B.E.

in

FOOD TECHNOLOGY

(APPLICABLE FOR STUDENTS ADMITTED FROM THE ACADEMIC YEAR 2016-2017 ONWARDS)

SYLLABUS

DEPARTMENT OF FOOD ENGINEERING AND TECHNOLOGY
SANT LONGOWAL INSTITUTE OF ENGINEERING AND TECHNOLOGY (SLIET)
LONGOWAL-148 106
SANGRUR, PUNJAB
INDIA

2016

VISION OF THE DEPARTMENT

To be a Centre of excellence in training, research, outreach and consultancy services in food engineering and technology with emphasis on value addition of agricultural produce, food bioprocessing and technology, food nutrition, food quality and safety.

MISSION OF THE DEPARTMENT

1. To produce trained technical manpower of highest standard in the field of food engineering and technology
2. To re-orient and develop safe food products by applying fundamental and applied technologies
3. To provide solutions to the problem and leadership in the area of education, training and research

PROGRAM EDUCATIONAL OBJECTIVES (PEO)

4. To develop the ability to apply the knowledge of Science, Mathematics, Computing and basic Engineering fundamentals to make students capable to analyze, interpret and design.
5. To develop the capability to apply latest engineering tools and techniques in Food processing with respect to social and global framework.
6. To create competent Professionals inculcated with leadership qualities and ethical responsibilities.
7. To develop the ability to communicate proficiently and work in a multidisciplinary team and competitive environment.
8. To build up the knowledge of current issues and capability to engage in life-long learning process and enable the students in totality to start-up their own business organizations or work as leaders in food industries.

PROGRAM OUTCOME (PO)

Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and teamwork:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write

effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOME (PSOs)

PSO1: Graduates having an ability to identify, analyze and solve technical problems relating to food systems together with allied streams.

PSO2: Graduates will be able to build the nation, by imparting technological inputs and managerial skills to become technocrats, entrepreneurs and will be able to develop new concepts on various emerging fields and pursue advanced research.

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GFT-Degree in Food Technology							
Group-A							
Semester-I Group-A (UG)							
S.No	Sub Code	Subject Name	L	T	P	Hrs.	Credits
1	AMT-411	Engineering Mathematics	3	1	0	4	4
2	PHT-411	Applied Physics	3	1	0	4	4
3	HUT-411	English communication and soft skills	3	0	0	3	3
4	EET-411	Elements of Electrical Engineering	3	1	0	4	4
5	MET-411	Elements of Mechanical Engineering	3	1	0	4	4
6	PHP-411	Applied Physics	0	0	2	2	1
7	HUP-411	English Communication & Soft Skills	0	0	2	2	1
8	EEP-411	Elements of Electrical Engineering	0	0	2	2	1
9	MEP-411	Elements of Mechanical Engineering	0	0	2	2	1
		Total	15	5	8	27	23
Semester-II Group-A (UG)							
S.No	Sub Code	Subject Name	L	T	P	Hrs.	Credits
1	CYT-421	Applied Chemistry	3	1	0	4	4
2	HUT-422	Engineering Economics and Entrepreneurship	3	1	0	4	4
3	CST-421	Elements of Computer Programming	2	0	0	2	2
4	ECT-421	Elements of Electronics Engineering	3	1	0	4	4
5	MET-421 Or	Workshop Technology & Practice-I	2	0	0	2	2
6	CYP-421	Applied Chemistry	0	0	2	2	1
7	CSP-421	Elements of Computer Programming	0	0	2	2	1
8	ECP-421	Elements of Electronics Engineering	0	0	2	2	1
9	MEP-423 Or	Engineering Drawing	0	0	4	4	2
10	WSP-422 Or	Workshop Technology & Practice-I	0	0	4	4	2
		Total	13	2	14	30	23
Semester-IIIA (UG:Practical Training)							
	TPS-501*^	Two weeks Practical Training during summer vacations				80	2 (S/US)
Semester-III Group-A (UG)							
S.No	Sub Code	Subject Name	L	T	P	Hrs.	Credits
1	AMT-511	Higher Engg Mathematics	4	0	0	4	4
3	FTT-511	Food Chemistry	3	0	0	3	3
4	FTP-511	Food Chemistry Lab	0	0	2	2	1
5	FTT-512	Food Microbiology	3	0	0	3	3
6	FTP-512	Food Microbiology Lab	0	0	2	2	1
7	FTT-513	Heat and Mass Transfer	3	1	0	4	4
8	FTP-513	Heat and Mass Transfer Lab	0	0	2	2	1
9	FTT-514	Unit Operations	3	0	0	3	3
10	FTP-514	Unit Operations Lab	0	0	2	2	1
		Total	16	1	8	25	21
Semester-IV Group-A (UG)							
S.No	Sub Code	Subject Name	L	T	P	Hrs.	Credits
1	FTT-521	Food Biochemistry and Nutrition	3	0	0	3	3
2	FTP-521	Food Biochemistry and Nutrition Lab	0	0	2	2	1
3	FTT-522	Food Engineering	3	1	0	4	4
4	FTP-522	Food Engineering Lab	0	0	2	2	1
5	FTT-523	Dairy Engineering	3	1	0	4	4

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6	FTP-523	Dairy Engineering Lab	0	0	2	2	1
7	FTT-524	Fluid Flow Operations and Rheology	3	0	0	3	3
8	FTP-524	Fluid Flow Operations and Rheology Lab	0	0	2	2	1
9	FTT-525	Technology of Cereal, Pulses and Oilseeds Processing	3	0	0	3	3
10	FTP-525	Technology of Cereal, Pulses and Oilseeds Processing Lab	0	0	2	2	1
		Total	15	2	10	27	22

Semester-V Group-A (UG)

S.No	Sub Code	Subject Name	L	T	P	Hrs.	Credits
1	AMT-611	Numerical Analysis	3	1	0	4	4
2	AMP-611	Numerical Analysis	0	0	2	2	1
3	FTT-611	Food Storage Engineering	3	1	0	4	4
4	FTP-611	Food Storage Engineering Lab	0	0	2	2	1
5	FTT-612	Packaging Technology	3	0	0	3	3
6	FTP-612	Packaging Technology Lab	0	0	2	2	1
7	FTT-613	Technology of Milk and Milk Products	3	0	0	3	3
8	FTP-613	Technology of Milk and Milk Products Lab	0	0	2	2	1
9	FTT-614	Food Laws and Regulations	3	0	0	3	3
10	FTT-61*	Elective-I	3	0	0	3	3
11	FTP-61*	Elective-I Lab	0	0	2	2	1
		Total	18	2	10	30	25

Semester-VI Group-A (UG)

S.No	Sub Code	Subject Name	L	T	P	Hrs.	Credits
1	PHT-621	Physics of Materials	3	1	0	4	4
2	PHP-621	Physics of Materials	0	0	2	2	1
3	**O-62*	Open Elective -I	3	0	0	3	3
4	FTT-621	Technology of Animal Products	3	0	0	3	3
5	FTP-621	Technology of Animal Products Lab	0	0	2	2	1
6	FTT-622	Food Analysis and Quality Control	3	0	0	3	3
7	FTP-622	Food Analysis and Quality Control Lab	0	0	2	2	1
8	FTT-623	Technology of Fruits and Vegetable Products	3	0	0	3	3
9	FTP-623	Technology of Fruits and Vegetable Products Lab	0	0	2	2	1
10	FTT-62*	Elective - II	4	0	0	4	4
11	FTP-62*	Elective - II Lab	0	0	2	2	1
		Total	19	1	10	30	25

Semester- VIIA (UG:Industrial Training)							
	TPS-701*^	Industrial Training during summer vacations (6 weeks)				200	8 (S/US)

Semester-VII Group-A (UG)

S.No	Sub Code	Subject Name	L	T	P	Hrs.	Credits
1	CHM-711	Environmental Studies	3	0	0	3	3
2	HUT-711	Principles of Management	3	1	0	4	4
3	**O-71*	Open Elective -II	3	0	0	3	3
4	FTT-711	Technology of Fats and Oils	3	0	0	3	3
5	FTP-711	Technology of Fats and Oils Lab	0	0	2	2	1
6	FTT-712	Food Processing Plant Layout & Design	3	1	0	4	4

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7	FTT-71*	Elective-III	3	0	0	3	3
8	FTP-71*	Elective-III Lab	0	0	4	4	2
9	FTP-715	Seminar/Self-study	0	0	4	4	2
		Total	18	2	10	30	25
Semester-VIII Group-A (UG)							
S.No	Sub Code	Subject Name	L	T	P	Hrs.	Credits
1	HUM-721	Human Values and Professional Ethics	2	0	0	2	2
2	**O-72*	Open Elective -III	3	0	0	3	3
3	FTT-721	Food Biotechnology	3	0	0	3	3
4	FTP-721	Food Biotechnology Lab	0	0	2	2	1
5	FTT-722	Innovative Techniques in Food Processing	3	0	0	3	3
6	FTT-72*	Elective-IV	3	0	0	3	3
7	FTP-72*	Elective-IV Lab	0	0	2	2	1
8	FTP-725	Project	0	0	12	12	6
		Total	14	0	16	30	22
*^ The credit will not be considered for CGPA calculation							

	Theory	Tutorial	Practical	Hrs.	Credits
Total Basic Sciences	19	5	8	32	28
Total Humanities	9	2	2	13	12
Total Other Engineering	13	3	16	32	24
Total Open Electives	9	0	0	9	9
Total Core Subject	73	5	48	125	102
Total Mandatory Courses	5	0	0	5	5
Projects	0	0	12	12	6
Summer Training and Industrial Training					10
Total	128	16	84	228	196

	Elective I
FTT-615	Technology of Bakery and Confectionery Products
FTT-616	Spices Technology
	Elective I (Lab)
FTP-615	Technology of Bakery and Confectionery Products Lab
FTP-616	Spices Technology Lab
	Elective II
FTT-624	Technology of Beverages
FTT-625	Post Harvest Engineering
	Elective II (Lab)
FTP-624	Technology of Beverages Lab
FTP-625	Post Harvest Engineering Lab
	Elective III
FTT-713	Biochemical Engineering
FTT-714	Industrial Microbiology
	Elective III (Lab)
FTP-713	Biochemical Engineering Lab
FTP-714	Industrial Microbiology Lab
	Elective IV
FTT-723	Health and Functional Foods
FTT-724	Food Additives and Ingredients
	Elective IV (Lab)

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FTP-723	Health and Functional Foods Lab
FTP-724	Food Additives and Ingredients Lab

	Open Elective I
FTO-621	Separation Technology
FTO-622	Statistical Quality Control
FTO-623	Food Process Engineering
	Open Elective II
FTO-711	Membrane Technology
FTO-712	Nano Technology
FTO-713	Flavour Technology
	Open Elective III
FTO-721	Numerical Computations in Food Processing
FTO-722	Instrumental Techniques in Foods
FTO-723	Drying Technology

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Title of the course	:	**Food Chemistry**	
Subject Code	:	**FTT-511**	
Weekly load(hours)	:	**3**	**LTP 3-0-0**
Credit	:	**3**	

Course Objective:

1. Develop and understanding of how individual food components contributes to the overall quality of foods.
2. Achieve an understanding of the chemical changes that take place with food components during processing and storage.
3. Recognize reactions and mechanisms important in food chemistry.
4. Be capable of designing and conducting experiments and interpreting data to understand important food chemistry principles.

