics of packaging materials.
L3	CO3	Use and comprehend about different forms of packaging and their types.
L4	CO4	Examine shelf life of different food materials using different packaging techniques.
L6	CO6	Design and develop the packaging requirement of different types of 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 types of packaging material: paper, metal, glass and plastic; Paper and paper based packaging materials: different types of pulp, paper making, types of paper, and properties of paper; Metal packaging materials: manufacture of tin plate, electrolytic chromium coated steel (ECCS), aluminium, container making process, corrosion and corrosiveness of foods and lacquers; Glass packaging materials: composition, properties, manufacture and closure; 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, food packaging applications, MIP, modified atmospheric packaging (MAP), active packaging; Printing processes, inks, adhesives and labeling of packaging materials; different types of printing material and processes, bar coding material, natural and synthetic adhesives, and types of label; packaging requirements of foods: fresh fruits and vegetables, meat, fish, poultry, dairy products, edible oils and spice products.

UNIT -IV

Recycling of packaging materials: collection, separation and processing of paper packaging, food packaging from recovered paper; collection, separation and recycling plastic packaging uses of plastic packaging; Packaging standards and regulations: packaging performance 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 Outcome (CO) and Program Outcome (PO)

Course Code: BTFT 421-19		Course Title: Food Packaging															
(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak																	
	Program Outcome (PO)												PSO				
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
Course Outcome (CO)	CO 1					1	1						2	1	3	1	
	CO 2		1		1	1						2	2	1	3	1	
	CO 3			1		1	3	2					1		2	1	
	CO 4			2	1								2		3	2	2
	CO 5			3		2	1						2			3	3

Course Title: Food Packaging Lab.

Hours per week: 0 + 0 + 2

Credits: 1

RBT Level	Course Outcomes: After the completion of the course, the students will be able to:	
L1	CO1	Describe various analytical procedure related to the food packaging.
L2	CO2	Classify different types of packaging materials.
L3	CO3	Choose the best packaging material as per the product requirement in consideration with environmental concerns.
L4	CO4	Evaluate Shelf life of packaged foods.
L6	CO6	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., study of shelf life of foods under different packaging and environmental conditions.

Mapping of Course Outcome (CO) and Program Outcome (PO)

Course Code: BTFT 422-19													Course Title: Food Packaging Lab				
(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak																	
	Program Outcome (PO)												PSO				
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
Course Outcome (CO)	CO 1		3			1							2	3		3	
	CO 2		2		1								2	2	1	2	2
	CO 3	1	1		2	1						1	2	2		2	2
	CO 4					2				2						2	3
	CO 5									2	2				3	2	3

Professional Elective –V**Course Code: BTFT 423.1-19****Course Title: Baking and Confectionary Technology****Hours per week:3+0+0****Credits: 3**

RBT Level	Course Outcomes: After the completion of the course, the students will be able to:	
L1	CO1	Define various raw materials used for preparation of bakery and confectionary products.
L2	CO2	Understand basic operation and working of various equipments involved in bakery and confectionary technology.
L3	CO3	Sketch various processes used for the manufacturing of bakery and confectionary products.
L4	CO4	Compare various processes used for the manufacturing of bakery and confectionary products and their quality determination.
L6	CO6	Develop new bakery and confectionary products according to food safety rules and regulations.

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; FSSAI specification of raw materials; Bakery equipments: divider, rounder, proofer, moulder; equipments used in baking, different types of oven, slicer.

UNIT-II

Different types of bread and preparation of bread using different methods, quality evaluation of bread, bread faults and remedies, staling of bread; Types, methods of preparation and quality evaluation of biscuits; Types, methods of preparation and quality evaluation of cakes, cake faults

and remedies; Preparation of other bakery products: rusks, crackers, buns, muffins and pizza; Pasta products.

UNIT-III

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.

UNIT-IV

Food safety rules and regulations for bakery and confectionery products; Layout, setting up of units and hygienic conditions required in bakery plant; Operation and maintenance of bakery equipments.