Course Outcomes:

On successful completion of the subject

1. The students will be able to understand chemical composition and structure of macro- and micro-constituents and their functions in foods.
2. The students will be able to learn major chemical reactions responsible for spoilage in different foods.
3. The students will be able to understand the role of enzymes in various transformations of foods.
4. The students will be able to understand the role of pigments in different food products and effect of processing on the pigments.
5. The students will be able to Differentiate in the enzymatic and non-enzymatic reactions and their role in food processing.

UNIT	*MAIN TOPIC*	*DETAILED CONTENTS*	*LECTURES*
I	***Introduction***	Development of food chemistry and its role in food processing	***2***
	Water	Importance of water in foods. Structure of water & ice. Concept of bound & free water and their implications. Sorption Phenomena and Sorption isotherms, examples– Dispersed systems–some basic considerations.	***4***
	Proteins	Nomenclature, classification, structure, chemistry and properties of amino acids, peptides, proteins. Essential and non- essential amino acids, Isolation, identification and purity of amino acids, peptides, proteins. Qualitative and quantitative analysis of amino acids and proteins. Changes	***8***

		during processing, protein determination methods. Physical and chemical characteristics of proteins	
II	***Carbohydrates***	Nomenclature and classification, structure, physical and chemical properties of polysaccharides (cellulose, starch, fructans, galactans, hemi-cellulose, pectic substances) and their functions; dietary fiber, changes in carbohydrates during processing**.**	***8***
	Lipids	Structure, classification, physical and chemical properties, utilization of fats and oils, margarine, shortenings, salad and cooking oils, importance of fats and oils in diet, introduction to hydrogenation and its importance.	***6***
	Browning reactions	Enzymatic and non-enzymatic browning, advantages and disadvantages, factors affecting their reaction and control	***4***
	Vitamins	Types of vitamins, chemistry and functions, source and deficiency diseases	***4***
	Plant pigment	Structure and properties of chlorophyll, anthocyanins, tannin, myoglobin and carotenoids, chemical changes during processing	***4***
	Flavor and aroma of foods	Importance and method of retention of flavour and aroma in foods, terpenes, esters, ketones and quinines.	***4***

Books Recommended:

Author **Title**

1. Meyer Food Chemistry
2. Fenemma Food Chemistry
3. BelitzFood Chemistry
4. Lee Basic Food Chemistry
5. Lehninger Principles of Biochemistry

Mapping of Course Outcome and Program Outcome:

Cos	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	0	0	0	0	1	0	1	0	0	2	2	0
CO2	2	3	1	2	0	0	1	0	1	1	2	2	2	0
CO3	2	2	0	0	0	0	1	1	1	1	1	1	3	0
CO4	0	2	1	0	3	0	0	3	1	0	2	2	3	0
C05	0	1	0	2	0	3	0	2	1	1	0	2	3	0
Average	**2.33**	**2.00**	**1.00**	**2.00**	**3.00**	**3.00**	**1.00**	**2.00**	**1.00**	**1.00**	**1.67**	**1.80**	**2.60**	**0.00**

Title of the course	:	**Food Chemistry Lab**	
Subject Code	:	**FTP-511**	
Weekly load(hours)	:	**2**	**LTP 0-0-2**
Credit	:	**1**	

Course Objectives:

1. Know the chemistry underlying the properties and reactions of various food components.
2. Have sufficient knowledge of food chemistry to control reactions in foods.
3. Know the major chemical reactions that limit shelf life of foods.
4. Use the laboratory techniques common to basic and applied food chemistry.

Course Outcomes:

On successful completion of the subject

1. The students will able to understand The importance of the major chemical constituents of food and the changes that occur.
2. The students will able to learn principles behind analytical techniques associated with food.
3. The students will be able to select the appropriate analytical technique when presented with a practical problem.
4. The students will able to understand chemical principles governing rates and extents of reactions may be used to rationalize and/or predict basic food phenomena
5. The students will obtain knowledge about the various methods of analysis for food and will understand when and how these should be applied.

List of Practicals:

1. Qualitative tests for the presence of carbohydrates in food samples
2. Qualitative test for the presence of protein in food and its products
3. Estimation of sugar in given food sample by Lane and Eynon and Nelson&Somogy method
4. Estimation of lactose in milk sample by titrimetric method
5. Determination of browning content and inhibition of browning reaction
6. Determination of acid value of given oil or fat sample
7. Estimation of amount of fat milk powder by Majonnier's method
8. Estimation of protein by micro-Kjeldhal method
9. Estimation of pectic substances and pectin in fruit
10. Determination of Vitamin B-complex in foods
11. Determination of saponification value and un-saponifiable matter
12. Determination of RM value, Polenske value of oil and fat.
13. Determination of proline content.
14. Determination of vitamin C in given sample.
15. Estimation of phosphatase activity in milk.

Mapping of Course Outcome and Program Outcome:

Cos	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	0	2	0	0	0	0	1	0	1	2	0	3	2	0
CO2	1	3	1	1	3	0	1	0	0	1	1	2	2	0
CO3	2	0	0	1	2	0	1	3	0	1	0	3	3	0
CO4	0	2	1	2	3	0	0	1	1	1	2	3	3	0
C05	0	0	0	0	0	2	0	0	1	1	2	2	3	0
Average	**1.50**	**2.33**	**1.00**	**1.33**	**2.67**	**2.00**	**1.00**	**2.00**	**1.00**	**1.20**	**1.67**	**2.60**	**2.60**	**0.00**

Title of the course : **Food Microbiology**
Subject Code : **FTT- 512**
Weekly load(hours) : **3** **LTP 3-0-0**
Credit : **3**

Course Objectives:

1. To learn about food microbiology and microorganisms
2. To understand concept of microbiology techniques
3. To study association of microorganisms in with food
4. To understand the role of microorganisms in food spoilage and their control

Course Outcomes:

On successful completion of the subject, the students will be able to

1. It helps to learn the students about the techniques used to prevent the microbial spoilage of food
2. It will help to understand about the concept of microbiology
3. Students can learn the techniques of microbiology study and culturing
4. Familiarize various aspects of food spoilage by microorganisms
5. Familiarize various aspects of food production and application of microbiology in food production

UNIT	***MAIN TOPIC***	***DETAILED CONTENTS***	***LECTURES***
I	***Introduction***	Importance and historical developments in food microbiology, prokaryotic and eukaryotic cell, morphology, structure, microbiology and reproduction of bacteria, yeast and mold.	***8***
	Techniques of pure culture	Serial dilution, pour plate, streak plate, spread plate, slant, broth and enrichment culture, lyophilization.	***4***
	Microbial growth and death kinetics	Definition, growth curves (different phases), synchronous growth, doubling/generation time, intrinsic and extrinsic factors, relationship between number of generations and total number of microbes.	***8***
II	***Microbiology and microbial spoilage of Food Products***	Microbiology of raw milk and fermented milk products viz. yoghurt, cheese; cereals products, fruits and vegetable, meat and meat product, egg and fish.	***10***
	Food spoilage	Bacterial and fungal food spoilage, food poisoning, food borne infection, food borne intoxication. Toxins produced by *Staphylococcus, Clostridium, Aspergillus*; bacterial	***10***

		pathogens-*Salmonella, Bacillus, Listeria, E. coli, Shigella, Campylobacter.*	
	Microbial Control	Source of microorganisms, Physical and chemical agents used in microbial control, disinfected agents and its dynamics.	***4***

Books Recommended:

Author	**Title**
1. George J Benwart	General Microbiology
2. Frazier &Westhoff	Food Microbiology

Mapping of Course Outcome and Program Outcome:

COs	Programme Outcomes (POs)												PSO	
	PO2	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2	2	2	2	2	2	2	2	3	0
CO2	2	3	2	2	3	2	2	2	2	2	1	2	3	0
CO3	2	3	3	2	2	2	2	2	2	2	2	2	3	0
CO4	2	2	2	1	2	2	2	2	2	2	2	2	3	0
CO5	2	2	2	2	2	2	2	2	2	2	2	2	3	0
Average	**2.20**	**2.40**	**2.20**	**1.80**	**2.20**	**2.00**	**2.00**	**2.00**	**2.00**	**2.00**	**1.80**	**2.00**	**3.00**	**0.00**

Title of the course	:	**Food Microbiology Lab**	
Subject Code	:	**FTP-512**	
Weekly load(hours)	:	**2**	**LTP 0-0-2**
Credit	:	**1**	

Course Objectives:

1. To learn about food microbiology equipments
2. To learn microbiology techniques practical aspects and culturing
3. To study about different microorganisms and their growth characteristics
4. To detect the role of microorganisms in food spoilage and remedies for shelf life enhancement

Course Outcomes:

On successful completion of the subject, the students will be able to

1. It will provide knowledge of equipments related to food microbiology and their working
2. Students can learn the techniques of microbiology study and culturing
3. Student will be able to learn the culture techniques for microorganisms
4. The student will be able to check the microbial load of food samples, learn to access the quality standard of food samples
5. It helps to learn the students about the techniques used to prevent the microbial spoilage of food

List of Practicals:

1. To study the working of various equipments related to Microbiology.
2. To isolate pure culture using pour plate technique.
3. To isolate pure culture using spread plate technique.
4. To isolate pure culture using pour plate technique.
5. To measure the size of given microbial cell using micrometery.
6. To enumerate total viable count in a culture.
7. To perform Gram staining technique of bacteria.
8. To study the growth curve of microorganisms.
9. Quantitative analysis of food sample by standard plate count (SPC) method.
10. To study quality of milk by methylene blue reductase test.
11. Demonstration of microbial production of curd.
12. To perform presumptive test for coliforms in milk.
13. To study the bacterial survival against UV irradiations.
14. To study the bacterial spoilage of given food sample.

Mapping of Course Outcome and Program Outcome:

COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2	2	2	2	2	2	2	2	3	0
CO2	2	3	2	2	3	2	2	2	2	2	1	3	3	0
CO3	2	3	2	2	2	2	2	3	2	2	2	2	3	0
CO4	2	2	2	2	2	2	3	2	2	2	2	2	3	0
CO5	2	2	2	2	2	3	3	2	2	2	3	3	3	0
Average	**2.20**	**2.40**	**2.00**	**2.00**	**2.20**	**2.20**	**2.40**	**2.20**	**2.00**	**2.00**	**2.00**	**2.40**	**3.00**	**0.00**

Title of the course : **Heat and Mass Transfer**
Subject Code : **FTT-513**
Weekly load(hours) : **4** **LTP 3-1-0**
Credit : **3.5**

Course Objectives:

1. To develop basic understanding to the various modes of heat transfer, mechanisms of boiling and condensation which are fundamental to food processing operations.
2. To understand the concepts of unsteady heat transfer, a predominant phenomena of heat transfer in food processing.
3. To understand the concepts of design of heat exchangers for a given heat load to be used in food industry.
4. To understand the concepts of steady and unsteady mass transfer, a predominant phenomena in food processing operations.

Course Outcomes:

On successful completion of the subject, the students will be able to

1. Learn the basic principles of heat and mass transfer referred to food processing.
2. Calculate the process (heating/freezing) time by using the concept of unsteady-state heat transfer in food products.
3. Possess the ability to present clearly the procedure adopted in the design of heat transfer and mass transfer apparatuses.
4. Solve the problems related to heat transfer, mass transfer, design of heat exchanger, HTST pasteurizer etc.
5. Solve the numerical problems related to heat and mass transfer etc. used in the food processing.

UNIT	***MAIN TOPIC***	***DETAILED CONTENTS***	***LECTURES***
I	***Conduction heat transfer***	Modes of heat transfer, Steady state unidirectional heat transfer with and without internal heat generation through slab, cylinder, spheres and composite geometries; insulation and its purposes, critical thickness of insulation for cylinders and spheres, Unsteady state heat transfer in simple geometry; Use of Heisler charts, Gaussian error function to solve transient heat transfer problems.	***12***
	Convection Heat Transfer	Natural and forced convection, dimensional analysis for free and forced convection, dimensionless numbers used	***5***

		in convective heat transfer, important correlations for free and forced convection	
	Boiling and condensation	Boiling phenomenon, hysteresis in boiling curve, nucleate and forced convection boiling; condensation phenomenon, condensation on vertical surface, outside a tube and inside horizontal tube.	***5***
II	***Radiation heat transfer***	Characteristics of black, grey and real bodies in relation to thermal radiation, Stefan Boltzmann law; Kirchhoff's law; Wein displacement law, Emissive power for a black body and real body, intensity of radiation, radiation between two bodies.	***5***
	Heat Exchanger	Classification, overall heat transfer coefficient, fouling factors, log-mean temperature difference for parallel and counter flow heat exchangers, effectiveness of parallel and counter flow heat exchanger by NTU method, Design of shell and tube heat exchanger.	***5***
	Mass Transfer	Introduction to mass transfer, different modes of mass transfer, Mass flux and molar flux for a binary system, Fick's law of diffusion of mass transfer, Derivation of general diffusion mass transfer equation, Molecular diffusion in gases, liquids and solids having steady state equi-molar counter diffusion and through non diffusing body; Steady state equimolar counter diffusion, convective mass transfer coefficient, natural and forced convective mass transfer, dimensional analysis for free and forced convective mass transfer, important correlations of convective mass transfer; permeability of films and laminates. Unsteady state diffusion in slabs, cylinders and spheres, transient mass transfer in semi infinite medium.	***12***

Books Recommended:

Author	**Title**
1. Arora&D'kundwar	A course in Heat and Mass Transfer
2. R.C. Sachdeva	Fundamentals of Engineering Heat & Mass Transfer Transfer
3. D.S. Kumar	Heat and Mass Transfer
4. R K Rajput	Heat and Mass Transfer
5. K A Gavhane	Unit Operations-II

Mapping of Course Outcome and Program Outcome:

Cos	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	0	2	1	2	0	0	2	0	0	0	3	2
CO2	3	3	2	2	1	2	0	0	2	0	1	1	3	0
CO3	3	3	2	2	0	2	1	1	2	0	0	2	3	1
CO4	3	3	1	2	0	2	1	1	2	0	0	2	3	2
CO5	3	3	0	0	0	2	0	0	0	0	0	0	3	2
Average	**3.00**	**3.00**	**1.67**	**2.00**	**1.00**	**2.00**	**1.00**	**1.00**	**2.00**	**0.00**	**1.00**	**1.67**	**3.00**	**1.75**

Title of the course	:	**Heat and Mass Transfer Lab**	
Subject Code	:	**FTP- 513**	
Weekly load(hours)	:	**2**	**LTP 0-0-2**
Credit	:	**1**	

Course Objectives:

1. To apply the theory of heat transfer mechanisms during the heating/cooling of bio-materials.
2. To apply the concepts of unsteady heat transfer for determination of process time and temperature profiles in various geometries of the biomaterials.
3. Design calculations for various types of heat exchangers and their comparison in terms of effectiveness.
4. To apply the concepts of steady and unsteady mass transfer operations in practical form.

Course Outcomes:

On successful completion of the subject, the students will be able to

1. Familiarize with the application of various modes of heat transfer in various processing operations.
2. Calculate the process (heating/freezing) time by using the concept of unsteady-state heat transfer in food products having various geometries.
3. Present clearly the procedure adopted in the design of heat and mass transfer apparatuses.
4. Find out the rate of heat transfer and effectiveness for the various heat transferring equipments like heat exchangers, HTST pasteurizer etc.
5. Familiarize with the application of mass transfer in various processing operations.

List of Practicals:

1. To find the thermal diffusivity of a food material during heat/cooling.
2. To find out the Overall heat transfer co-efficient for a viscous food material assuming negligible internal thermal resistance (lumped heat capacity system).
3. To find out the temperature profile and rate of heat transfer from a rectangular/cylindrical/ spherical body losing heat to the surrounding by use of Heisler and correction factor chart.
4. To calculate the surface and centre temperature of a rectangular/cylindrical/spherical body loosing heat to the surrounding by use of Heisler and correction factor chart.
5. To determine surface heat transfer coefficient for a vertical tube losing heat by free convection.
6. To determine surface heat transfer coefficient for pipe losing heat by forced convection.
7. Determination of overall heat transfer coefficients for unsteady state heating process
8. To determine LMTD, rate of heat transfer and effectiveness by NTU method for parallel flow double pipe heat exchanger.
9. To determine LMTD, rate of heat transfer and effectiveness by NTU method for counter current flow double pipe heat exchanger.
10. To determine the moisture diffusivity and activation energy for different geometries of food materials having rectangular/cubical/ cylindrical/spherical geometry.

11. To study the behavior of boiling curve
12. To study the mechanism of mass flux during the film-wise and drop-wise condensation.

Mapping of Course Outcome and Program Outcome:

COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	1	0	0	2	0	1	0	0	2	3	0
CO2	3	3	3	0	2	2	0	3	1	0	0	2	3	0
CO3	3	3	3	2	2	2	2	2	1	0	2	3	3	0
CO4	3	3	3	2	0	1	2	3	1	0	3	2	3	0
CO5	3	3	3	1	0	0	2	0	1	0	0	2	3	0
Average	**3.00**	**3.00**	**3.00**	**1.50**	**2.00**	**1.67**	**2.00**	**2.67**	**1.00**	**0.00**	**2.50**	**2.20**	**3.00**	**0.00**

Title of the course	:	**Unit Operations**	
Subject Code	:	**FTT-514**	
Weekly load(hours)	:	**3**	**LTP 3-0-0**
Credit	:	**3**	

Course Objectives:

1. To familiarize the students to the theory and application of basic unit operations performed in various food processing industries.
2. To familiarize the students with the size reduction, and mixing operations of different types of foods necessary in the processing of foods.
3. Apply the engineering principles to analyze and design the various unit operations and equipments.
4. To familiarize the students with the separation of valuable components from the liquid, solid streams by physical, contact equilibrium processes as well as distillation process

Course Outcomes:

On successful completion of the subject, the students will be able to:

1. describe and discuss the processing of foods in terms of commonunit operations like size reduction, mixing, and separation.
2. apply his computational skills in calculating the energy required in size reduction, mixing operations.
3. understand the construction, working and applicability of various size reduction, mixing and separation equipments.
4. analyse the optimum value of reflux ratio to achieve best quality product at minimum total cost in case of the continuous distillation system.
5. able to understand the principle and application of leaching and extraction process.

UNIT	*MAIN TOPIC*	*DETAILED CONTENTS*	*LECTURES*
1	***Introduction***	Definition and application in food processing.	***2***
	Size reduction	Theory of commination, Ritinger's law, Kick's law, Bond's law and their applications in calculation of energy required in grinding, Crushing efficiency, Size reduction equipment used in food industry.	***6***
	Mixing	Theoretical aspects of solid mixing. Mixing index, rate of mixing, Theory of liquid mixing, Equipment for liquid and solid mixing.	***6***
	Sieving	Separation based on size, Effectiveness of screens, Types of screens, Factors affecting the sieving	***6***

		process, Fineness modules and particle size distribution	
	Sedimentation	Theory, Gravitational sedimentation of particles in liquids and gases, Sedimentation equipment.	***4***
II	***Centrifugal separation***	Basic equation, centrifugal clarification, Equipments.	***4***
	Filtration	Theoretical aspects, Fundamental equation for filtration, Filtration equipment.	***5***
	Crystallization	Rate of crystallization, crystallization equilibrium.	***4***
	Distillation	Liquid vapor equilibrium, distillation of binary mixtures, simple distillation, continuous distillation, flash distillation, steam distillation.	***6***
	Leaching and extraction	Gas – Liquid equilibria, Solid – Liquid equilibria, Extraction-Solid Liquid extraction, Liquid-Liquid extraction, stage equilibrium extraction.	***6***

Total=48

Recommended Books:

Author	**Title**
1. P. Fellows	Food Processing Technology
2. R. L. Earle	Unit Operations in Food Processing

Mapping of Course Outcome and Program Outcome:

Cos	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	0	0	0	0	0	0	0	0	0	1	0	3	0
CO2	3	2	0	0	2	0	0	0	0	0	2	0	3	0
CO3	2	2	2	0	0	0	1	0	0	0	1	0	3	0
CO4	3	2	0	0	0	0	0	0	0	0	1	0	3	0
CO5	2	1	1	0	0	0	1	0	0	0	1	0	3	0
Average	**2.40**	**1.75**	**1.50**	**0.00**	**2.00**	**0.00**	**1.00**	**0.00**	**0.00**	**0.00**	**1.20**	**0.00**	**3.00**	**0.00**

Title of the course	:	**Unit Operations Lab**	
Subject Code	:	**FTP- 514**	
Weekly load(hours)	:	**2**	**LTP 0-0-2**
Credit	:	**1**	

Course Objectives:

1. Identification of various unit operations in food processing.
2. To familiarize the students with the construction and working of equipments used for various unit operations
3. Apply the engineering principles to analyze and design the various unit operation equipments.
4. To familiarize the students with the separation of valuable components from the liquid, solid streams.