Recommended Readings:

1. Khatkar B. S. (2011) *Baking Science and Technology*, Arihant Publication.
2. Amendola J. & 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 Outcome (CO) and Program Outcome (PO)

Course Code: BTFT 423.1-19 Course Title: Baking and Confectionary Technology																	
(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak																	
	Program Outcome (PO)												PSO				
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
Course Outcome (CO)	CO 1			1	1	1						2	2	3	3	3	2
	CO 2	1	1			2						2	2	3	3	3	2
	CO 3				2	1	1						2	2			
	CO 4			1			1						1	2	2	2	2
	CO 5			2		1	2					3	2	1	2	2	1

Course Title: Technology of Fats and Oils

Hours per week:3+0+0

Credits: 3

RBT Level	Course Outcomes: After the completion of the course, the students will be able to:	
L1	CO1	Define various types of fats and oils and their physicochemical properties related to food industries.
L2	CO2	Compare the importance and compositions of different fats & oils.
L3	CO3	Choose the best methods of extraction of animal and plant fats and refining of oils.
L4	CO4	Distinguish between various fats and oils on the basis of their origin, use, shelf life.
L6	CO6	Judge various quality parameters in controlling the quality of fats and oils.

UNIT-I

Status of oils and fats in Indian economy, importance of fats and oils in foods; Sources, chemical composition and properties of fats and oils (plant and animal origin); Fats in diet, nutrition and disease, pretreatment and storage of oil seeds, reversion and rancidity of fats and oils, causes and prevention.

UNIT-II

Extraction of oils: cold pressing and hot pressing, solvent extraction, rendering-removal and recovery of solvent from miscella, removal and recovery of solvent from extracted residue; Refining of oil; neutralization, degumming, bleaching, alkali refining, deodorization, winterization of oil, hardening of oil, generation and storage of hydrogen, production and regeneration of catalysts, 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: industrial application; Lards, tallow: physical nature, production and storage, production of margarine, partial sterilization, emulsification, chilling, kneading and cooling; Incorporation of salt and coloring agent, confectionery plastic fat, application of plastic fat in bakery, confectionary (including cocoa butter replacers), shortening processing.

UNIT-IV

Preparation of various products including different shortenings, margarine, salad dressing and mayonnaise, imitation of dairy products low calorie spreads; By-products of fat/oil processing industries – oil seed protein isolates; quality standards of edible oils and fats; Antioxidants and rancidity of fats and oils.

Recommended books

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. Churchill 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 Outcome (CO) and Program Outcome (PO)

Course Code: BTFT 423.2-19		Course Title: Technology of Fats and Oils															
(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak																	
	Program Outcome (PO)												PSO				
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
Course Outcome (CO)	CO 1			2	1		1							1		1	
	CO 2						2				2	2	3	1	1	3	
	CO 3						2			1		1	3	1	1	2	
	CO 4				1					1	1		1	1	1	1	
	CO 5		1			1	3					2	3	1	1	2	3

Course Title: Snack Food Technology

Hours per week:3+0+0

Credits: 3

RBT Level	Course Outcomes: After the completion of the course, the students will be able to:	
L1	CO1	Describe and understand extrusion technology.
L2	CO2	Compare the various technological aspects of traditional and modern snack foods.
L3	CO3	Operate and manage various equipments used in value addition in snack food areas .
L4	CO4	Evaluate the changes caused by various factors in snack food processing.
L6	CO6	. Develop the economically and nutritionally crucial procedures to manufacture snack foods.

UNIT-I

Extrusion: Introduction to extruders and their principles, types of extruders. Extruders in the food industry: History and uses. Single screw extruder: principle of working, factors affecting extrusion process, co-kneaders. Twin screw extruder: Feeding, screw design, screw speed, screw configurations. Pre-conditioning of raw materials used in extrusion process: operations and benefits and devolatilization. Chemical and nutritional changes in food during extrusion. Addition and subtraction of materials, shaping and forming at the die. Post-extrusion processes- colouring, flavouring and packaging of extruded snack foods.

UNIT-II

Breakfast cereals: Introduction and classification (flaked cereals, oven puffed cereals, gun puffed cereals, shredded products). Breakfast cereal-manufacturing processes (traditional and modern methods), High shear cooking process and steam cookers. Texturized vegetable protein: definition, processing techniques. Direct expanded (DX) and third generation (3G) snacks: types. Concept of junk & fried foods and their impact on human health.

UNIT-III

Technology for grain-based snacks: Whole grains- roasted, toasted, puffed, popped, flaked. Coated grains- salted, spiced and sweetened. Formulation, processing and quality assessment of chips and wafers, papads, instant premixes of traditional Indian snack foods.

UNIT-IV

Technology for fruit and vegetable-based snacks- chips, wafers; Technology for coated nuts- salted, spiced and sweetened *chikkies*. Equipments for frying, baking, drying, toasting, roasting, flaking, popping, blending, coating and chipping.