Course Outcomes:

On successful completion of the subject, the students will be able to:

1. understand the theory and application of common unit-operation used in the food industry like size reduction, mixing, and separation.
2. operate various size reduction, mixing and separation equipments.
3. calculate the energy required in size reduction and mixing operations.
4. understand the basis of various separation techniques.
5. analyse the effect of process parmeters on the performance of unit operation equipments.

List of Practicals:

1. Study of various equipments in Unit Operation Lab
2. Determination of critical speed of ball mill
3. Determination of power requirement of a given grinding equipment
4. Determination of the effect of hammer mill speed and screen size on particle size of the ground material
5. Determination of effectiveness of screen
6. Determination of fineness modulus of a ground sample
7. Effect of mixing time on the mixing index of solid mixing
8. Calculation of power requirement of a mixer.
9. Dismantling and Assembly of horizontal filter press.
10. Constructional features of rotary drum vacuum filter.
11. Determination of factitious thickness of filter medium.
12. Dismantling and assembly of disc bowl centrifuge.
13. Effect of speed of centrifuge on the composition and yield of cream.
14. Determination of sedimentation rate of slurry.

Mapping of Course Outcome and Program Outcome:

COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	0	0	0	0	0	0	0	1	1	0	0	3	0
CO2	0	0	0	0	0	0	0	0	1	1	1	0	3	0
CO3	2	2	0	0	0	0	0	0	1	1	0	0	3	0
CO4	3	0	0	0	0	0	0	0	1	1	0	0	3	0
CO5	2	2	1	0	0	0	0	0	1	1	0	0	3	0
Average	**2.50**	**2.00**	**1.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.00**	**1.00**	**1.00**	**0.00**	**3.00**	**0.00**

Title of the course : **Food Biochemistry and Nutrition**
Subject Code : **FTT- 521**
Weekly load(hours) : **3** **LTP 3-0-0**
Credit : **3**

Course Objectives:

1. To understand concept of human food requirements and digestion.
2. To make best use of available nutrients in order to full fill the requirements of balanced diet for the consumers.
3. To understand the role of safe food in health promotion and disease prevention.
4. To familiarize the students about the nutritional daily requirements of various age groups as per ICMR, FA.

Course Outcomes:

On successful completion of the subject, the students will be able to

1. It will help to understand about the concept of food digestion and absorption
2. Students can learn the techniques of food and its health benefits, Make learn the role of enzymes and their importance in food digestion
3. Familiarize various aspects of food nutritional requirements and concept of balance diet
4. It helps to learn the students about the techniques used to calculate protein quality, Preparation of diets as per requirements of different people
5. Helps the students and indirectly the society to develop preventive measures for eradication of malnutrition

UNIT	*MAIN TOPIC*	*DETAILED CONTENTS*	*LECTURES*
I	***Enzymes***	Enzymes classification, specificity of enzymes, co-enzymes, co-factors, enzyme inhibitors and activators, Factors effecting enzyme activity, Enzyme kinetics, Line weaver Burk plot, Allosteric enzymes.	***10***
	Metabolism of carbohydrates and biological oxidation	Digestion and absorption, glycolysis, gluconeogenesis, Feeder pathway of glycolysis, disorders of carbohydrate metabolism Kreb's cycle, electron transport chain and oxidative phosphorylation.	***11***
II	***Metabolism of lipids***	Digestion, absorption and function of lipid, β-oxidation of fatty acids, Pathway of synthesis of fatty acids, Biosynthesis of triacylglycerol.	***7***
	Metabolism of Proteins	Importance of protein, digestion and absorption of proteins, nitrogen balance, Biosynthesis of protein, general catabolism of amino acids, deamination,	***7***

		transamination, urea cycle, disorders of amino acid metabolism.	
	Food Nutrition	Functions and energy values of foods, basal energy metabolism: BV, NPU, BMR, PER calculations, dietary allowances and standards for different age groups, nutritive value of Indian food, techniques for assessment of human nutritional status. Causes and preventions of malnutrition.	***9***

Books Recommended:

Author	**Title**
1. A.V.V.S Ramarao	Biochemistry
2. Lahninger	Principles of Bio-Chemistry
3. Mohinder Singh	Biochemistry
4. M.S.Swaminathan	Food and Nutrition Vol. I&II

Mapping of Course Outcome and Program Outcome:

COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	0	3	1	0	1	0	0	1	3	2	2	0
CO2	1	2	1	2	2	2	0	0	0	1	2	1	2	0
CO3	3	0	0	2	3	3	1	3	1	0	1	3	3	0
CO4	2	2	1	1	2	1	0	3	1	0	2	3	3	0
CO5	1	0	1	1	0	3	0	1	0	1	0	2	3	0
Average	**1.6**	**2**	**1**	**1.8**	**2**	**2.25**	**1**	**2.33**	**1**	**1**	**2**	**2.2**	**2.6**	**0**

Title of the course	:	**Food Biochemistry and Nutrition Lab**	
Subject Code	:	**FTP-521**	
Weekly load(hours)	:	**2**	**LTP 0-0-2**
Credit	:	**1**	

Course Objectives:

1. To strengthen the practical aspects
2. To determine the nutritional quality of food
3. To handle the equipments and analytical techniques learning
4. To determine the nutritional status of the marketed product

Course Outcomes:

On successful completion of the subject, the students will be able to

1. It will help to know about the practical aspects of food quality control, Students can learn the techniques of food quality measurements
2. Learn application of enzymes in product development, Student can learn techniques of preparation of balanced diets and formulations
3. It helps to learn the students about the techniques used to determined nutritional food quality
4. Student can learn to handle determination of anti-nutritional factors in food
5. Practical aspects of measuring the overall food quality

List of Practicals:

1. Estimation of total sugars by Dubois method in a given food sample
2. Estimation of glucose
3. Estimation of fructose
4. Estimation of enzymatic activity in a given food sample
5. Estimation of ascorbic acid in a given food sample
6. Estimation of cholesterol content
7. Estimation of protein by Lowry method
8. Estimation of phytic acid
9. Estimation of phosphatase activity in a milk sample
10. Estimation of products of anaerobic fermentation
11. Estimation of nutritive value of given food sample
12. Estimation of calorific value by Bomb calorimeter

Mapping of Course Outcome and Program Outcome:

COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	0	2	0	0	0	1	1	0	0	0	2	3	2	0
CO2	1	3	1	2	3	2	0	1	0	0	2	1	2	0
CO3	0	0	1	2	2	1	0	1	1	0	1	1	3	0
CO4	2	2	1	1	1	0	1	2	1	1	2	3	3	0
CO5	0	0	1	3	2	2	1	3	1	1	3	2	3	0
Average	**1.5**	**2.33**	**1**	**2**	**2**	**1.5**	**1**	**1.75**	**1**	**1**	**2**	**2**	**2.6**	**0**

Title of the course	:	**Food Engineering**	
Subject Code	:	**FTT-522**	
Weekly load(hours)	:	**4**	**LTP 3-1-0**
Credit	:	**4**	

Course Objectives:

1. To familiar the students to the concept of SI system and the conversion from one system to another.
2. Apply the fluid flow, heat and mass transfer principles to analyze and design food processes
3. To familiar the students to the theory and application of basic engineering operations.
4. To understand engineering principles and practical applications of food processing techniques useful for increase shelf life of foodproducts

Course Outcomes:

On successful completion of the subject, the students will be able to

1. Apply the principles of mass and energy balance to food processing systems.
2. Determine heat loads and heat losses in heating and cooling food process systems.
3. Use psychometric charts to analyze the thermodynamic properties of the atmospheric air and its applications in drying, humidification etc
4. Describe the construction , operation and design principles of evaporators, dryers, freezers, sterilizers using engineering terminology
5. Solve the numerical problems related to material and energy balances, thermal processing, freezing, evaporation, drying etc. used in the food processing.

UNIT	*MAIN TOPIC*	*DETAILED CONTENTS*	*LECTURES*
I	***Units and conversions***	Fundamental and derived units; Systems of units, Conversions from other systems to SI system. Numerical problem	***3***
	Material balance	Introduction to material balance, Numerical problems on material balance related to food processing	***5***
	Energy balance	Introduction to energy balance, Steam properties, Use of Steam tables, Numerical problems on material and energy balance related to food processing	***5***
	Thermal Processing	Target microorganism for thermal processing, Concept of D, F and Z value,Microbial inactivation; Derivation and application of equation for determination of thermal process time for cans, evaluation of thermal process time for batch sterilization by graphical method; calculation of process time for continuous sterilization of liquid foods;	***7***

		factors affecting rate of heat penetration; effect of can size on sterility requirement; related numerical problems, concept of activation energy, concept of Q value, Application of Q rule for Estimation of shelf life, amount of change and Accelerated Storage Study.	
II	***Psychrometry***	Properties of air- water vapour mixture, psychometric chart, Humidification and dehumidification operations, Application of psychrometry to drying; related numerical problems.	***4***
	Drying	Principles of drying and dehydration, water activity, sorption and desorption isotherms, rates of drying: constant and falling rate periods during convective drying, drying rate constant; capillary flow and diffusion in falling rate period; determination of moisture diffusivity for various geometries of food materials; freeze drying and spray drying; calculations of freeze drying and spray drying times; related numerical problems	***5***
	Evaporation	Boiling point elevation, Duhring rule, basic principles of evaporators; capacity and economy of evaporator; multiple effect evaporator: operation and various feeding systems, calculation of heat transfer area in single and multiple effect evaporators; Thermal vapour recompression and Mechanical vapour recompression system to improve evaporator economy; related numerical problems	***5***
	Food Freezing	Basic concepts, theories of crystallization; Depression in freezing point, Planks equation and other modified equations for prediction of freezing time, freezing time calculations for a product having uniform temperature (negligible internal resistance), different types of freezers.	***5***

Recommended Books:

Author	**Title**
1. R.T. Toledo	Fundamentals of food process Engg
2. Brennan and Cowell	Food Engineering Operations
3. Heldman and Singh	Food Process Engineering
4. Smith P.G. .	Intro to Food Process Engg
5. Geankoplis	Transport Process & Unit operations

Mapping of Course Outcome and Program Outcome:

COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	1	1	3	2	3	2	0	0	3	2
CO2	3	3	2	3	3	2	2	3	1	0	3	2	3	0
CO3	2	2	3	2	1	1	2	3	1	3	0	0	3	1
CO4	3	3	3	3	2	1	1	2	1	0	1	1	3	0
CO5	3	3	3	3	1	1	3	3	2	0	0	0	3	3
Average	**2.80**	**2.80**	**2.60**	**2.60**	**1.60**	**1.20**	**2.20**	**2.60**	**1.60**	**2.50**	**2.00**	**1.50**	**3.00**	**2.00**

Title of the course	:	**Food Engineering Lab**	
Subject Code	:	**FTP-522**	
Weekly load(hours)	:	**2**	**LTP 0-0-2**
Credit	:	**1**	

Course Objectives:

1. To familiar the students to applications of fundamentals of food engineering operations
2. To familiarize the students with the practical application of processes involving simultaneous heat and mass transfer operations.
3. To understand the concepts involved in the preservation of food materials by the application of heat, cooling, freezing operations.
4. To understand the concepts involved in the design of apparatus meant for preservation of food by concentration like evaporators, multiple effect evaporators, spray dryer, drum dryer etc.

Course Outcomes:

On successful completion of the subject, the students will be able to

1. Apply the principles of mass and energy balance to food processing systems.
2. Find out the thermal process time and freezing time for a given food material.
3. Find out the thermo-physical properties of the air for drying, humidification, dehumidification and air conditioning etc.
4. To observe the mechanism of dehydration of different bio-materials having different geometries.
5. Describe the construction and operating principles of multiple effect evaporators and heat exchangers using engineering terminology

List of Practicals:

1. To find out the D.F.Z value for a heating process meant for inactivation of microorganisms.
2. Calculation of thermal process time by formula method
3. Calculation of thermal process time by graphical method
4. Determination of steam properties using Mollier diagram
5. Determination of steam properties using steam tables
6. Determination of Boiling point elevation
7. Design of multiple effect evaporator
8. Determination of relative humidity and other thermodynamic properties of air using psychrometric chart
9. Study the drying characteristics of a food material during convective dehydration
10. Determination of moisture diffusivity of a food material during dehydration.
11. Determination of activation energy for dehydration of a food sample.
12. Comparison of freeze drying time determined by experiment and from modified Plank's equation

13. Determination of freezing point depression of a food material.
14. Study of freezing curve for pure water and a food material.
15. Determination of the freezing time for a given food sample using Heislier charts or unsteady state heat transfer solutions

Mapping of course outcome and Program outcomes:

COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	3	3	2	2	3	3	0	0	3	2
CO2	3	3	2	2	2	2	3	3	3	0	2	0	3	2
CO3	2	2	2	3	3	3	2	2	1	0	0	1	3	0
CO4	3	3	2	2	3	2	2	2	3	0	0	0	3	0
CO5	3	3	3	3	3	1	1	3	1	0	1	0	3	0
Average	**2.80**	**2.80**	**2.20**	**2.40**	**2.80**	**2.20**	**2.00**	**2.40**	**2.20**	**3.00**	**1.50**	**1.00**	**3.00**	**2.00**

Title of the course	:	**Dairy Engineering**	
Subject Code	:	**FTT-523**	
Weekly load(hours)	:	**4**	**LTP 3-1-0**
Credit	:	**4**	

Course Objectives:

1. To provide basic knowledge on milk composition and its various properties.
2. To know about various unit operations involved in the processing of milk and its products
3. To provide knowledge about different equipments and technologies applied in a dairy plant from the point of reception of milk till it is packed and stored.
4. To know about cleaning and sanitation of dairy industry.

Course Outcomes:

Students will attain/acquire knowledge about

1. engineering properties and composition of milk
2. various equipments involved in thermal processing and drying of milk
3. use of membrane processing and drying theories in milk and milk products
4. formulation of ice-cream and different process in its manufacturing
5. importance of cleaning, sanitation and CIP in dairy industry

UNIT	*MAIN TOPIC*	*DETAILED CONTENTS*	*LECTURES*
I	***Introduction***	Status of dairy industries in India, Engineering properties of milk and milk products and their significance in equipment design.	***2***
	Composition of milk	Composition, factors affecting composition of milk, Effect of milk on metals. Reception and storage testing, milk grading and defects	***4***
	Homogenization of milk	Principle of homogenization, Classification, single stage and two stage homogenizers, power requirement, care and maintenance of homogenizers, application of homogenization in dairy industry.	***6***
	Thermal processing of milk	Pasteurization: Batch, flash and continuous (HTST) pasteurizers, Flow diversion valve, Care and maintenance of pasteurizers. UHT method: Direct and indirect heating system. Equipments for sterilization in the package (Batch and continuous sterilizers).	***6***
II	***Concentration of milk***	Concentration of milk and machineries, heat and mass balance in single and multiple effect evaporator, types of evaporators and their performances characteristics and selection criteria, Membrane processing-principles of -	***6***

		Reverse osmosis – Ultra filtration and Electro dialysis. Bactofugation treatment- Factors affecting bactofugation-Application	
	Drying and dehydration of milk	Drying theories, estimation of drying rates and drying time, drying equipment (spray drier, drum drier).	***6***
	Freezing	Types of ice-cream and ingredients, Technology of ice-cream preparation: Preparation of ice-cream mix, partial freezing, final freezing and hardening, freezing methods and equipment, freezing time calculations.	***8***
	Cleaning and sanitation	Importance, Selection and use of dairy cleaners and sanitizers, washing equipment, working and maintenance of can washers, steam sterilization of cans, clean in place system, factors affecting, and washing operation.	***7***

Books Recommended:

Author **Title**

1. Su Kumar De Outlines of dairy technology
2. WalstraDairy Technology
3. SpreerMilk and Dairy Product Technology
4. Eckles, Comb and Macy Milk and Milk Products
5. Kessler Food Engineering and Dairy technology
6. FarralEngineering of Food and Dairy products

Mapping of Course Outcome and Program Outcome:

COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	0	0	0	0	2	0	2	0	0	2	2	0
CO2	2	3	3	2	0	0	2	0	1	1	2	2	2	0
CO3	2	2	0	0	0	0	2	3	2	3	1	1	3	0
CO4	0	2	3	0	3	0	0	3	3	0	2	0	3	0
CO5	0	0	0	2	0	3	0	2	3	3	0	2	3	0
Average	**2.33**	**2.25**	**3.00**	**2.00**	**3.00**	**3.00**	**2.00**	**2.67**	**2.20**	**2.33**	**1.67**	**1.75**	**2.60**	**0.00**

Title of the course	:	**Dairy Engineering Lab**	
Subject Code	:	**FTP-523**	
Weekly load(hours)	:	**2**	**LTP 0-0-2**
Credit	:	**1**	

Course Objectives:

1. To enable the students to estimate different physic-chemical and platform test of milk.
2. To facilitate the students to know various unit operation / working of different milk processing equipments.
3. To enable the students to analyze the milk and milk products for their quality.
4. To help the students to prepare various milk products.

Course Outcomes:

It will enable the students to

1. Estimate various physico-chemical properties of milk
2. Estimate the platform test of milk to judge the milk quality at reception
3. Learn working of various equipments involved in milk processing
4. Know effect of processing on quality of milk and milk product
5. Develop various milk products

List of Practicals:

1. To analyze milk sample for following parameters.

i) % Acidity & pH ii) Specific gravity iii) Total solids & SNF iv) Fat
v) COB and Alcohol test.

2. Lactose determination in milk
3. To study cream separation and maintenance of cream separator and functions of various parts
4. To study the various types of pumps and their performance.
5. To study the effect of homogenization on fat and different parts of a homogenizer.
6. To study the effect of temperature and pressure on homogenization.
7. To observe the effect of pasteurization on milk quality
8. To analyze milk powder sample for various parameters.
9. To analyze condensed milk for various parameter.
10. To prepare paneer and to examine their quality parameters
11. Development of heat and acid coagulated Product
12. Preparation of ice-cream.
13. To analyze the butter for its quality
14. Preparation of softy (soft-service-ice-cream) and evaluate quality attributes of softy.
15. Experiment on spray dying

Mapping of Course Outcome and Program Outcome:

COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	0	0	1	1	0	1	2	2	3	2	0
CO2	1	3	3	2	3	2	3	3	0	3	0	3	2	0
CO3	3	0	0	2	2	1	0	1	0	1	1	1	3	0
CO4	2	2	3	1	1	0	0	3	3	0	2	3	3	0
CO5	0	0	3	3	2	2	1	3	2	2	3	2	3	0
Average	**2.25**	**2.33**	**3.00**	**2.00**	**2.00**	**1.50**	**1.67**	**2.50**	**2.00**	**2.00**	**2.00**	**2.40**	**2.60**	**0.00**

Title of the course	:	**Fluid Flow Operations and Rheology**	
Subject Code	:	**FTT-524**	
Weekly load(hours)	:	**3**	**LTP3-0-0**
Credit	:	**3**	

Course Objectives:

1. To familiarize the students to the theoretical concepts and application related to behavior of fluids and rheology with respect to foods.
2. To familiarize the students with various pressure, flow and viscosity measuring devices.
3. Students will be able to apply the engineering principles to understand the rheology of viscoelastic fluids
4. To familiarize the students with fluidization process and its application in conveyors and driers.

Course Outcomes:

On successful completion of the subject, the students will be able to:

1. understand and apply the basic concepts of fluid-flow phenomena.
2. differentiate the fluid food based on rheological parameters.
3. understand the construction and working of various pressure, flow and viscosity measuring devices and pumps.
4. understand the viscoelastic behaviour of foods particularly by mathematical models.
5. understand the basics of fluidization and its applications in food processing and solve simple practical problems.