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 Outcome (CO) and Program Outcome (PO)

Course Code: BTFT 423.3-19		Course Title: Snack Food Technology															
		(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak															
		Program Outcome (PO)												PSO			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
Course Outcome (CO)	CO 1			2	1		1							1		1	
	CO 2						2				2	2	3	1	1	3	
	CO 3						2			1		1	3	1	1	2	
	CO 4				1					1	1		1	1	1	1	
	CO 5		1			1	3					2	3	1	1	2	3

Professional Elective –VI**Course Code: BTFT 424.1-19****Course Title: Introduction to Food Additives****Hours per week:3+0+0****Credits: 3**

RBT Level	Course Outcomes: After the completion of the course, the students will be able to:	
L1	CO1	Define food preservatives, additives, flavoring agents, sweeteners, nutrients and thickeners for healthy foods.
L2	CO2	Classify the role of different food additives in food processing industry with their roles
L3	CO3	Apply various techniques for commercial production of different food additives.
L4	CO4	Compare role of various food additives in health maintenance and cure of diseases.
L6	CO6	Select the additives according to their mode of action and compatibility with food products

UNIT - I

Food Additives: definitions, classification and applications, food preservatives- classifications, antimicrobial agents, types and their action, safety concerns, 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: color retention agents, applications and natural colorants, sources of natural color, misbranded colors, 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 sequesterant, hydrocolloids, acidulants, pH control agents buffering salts, anticaking agents.

UNIT - III

Sweeteners: natural and artificial sweeteners, nutritive and non-nutritive sweeteners, properties and uses of saccharin, acesulfame-K, aspartame, corn sweeteners, invert sugar sucrose and sugar alcohols (polyols) as sweeteners in food products; Emulsifiers: types, selection of emulsifiers, emulsion stability, functions and mechanism of action.

UNIT - IV

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

Recommended Readings:

1. Branen A. L., Davidson P. M., and Salminen S. (2001) *Food Additives*. 2nd Ed. Marcel Dekker.
2. George A. B., (1996) *Encyclopedia of Food and Color Additives. Vol. III*. CRC Press.
3. George A. B., (2004) *Fenaroli's Handbook of Flavor Ingredients 5th 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 Outcome (CO) and Program Outcome (PO)

Course Code: BTFT 424.1-19		Course Title: Introduction to Food Additives															
(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak																	
	Program Outcome (PO)												PSO				
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4	
Course Outcome (CO)	CO 1			1	2	1						1	3	2	2		
CO 2			1	1								1	1	3	2		
CO 3				1		1				1		1	3	3	2		
CO 4						2						3	2	3	3		
CO 5						1					1	2	3	2	3	2	

Course Title: Technology of Traditional Foods

Hours per week:3+0+0

Credits: 3

RBT Level	Course Outcomes: After the completion of the course, the students will be able to:	
L1	CO1	Describe various traditional and modern methods of milling equipments and process.
L2	CO2	Classify Indian traditional foods used during different rituals.
L3	CO3	Apply modern food with traditional flavor and nutrition .
L4	CO4	Distinguish the needs of modern society to make safe and healthy ready to use formulations.
L6	CO6	Judge the knowledge of nutrients bioactive components of traditional foods for specific illness.

UNIT-I

Traditional methods of milling grains – rice, wheat and corn – equipments and processes as compared to modern methods. Equipments and processes for edible oil extraction, paneer, butter and ghee manufacture – comparison of traditional and modern methods. Traditional methods of food preservation– sun-drying, osmotic drying, brining, pickling and smoking.

UNIT-II

Typical breakfast, meal and snack foods of different regions of India. Regional foods that have gone Pan Indian / Global. Popular regional foods; Traditional fermented foods, pickles and preserves, beverages, snacks, desserts and sweets, street foods; IPR issues in traditional foods.

UNIT-III

Commercial production of traditional breads, snacks, ready-to-eat foods and instant mixes, frozen foods – types marketed, turnover; role of national and multinational companies; commercial production and packaging of traditional beverages such as tender coconut water, neera, lassi,

buttermilk, dahi. Commercial production of intermediate foods – ginger and garlic pastes, tamarind pastes, masalas (spice mixes), idli and dosa batters.

UNIT-IV

Comparison of traditional foods with typical fast foods / junk foods – cost, food safety, nutrient composition, bioactive components; traditional foods used for specific ailments /illnesses.