UNIT	*MAIN TOPIC*	*DETAILED CONTENTS*	*LECTURES*
I	***Introduction to fluid flow***	Physical properties of fluids like mass density, specific gravity, viscosity, pressure, factors affecting the rheological parameters; fluid pressure and its measurement; manometers, simple manometers, differential manometers; concept of Reynolds's number.	***6***
	Fluid flow measurement	Derivation of continuity equation; different types of energies of a liquid in motion; derivation of Bernoulli's equation; practical applications of Bernoulli's equation like venturimeter, orifice meter, pitot tube, rotameter. Numerical problems.	***6***
	Types of fluids	Newtonian and non-Newtonian fluids, Concept of apparent viscosity. Thixotropic and antithixotropic fluids; Viscous (Power law fluids); Plastic fluids, Viscoelastic fluids. Important models describing the	***4***

		time dependent and time independent behavior of fluids.	
	Laminar viscous fluid flow	Flow of viscous fluid through circular pipe, Coefficient of friction; head loss due to Friction in pipes; head loss due to sudden enlargement, contraction, vena contracta, entrance and exit losses; Stokes law (laminar flow around a sphere); laminar flow through porous media; pressure drop in flow through porous media.	***6***
II	***Pumps***	Types of pumps and classification criteria, Theory and working of centrifugal pump, reciprocating pumps, external gear pump (rotary pump), Lobe pump, Vane pump etc.	***3***
	Viscometery	Theory and working of capillary tube viscometer for Newtonian and non-Newtonian fluids; Falling sphere resistance method; Rotational viscometer; Cone and plate type viscometer; Circular disc viscometer.	***5***
	Rheology of Viscoelastic Fluids	Introduction to viscoelastic materials, stress relaxation; creep (retarded deformation); static or quasi-static or transient methods for viscoelastic material; Maxwell model, Kelvin- voigt model and Burger model; dynamic (varying stress or strain) or oscillatory measurements methods; Textural Profile Analysis.	***7***
	Fluidization	Physical properties of particles like size, shape, sphericity, porosity, superficial and interstitial velocity, hydraulic radius,equivalent diameter etc. Mechanism of fluidization, characteristics of gas – solid fluidized systems, Fanning friction factor for porous media; ; minimum porosity, bed weight, pressure drop in fluidized bed, theory and analysis of fluidization process; particulate fluidization; aggregative (or bubbling) fluidization; principle of fluidized bed drying equipment; pneumatic conveyers. Numerical problems.	***7***

Recommended Books:

Author	Title
1. McCabe & Smith	Unit Operations in Chemical Engineering,
2. V. Gupta & S.K. Gupta	Fluid Mechanics & Application,
3. G. S. Sawhney	Fundamentals of Fluid Mechanics
4. R K Bansal	A Text book of Fluid Mechanics and Hydraulic machines.
5. Arora K. R	Fluid Mechanics Hydraulic and Hydraulic machines
6. Ghosal, S K, Sanyal S K and Datta S	Introduction to Chemical Engineering,
7. Ibraz Albert and Barbosa-Canovas G V	Unit Operations in Food engineering
8. S C Rao& C Guha	Transport Phenomena

Mapping of Course Outcome and Program Outcome:

COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	0	0	0	0	0	0	0	0	0	0	0	3	0
CO2	2	2	0	0	0	0	0	0	0	0	2	0	3	1
CO3	3	1	0	0	0	0	0	0	0	0	2	1	3	2
CO4	2	2	0	1	0	0	0	0	0	0	2	0	3	0
CO5	2	2	1	0	0	0	0	0	0	0	2	1	3	2
Average	**2.40**	**1.75**	**1.00**	**1.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**2.00**	**1.00**	**3.00**	**1.67**

Title of the course	:	**Fluid Flow Operations and Rheology Lab**	
Subject Code	:	**FTP- 524**	
Weekly load(hours)	:	**2**	**LTP 0-0-2**
Credit	:	**1**	

Course Objectives:

1. To familiarize the students with various pressure, flow and viscosity measuring devices.
2. To familiarize the students to the applications related to behavior of fluids and rheology with respect to foods.
3. Students will be able to understand the textural characteristics of food materials
4. To familiarize the students with fluidization process and its application in drying and pneumatic conveying.

Course Outcomes:

On successful completion of the subject, the students will be able to:

1. measure the pressure using U- tube manometer and the flow rate using the orifice meter, venturimeter and rotameter.
2. understand the construction and working of various pumps.
3. handle various viscometers and measure the viscosity of unknown fluids.
4. classify the foods on the basis of viscoelastic behaviour.
5. apply the fluidization process for drying and conveying of particulate food materials.

List of Practicals:

1. To calculate the average flow velocity at different sections of a tube having variable area.
2. Estimation of pressure by use of manometer.
3. Determination of fluid flow behavior by Reynolds number apparatus
4. Determination of fluid flow velocity by venturimeter
5. Determination of fluid flow velocity by orifice meter
6. Verification of Bernoulli equation
7. Effect of temperature on the viscosity of a fluid food.
8. Determination of terminal/fluidization velocity for fluidization of particles
9. Study of various types of pumps.
10. To calculate the terminal velocity for fluidization.
11. Determination of viscosity by capillary viscometer.
12. Determination of viscosity by Ostwald viscometer
13. Determination of viscosity by rotational viscometer
14. TPA study of a biomaterial.

Mapping of Course Outcome and Program Outcome:

COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	0	0	0	0	0	0	1	1	0	0	3	1
CO2	2	0	0	0	0	0	0	0	1	1	0	0	3	2
CO3	2	1	0	0	0	0	0	0	1	1	0	0	3	2
CO4	2	2	2	0	0	0	0	0	1	1	0	0	3	2
CO5	2	2	0	0	0	0	0	0	1	1	0	0	3	1
Average	**2.20**	**1.75**	**2.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.00**	**1.00**	**0.00**	**0.00**	**3.00**	**1.60**

Title of the course	:	**Technology of Cereal Processing**	
Subject Code	:	**FTT-525**	
Weekly load(hours)	:	**3**	**LTP 3-0-0**
Credit	:	**3**	

Course Objectives:

1. To provide basic understanding of cereals, pulses and oilseeds after harvesting.
2. To make student aware on various types of processing methods of cereals, pulses and oilseeds
3. To make student aware on various products and by-products of cereals, pulses and oilseeds
4. To make students able to implement their knowledge about detailed manufacturing technologies of cereals, pulses and oilseeds consumed in daily life in food industries.

Course Outcomes:

On successful completion of the subject, the students will be able to

1. Know about structure and composition of cereals, pulses and oilseeds.
2. Get exposure to the preparation of products from cereals, pulses and oilseeds
3. Identify suitable equipments for cereals, pulses and oilseeds processing
4. Apply the knowledge of primary, secondary and tertiary processing methods of cereals, pulses and oilseeds in food industries.
5. Know the techniques for the safe storage of cereals, pulses and oilseeds.

UNIT	*MAIN TOPICS*	*DETAILED CONTENTS*	*Hours*
I	***Introduction***	General introduction to cereals, pulses and oilseeds; Production and utilization trends of various cereals, pulses and oilseeds; Grain classification, structure and composition;	***6***
	Pulses	Anti-nutritional factors and methods of inactivation; pre-treatments; Traditional and modern milling methods and equipment involved; Byproducts of pulse milling and their utilization	***8***
	Wheat	Milling of wheat; Factors affecting yield and quality of flour; Flour treatments; Air-classification; Quality assessment of grain and flour; Technology of Pasta products.	***8***
II	***Rice***	Rice milling; milling machines; effect of different factors on milling yield and rice quality; Parboiling of paddy- different methods of parboiling; Curing and aging of rice; Milled rice products and by-products	***8***
	Corn	Wet and dry milling of corn; Comparison of conventional and modern process for wet milling processes; Milling machines; Corn flakes, syrups	***6***

	Oil extraction and Refining of oils	Oil extraction methods: mechanical Pressing. Solvent extraction process: principle, pretreatment-breaking, cracking, flaking, extraction principle and Desolventization. Factors affecting the extraction process, Refining of oils	***8***

Books Recommended:

Author	**Title**
1. Mathews, R.H. Ed.	Legumes: Chemistry, Technology and Human Nutrition
2. Hoseney RS.	Principles of Cereal Science and Technology
3. Kent NL.	Technology of Cereals
4. A. Chakraverty et. al	Handbook of Post-Harvest Technology
5. B.D. Shukla	Oil Seed Processing Technology

Mapping of Course Outcome and Program Outcome:

Cos	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	0	0	2	0	1	1	0	2	0	2	3	1
CO2	2	3	1	0	2	3	3	2	1	0	0	3	3	2
CO3	2	3	1	2	3	0	0	1	0	0	2	3	3	2
CO4	3	3	0	2	3	1	2	2	3	1	3	3	3	1
CO5	0	1	3	2	3	3	3	2	3	3	3	2	3	3
Average	**2.50**	**2.60**	**1.67**	**2.00**	**2.60**	**2.33**	**2.25**	**1.60**	**2.33**	**2.00**	**2.67**	**2.60**	**3.00**	**1.80**

Title of the course	:	**Technology of Cereal, Pulses and Oilseeds Processing Lab**	
Subject Code	:	**FTP-525**	
Weekly load(hours)	:	**2**	**LTP 0-0-2**
Credit	:	**1**	

Course Objectives:

1. To provide basic understanding of cereals, pulses and oilseeds
2. To make student aware on various analysis of cereals, pulses and oilseeds
3. To make student aware on various products and by-products of cereals, pulses and oilseeds
4. To make students able to learn manufacturing technologies of cereals, pulses and oilseeds consumed in daily life.

Course Outcomes:

On successful completion of the subject, the students will be able to

1. Learn to analyze data.
2. Develop skills to control the quality of food
3. Develop skills to monitor various food processing operations in food industries.
4. Generate familiarity with process equipment via hands-on learning.
5. Learn to develop procedures and carry them out.

List of Practicals:

1. Physical properties of pulses and oil seeds
2. Determination of acid insoluble ash of different cereal flours.
3. Determination of dry and wet gluten of a given flour sample.
4. Determination of sedimentation value.
5. Particle size index determination by sieve analysis.
6. Determination of Hagberg'sFalling number.
7. Determination of alcoholic acidity of flour.
8. Determination of hectolitre weight and 1000 Kernel weight.
9. Determination of dehusking efficiency and breakage in dehusking of rice
10. Determination of dehusking efficiency and breakage in dehusking of pulse.
11. Determination of percentage impurities in grain by aspirator and seed blower.
12. Pretreatments for milling of pulses
    a) Application of water
    b) Application of oil
    c) Application red earth slurry.
    d) Application of steam
13. Milling of pulses and determination of dehusking efficiency
14. Preparation of noodles and its quality evaluation.
15. Solvent extraction of selected oilseeds.

16. Visit to rice, pulses, oils and flour mills.

Mapping of Course Outcome and Program Outcomes:

COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	0	0	2	0	1	1	0	2	0	2	3	1
CO2	2	3	1	0	2	3	3	2	1	0	0	3	3	2
CO3	2	3	1	2	3	0	0	1	0	0	0	3	3	2
CO4	3	3	0	2	3	1	2	2	3	1	2	3	3	1
CO5	0	1	3	2	3	3	3	2	3	3	3	2	3	3
Average	**2.50**	**2.60**	**1.67**	**2.00**	**2.60**	**2.33**	**2.25**	**1.60**	**2.33**	**2.00**	**2.50**	**2.60**	**3.00**	**1.80**

Title of the course	:	**Food Storage Engineering**	
Subject Code	:	**FTT-611**	
Weekly load(hours)	:	**4**	**LTP 3-1-0**
Credit	:	**4**	

Course Objectives:

1. To give basic understanding to students about the storage of perishables and non-perishables and its requirements.
2. To provide information about the different types of handling equipments and their design.
3. To familiarize the students with the design of storage structures for both perishables and non-perishables.
4. To acquaint the students with different management practices followed in storage systems.

Course Outcomes:

On successful completion of the subject, the students will be able to

1. Know the engineering properties of biological materials.
2. Understand the storage environment and its interaction with stored products.
3. Have basic understanding of the design of various handling equipments and storage structures like silos and bins.
4. Understand the theories associated with storage structures of grains.
5. Familiarize with the management practices followed for storage structures and godowns.

UNIT	*MAIN TOPIC*	*DETAILED CONTENTS*	*LECTURES*
I	***Introduction***	Purpose and justification of storage of perishable and non-perishable foods, factors influencing shelf life of food materials, Brief account of engineering properties of biological materials important in design of handling and storage equipments	***4***
	Storage requirements	Storage environment and its interaction with stored product; temperature and moisture migration;, storage practices (including fumigation and aeration of stored product); design of aeration systems.	***8***
	Mechanical Handling equipments	Design of handling equipments like bucket elevators, belt, screw and pneumatic conveyors, and fans	***10***
II	***Storage structures for non perishables***	Grain pressure theories- Rankine and Airy theory: Design of bulk storage structures like bins and silos; Design of bag storage structures such as cover and plinth (CAP) and warehouses	***10***

	Storage structures for perishables	Design aspects of ventilated, cold, modified and controlled atmosphere storage systems.	***8***
	Management practices	Labeling, record keeping and management of godowns, silos and cold storages; maintenance of buildings and equipments; sanitary conditions in storages	***4***

Books Recommended:

Author	**Title**
1. Bala, B. K.	Drying and storage of cereal Grains
2. Sinha and Muir	Grain storage-Part of a System
3. Volkind and Roslov A.	Modern Potato and Vegetable storage
4. Multon, J.L.	Preservation and storage of grains, seeds and their by products
5. Vijayaraghavan, S	Grain storage Engineering and Technology
6. Singh and Sahay	Unit operations in Agril processing

Mapping of Course Outcome and Program Outcome:

COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	3	3	1	1	0	1	2	1	3	1
CO2	3	1	3	2	1	1	3	1	3	2	1	2	1	2
CO3	3	3	1	3	3	1	2	0	1	2	1	1	1	3
CO4	3	3	2	1	1	3	1	1	0	0	2	2	3	3
CO5	3	3	3	3	3	3	1	1	1	2	2	1	3	2
Average	**3**	**2.4**	**2**	**2**	**2.2**	**2.2**	**1.6**	**0.8**	**1**	**1.4**	**1.6**	**1.4**	**2.2**	**2.2**

Title of the course	:	**Food Storage Engineering Lab**	
Subject Code	:	**FTP-611**	
Weekly load(hours)	:	**2**	**LTP0-0-2**
Credit	:	**1**	

Course Objectives:

1. To assist the students in sampling techniques from bulk storage systems like silos.
2. To help the students in determination of various physical properties of food grain samples.
3. To acquaint students with various food grain handling equipments.
4. To help the students in calculating the shelf life of food samples by various methods.

Course Outcomes:

On successful completion of the subject, the students will be able to

1. Know the sampling techniques from bulk food grain.
2. Physical properties of food grains.
3. Shelf life estimation of food grains and change in properties of food grains with increase in storage period.
4. Analysis of stored food grains for their purity.
5. Design of various types if indoor and outdoor storage structures and grain handling equipments.

List of Practicals:

1. Effect of moisture content on Bulk density, True density and porosity of grains
2. To determine the shape characteristics of various food samples
3. To determine static angle of repose of a food grain sample
4. To determine dynamic angle of repose of a food grain sample
5. To determine coefficient of static friction of food grains
6. To study the effect of various surfaces on external friction
7. To study the change in α-amylase activity of stored flour using falling number apparatus
8. To determine equilibrium moisture content (EMC) of the food product using static method
9. To determine equilibrium moisture content (EMC) of the food product using dynamic method
10. To determine water activity of given food material
11. To determine pressure over different depth in a silo using Janssen equation
12. To determine the effect of various parameters (temperature, moisture etc.) on germination capacity of food grains
13. To analyze stored food material for various impurities : insect parts, rodent excreta, bird droppings, infested grains
14. Visit to cold storage, warehouses.
15. Study various grain handling equipments, conveyors, elevators etc

Mapping of Course Outcome and Program outcome:

COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	0	0	0	0	0	0	1	1	0	0	3	1
CO2	2	0	0	0	0	0	0	0	1	1	0	0	3	2
CO3	2	1	0	0	0	0	0	0	1	1	0	0	3	2
CO4	2	2	2	0	0	0	0	0	1	1	0	0	3	2
CO5	2	2	0	0	0	0	0	0	1	1	0	0	3	1
Average	**2.20**	**1.75**	**2.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.00**	**1.00**	**0.00**	**0.00**	**3.00**	**1.60**

Title of the course	:	**Packaging Technology**	
Subject Code	:	**FTT-612**	
Weekly load(hours)	:	**3**	**LTP 3-0-0**
Credit	:	**3**	

Course Objectives:

1. To provide knowledge to the students about functions of packaging and familiarize them with different types of food packaging materials and their properties.
2. To make the students acquire knowledge about theory of permeability and barrier properties of different food packaging materials.
3. To familiarize the students with different food packaging equipment and machinery.
4. To enable the students to select and finalize different types of packaging materials based on the composition and requirements of foods.

Course Outcomes:

On successful completion of the subject, the students will be able to

1. Understand the objectives and functions of packaging.
2. Know different types and characteristics of packaging materials viz paper, glass, metal, and plastic.
3. Provide knowledge about different forms of packaging i.e. pouch, cans, bottles, tetrapack and their types.
4. Predict shelf life of different food materials.
5. Enable the students to know principle and working of different food packaging equipments and machinery.

UNIT	*MAIN TOPIC*	*DETAILED CONTENTS*	*LECTURES*
I	***Introduction***	Definitions; objectives and functions of packaging and packaging materials. Labeling types; functions and regulations.	***2***
	Properties of Packaging Material	Packaging requirements and selection of packaging materials; properties of materials such as tensile strength, bursting strength, tearing resistance, puncture resistance, impact strength, tear strength and their methods of testing and evaluation	***6***
	Packaging materials	(a) Paper: pulping; fibrillation and beating; types of papers and their testing methods; paper board (b) Glass: composition; properties; types of closures; methods of bottle making	***8***

		(c) Metals: Tinplate containers; tinning process; components of tinplate; tin free steel (TFS); types of cans; aluminium containers; lacquers (d) Plastics: types of plastic films; laminated plastic materials; coextrusion; edible films; biodegradable plastics	
	Barrier properties of packaging materials	Theory of permeability; factors affecting permeability; permeability coefficient; gas transmission rate (GTR) and its measurement; water vapour transmission rate (WVTR) and its measurement; prediction of shelf life of foods; selection and design of packaging material for different foods.	***6***
II	***Packaging equipment and machinery***	Vacuum packaging machine; gas packaging machine; seal and shrink packaging machine; form-fill-seal machine; bottling machines; carton making machines.	***6***
	Food packaging systems	Different forms of packaging such as rigid, semi-rigid, flexible forms and different packaging system for (a) dehydrated foods (b) frozen foods (c) dairy products (d) fresh fruits and vegetables (e) meat, poultry and sea foods	***8***
	Specialized techniques in food packaging	Active packaging system; retortable pouches; aseptic packaging; controlled and modified atmospheric packaging; irradiation in food packaging	***6***

Books Recommended:

Author	**Title**
1. Frank A. Paine	A Handbook of Food Packaging
2. Stanley Sacharow and Griffin	Food Packaging
3. A.S. Athalye	Plastics in Packaging
4. Gordon L. Robertson	Food Packaging: Principles and Practice

Mapping of Course Outcome and Program outcome:

COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	1	1	3	2	3	2	0	0	3	2
CO2	3	3	2	3	3	2	2	2	1	0	3	2	3	0
CO3	2	2	2	2	1	1	2	3	1	3	0	0	3	1
CO4	3	3	3	3	2	1	1	2	1	0	1	1	3	0
C05	3	3	3	3	1	1	3	3	2	0	0	0	3	3
Average	**2.80**	**2.80**	**2.40**	**2.60**	**1.60**	**1.20**	**2.20**	**2.40**	**1.60**	**2.50**	**2.00**	**1.50**	**3.00**	**2.00**

Title of the Course	:	**Packaging Technology Lab**	
Subject Code	:	**FTP-612**	
Weekly Load(hours)	:	**2**	**LTP 0-0-2**
Credit	:	**1**	

Course Objectives:

1. To enable the students to identify different packaging materials.
2. To provide information about different tests performed on packaging materials and filled packages.
3. To enable the students to calculate shelf life of foods inside packaging materials and selection of suitable packaging materials.
4. To enable the students to acquaint with different food packaging equipments and machinery.

Course Outcomes:

On successful completion of the subject, the students will be able to

1. Identification of different kinds of packaging materials.
2. Determination of different types of strength of packaging materials.
3. Different testing methodology and characteristics of tin plates,aluminium, glass, paper and plastic used for making packages.
4. Working and construction of different package filling and testing machinery.
5. Selection and design of packaging material for different foods.

List of Practicals:

1. To estimate wax content of wax paper.
2. To determine the bursting strength of a carton board.
3. To determine the amount of tin coating in a can plate.
4. To determine tensile strength & Young's Modulus of given material.
5. Testing of lacquered tin plate steel for following: -

i) Continuity of tin layer

ii) Resistance of lacquer to acid.

6. Determination of iron content in canned foods.
7. Test for alkalinity on the surface of glass jar.
8. To study the effect of shrink and vacuum packaging on storage of food material.
9. To study the compression strength of a box.
10. To study the puncture resistance of a cardboard.
11. To study the drop resistance of a given packaging material.
12. To determine thickness of plastic film using gauge meter.
13. To determine tensile strength of a given test material.
14. To study and construction of

    i). Seal and Shrink machine.

ii). Vacuum packaging machine.

15. To determine moisture content and shelf life of a given product.

Mapping of Course Outcome and Program outcome:

COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	3	3	2	2	3	3	0	0	3	2
CO2	3	3	2	2	2	2	3	3	3	0	2	0	3	2
CO3	2	2	2	3	3	3	2	2	1	0	0	1	3	0
CO4	3	3	2	2	3	2	2	2	3	0	0	0	3	0
C05	3	3	3	3	3	1	1	3	1	0	1	0	3	0
Average	**2.80**	**2.80**	**2.20**	**2.40**	**2.80**	**2.20**	**2.00**	**2.40**	**2.20**	**3.00**	**1.50**	**1.00**	**3.00**	**2.00**

Title of the course	:	**Technology of Milk and Milk Products**	
Subject Code	:	**FTT-613**	
Weekly load(hours)	:	**3**	**LTP 3-0-0**
Credit	:	**3**	

Course Objectives:

1. To provide basic knowledge about milk pricing and production pattern and the possible adulterants and their detection.
2. To understand different methods of chilling, transportation and method of manufacturing of different special milks and creams.
3. To understand process methodology of butter, butter oil and cheese and traditional milk products.
4. To understand drying methodology of different milk products and their uses and application.
5. To understand value addition and utilization of by- products.