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 Outcome (CO) and Program Outcome (PO)

Course Code: BTFT 424.2-19													Course Title: Technology of Traditional Foods				
(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak																	
	Program Outcome (PO)												PSO				
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
Course Outcome (CO)	CO 1	1	1			2	2	2			2	2	2	3	3	2	2
	CO 2	1	1	2			1	2			1		3	3	3	2	2
	CO 3		1	2	1	3		3	1	2			2	3	1	3	1
	CO 4			2	1	1	3		3	3	3	2	2	2	2	2	3
	CO 5			1	1	1	1	1	2			1	3	1	1	3	1

Course Title: Functional Foods and Nutraceutical

Hours per week:3+0+0

Credits: 3

RBT Level	Course Outcomes: After the completion of the course, the students will be able to:	
L1	CO1	Define various terminology relevant to functional and nutraceuticals.
L2	CO2	Classify different types of functional foods and their related functional ingredients.
L3	CO3	Apply knowledge of fortification and enrichment to create different type of functional food.
L4	CO4	Evaluate the effects of functional foods and nutraceuticals on human health.
L6	CO6	Judge the stability of various functional ingredients under different processing condition.

UNIT-I

Introduction: Relevant terminologies – Enrichment, value addition, fortification, supplementation, Sources, Significance, Fortification and Enrichment in different foods (MSG; Bakery and confectionary products e.g. bread, biscuit and cookies; Breakfast and ready to eat cereals; Infant formulas; Protein mixes; Vegetable Mixes; Dairy product e.g. ice cream; Beverages including diet beverages)

UNIT-II

Value addition in processed food products e.g. pasta, ice cream, pizza, wafers, rolls, buns, jam, jelly, sauce, pickles, waffles etc Types of functional foods: Concepts of Probiotic, Nutraceuticals, Spiceuticals, Regulatory and labeling issues, CODEX

UNIT-III

Functional ingredients: Extraction / purification of lycopene, isoflavonoids, prebiotics and probiotics glucosamine, phytosterols, and their stability in processing conditions; Manufacturing of dietary supplements in the form of liquid, rehydration powder, tablet, pill, capsule or mix

UNIT-IV

Nutritional significance: Role of nutraceutical/ functional foods in cardiovascular health, diabetes, obesity, immunity, age related muscular degeneration, stress management; 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 Outcome (CO) and Program Outcome (PO)

Course Code: BTFT 424.3-19		Course Title: Functional Foods and Nutraceuticals															
		(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak															
		Program Outcome (PO)												PSO			
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
Course Outcome (CO)	CO 1					2							2	3	3	2	
	CO 2						1						3	3	3	2	
	CO 3				1	3							2	3	1	3	1
	CO 4					1	3					2	2	2	2	2	3
	CO 5			1			1							3	1	1	3

Course Title: Project

Duration: 6-8 weeks

Credits: 6

RBT Level	Course Outcomes: After the completion of the course, the students will be able to:	
L1	CO1	Outline and indicate about new ideas on current issues in food sector.
L2	CO2	Compare and expand their knowledge base with literature review on the current topic.
L3	CO3	Apply the Research methodology and Research plan in practice to resolve the problem.
L4	CO4	Examine the whole process to compare with the trending ideas and gain exposure while doing NPD practices.
L5	CO5	Appraise new research and study on various problems pertaining to research area.

Mapping of Course Outcome (CO) and Program Outcome (PO)

Course Code: BTFT 425-19													Course Title: Project-2				
(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak																	
Course Outcome (CO)	Program Outcome (PO)												PSO				
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	CO1	2	1	3	2	2				2	2	3	3	3	2	3	
	CO2		2	1	3									3	2	3	2
	CO3			2	1	3								2	3	2	3
	CO4	2	1	3	2	2				2	2	3	3	3	2	3	2
CO5	1	2		3	2						2	1	2	3	3	3	

OR

RBT Level	Course Outcomes: After the completion of the course, the students will be able to:	
L1	CO1	Outline the nature, scope and structure of modern industry and the Production function.
L2	CO2	Understand the significance and knowledge of employee relations and legislation related to employees in modern Food Industries and business operations.
L4	CO3	Test the process of starting a new venture and create their business plan.
L5	CO4	Judge the process of entrepreneurship and the institutional facilities available to an entrepreneur in India
L6	CO5	Develop the knowledge on legal aspects and government policy relating to entrepreneurship.

Mapping of Course Outcome (CO) and Program Outcome (PO)

Course Code: BTFT 426-19		Course Title: In-Plant Training															
(1/2/3 indicates strength of the correlation) 3-Strong, 2-Medium, 1-Weak																	
	Program Outcome (PO)												PSO				
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
Course Outcome (CO)	CO1	2	1	3	2	2				2	2	3	3	3	2	3	3
	CO2	2	3	1		3				1	1	1	2	1	3		3
	CO3			2	3	2				2	2	1	2	3	1	3	2
	CO4									3	2		1		3	1	2
	CO5	1	2		3	2				1		2	1	2	3	3	3