Course Outcomes:

1. The students will be able to know the pricing patternn for the milk procurement and different adulterants and their detection
2. Students will also know different methods of transportation and chilling
3. Student will know the manufacturing technology of different special milks and milk products
4. Students will know different drying techniques and their applications in dairy industry
5. Students will have knowledge to add value of different by-products and their applications

UNIT	*MAIN TOPIC*	*DETAILED CONTENTS*	*LECTURES*
I	***Introduction***	Dairy Development in India and Operation Flood programs (OFP), Production and pricing pattern in India, Different adulterants in milk and the common practice adopted in industry to detect, Physico-chemical properties of milk. Micro-organisms in milk (factors affecting growth of microorganisms-lactose fermenting bacteria, Proteolytic bacteria, lipolytic bacteria: Specific fermentation of milk, Pathogenic organisms). Chilling of milk (importance and methods) and transportation.	***10***
	Special milks and creams	Objectives, manufacturing/preparation of toned milk, standardized milk, recombined milk, Filled milk, Chocolate milk, Vitamin D milk, Multivitamin fortified and mineralized milk, homogenized milk, flavored milk and synthetic milk. Cream - classification, composition, production, collection and neutralization, standardization, pasteurization and manufacturing of different types of cream.	***8***

	Butter and Butter oil	Butter, Definition, classification and composition, method of manufacture, packaging and storage, defects, causes and their prevention. Butter oil, definition, composition, method of manufacturing, packaging and storage, defects, causes and their prevention.	***7***
II	***Cheese***	Introduction, definition, classification, composition, Enzymes in cheese making, factors governing manufacturing of cheese. Manufacture of cheddar cheese, cottage cheese and processed cheese, defects in cheese, their causes and prevention, packaging and storage.	***7***
	Dried milks:	Manufacturing methods for SMP and WMP, Instantization, manufacturing methods for Malted milk powder, Infant milk food, casein, sodium caseinate, whey powder and lactose.	***13***
	Traditional Milk products	Manufacturing methods for Khoa, Paneer, Chhana, Ghee, lassi, kheer, kulfi, dahi and Shrikhand and their quality criterion and composition.	***9***

Books Recommended:

Author	**Title**
1. Su Kumar De	Outlines of dairy technology
2. Walstra	Dairy Technology
3. Spreer	Milk and Dairy Product Technology
4. Eckles, Comb and Macy	Milk and Milk Products

<u>Mapping of Course Outcome and Program Outcome:</u>

COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	0	0	0	0	2	0	2	0	0	2	2	0
CO2	2	3	3	2	0	0	2	0	1	1	2	2	2	0
CO3	2	2	0	0	0	0	2	3	2	3	1	1	3	0
CO4	0	2	3	0	3	0	0	3	3	0	2	0	3	0
CO5	0	0	0	2	0	3	0	2	3	3	0	2	3	0
Average	**2.33**	**2.25**	**3.00**	**2.00**	**3.00**	**3.00**	**2.00**	**2.67**	**2.20**	**2.33**	**1.67**	**1.75**	**2.60**	**0.00**

Title of the course	:	**Technology of Milk and Milk Products Lab**	
Subject Code	:	**FTP-613**	
Weekly load(hours)	:	**2**	**LTP 0-0-2**
Credit	:	**1**	

Course Objectives:

1. To provide basic knowledge about quality parameters of milk.
2. To understand determination of quality parameters for different milk and milk products.
3. To understand the effect of change in constituents on the quality of milk products.
4. To develop a skill to understand the processing of different milk and milk products.
5. To develop a skill to utilize the by-products and their quality control.

Course Outcomes:

1. The students will be able to control the quality of different milk and milk products
2. Students will also know the effect of different parameters on the quality of milk and milk products
3. Student shall be able to control the processing of milk and milk products
4. Students will have a skill to develop different norms of quality for the different milk products
5. Students will have knowledge to develop processing methodology for different milk products

List of Practicals:

1. To determine composition of milk
2. To determine different adulterants and preservatives in milk.
3. To prepare different types of special milks such as toned milk, flavored milk sterilized milk etc.
4. To prepare ghee/butter oil and determine their quality
5. To prepared skim milk powder and determine their quality
6. Preparation of khoa
7. Preparation of paneer.
8. Preparation of chhana
9. Preparation of kulfy
10. Preparation of processed cheese
11. Preparation of Shrikhand
12. Preparation of Yoghurt

Books Recommended:

Author	**Title**
1. Su Kumar De	Outlines of dairy technology
2. Walstra	Dairy Technology
3. Spreer	Milk and Dairy Product Technology
4. Eckles, Comb and Macy	Milk and Milk Products

Mapping of Course Outcome and Program Outcome:

COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	0	0	1	1	0	1	2	2	3	2	0
CO2	1	3	3	2	3	2	3	3	0	3	0	3	2	0
CO3	3	0	0	2	2	1	0	1	0	1	1	1	3	0
CO4	2	2	3	1	1	0	0	3	3	0	2	3	3	0
CO5	0	0	3	3	2	2	1	3	2	2	3	2	3	0
Average	**2.25**	**2.33**	**3.00**	**2.00**	**2.00**	**1.50**	**1.67**	**2.50**	**2.00**	**2.00**	**2.00**	**2.40**	**2.60**	**0.00**

Title of the course	:	**Food Laws and Regulations**	
Subject Code	:	**FTT-614**	
Weekly load(hours)	:	**3**	**LTP 3-0-0**
Credit	:	**3**	

Course Objectives:

1. To provide basic knowledge about the food quality, being affected from the adulterants, hazards etc and its safety.
2. To understand different food laws and standards in India and their importance in controlling the quality
3. To understand different international laws and regulatory agencies and their importance in controlling the quality.
4. To understand different food safety regulations and their implementation in food industry to ensure the quality and safety of the foods.
5. To understand retail standards and other regulatory agencies and their importance in controlling the operations.

Course Outcomes:

1. The students will be able to know different food laws and their importance
2. Students will also know different adulterants and hazards and their safety measures
3. Student shall be able to implement different safety tools and regulation in food industry to produce safe products
4. Students will understand different retail standards and other regulatory agencies
5. Students will have knowledge of international food laws and safety regulations

UNIT	*MAIN TOPIC*	*DETAILED CONTENTS*	*LECTURES*
I	***Introduction***	Concept and meaning of Food quality and food Safety, food adulteration, food hazards, Natural toxins. Essential commodities Act (ECA).	***6***
	Food Laws and Standards in India and their importance	Food Safety and Standards (FSS) Act, 2006, FSS Rules and Regulations, 2011. Agricultural Produce Act, 1937 (Grading and Marketing), Sugar cane control order-2006 (Under ECA), Export (Quality Control & Inspection), Act, 1963, Bureau of Indian Standards (BIS).	***12***
	International food laws and regulatory agencies.	International Organizations – FAO (Food & Agriculture Organization), WHO (World Health Organization), Codex Alimentarius Commission (CAC) and WTO. ISO: Understanding and implementation of ISO 9001.	***13***

II	***Food Safety regulations***	Hazard Analysis Critical Control Points (HACCPs) and ISO 22 000, Implementation and case study.	***14***
	The Regulation of Irradiated Foods and ISO 9001	Irradiation of foods, Exposure, dose of irradiation, requirement for the process of irradiation, restrictions on irradiations of foods and record of irradiations.	***2***
	Retail standards and Other regulatory agencies	Food and BRC/IOP standards and International Food standards. Food and Drug Administration (FDA), U.S. Department of Agriculture (USDA).	***10***

Books Recommended:

Author	**Title**
1. Ronald S.	Pearson's Composition and Analysis of foods
2. Ranganna	Handbook of Analysis of Fruit and Vegetable and their Products
3. Pomeranz and Melon	Food Analysis
4. I.S.A	HACCP & ISO 22000

Mapping of Course Outcome and Program Outcome:

COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	0	3	1	0	1	0	0	1	3	2	2	0
CO2	1	2	1	2	2	1	0	2	0	1	2	1	2	0
CO3	3	0	0	2	3	3	1	3	1	0	1	3	3	2
CO4	2	2	1	1	2	1	0	3	1	0	2	3	3	2
CO5	1	0	0	1	0	3	1	1	0	1	2	3	3	3
Average	**1.60**	**2.00**	**1.00**	**1.80**	**2.00**	**2.00**	**1.00**	**2.25**	**1.00**	**1.00**	**2.00**	**2.40**	**2.60**	**2.33**

Title of the course	:	**Technology of Bakery and Confectionery Products**	
Subject Code	:	**FTT-615A**	
Weekly load(hours)	:	**3**	**LTP3-0-0**
Credit	:	**3**	

Course Objectives:

1 To make aware a student with knowledge and understanding of the raw material used for preparation of various bakery and confectionary products.
2. To make aware a student with knowledge and understanding of the basic of various rheological properties and use of various equipment like Mixograph, RVA, Extensographetc for measuring the properties of flour and dough.
3. To make aware a student with knowledge and understanding in the basic steps and operation in preparation of Bread, Biscuits, cakes and other confectionary products.
4. To make aware a student with knowledge and understanding in the basic operation and working of various equipments involved in bakery and confectionary technology.

Course Outcomes:

On successful completion of the subject

1. Student will acquire knowledge on various raw material and rheological properties flour and dough.
2. Student will acquire knowledge on basic of working and use of various rheological equipment like Falling number, RVA etc.
3. Student will acquire knowledge on process for development of various bakery products and their quality determination.
4. Student will acquire knowledge on processing and preparation of confectionary products like fruits drops, different gums and their quality evaluations.
5. Student will acquire knowledge on the construction and working of various equipments involved in manufacturing of bakery products.

UNIT	*MAIN TOPIC*	*DETAILED CONTENTS*	*LECTURES*
I	***Introduction***	Global status of Bakery and Confectionary industry	***4***
	Raw material for bakery products	Essential and optional raw materials for bakery products, Dough development, Methods of dough mixing, Dough chemistry, Rheological testing of dough-Farinograph, Mixograph, Extensograph, Amylograph / Rapid Visco Analyzer, Falling number, Hosney's dough stickiness tester and interpretation of the data	***6***
	Manufacturing of bakery products	Detailed description of unit operations for the manufacturing of bakery products-Bread, Biscuits, Cakes and the effect of variations in formulation and process parameters on the	***12***

		quality of the finished product; quality consideration and parameters; Staling and losses in baking	
II	***Manufacturing of confectionary products***	Characteristics and processing of raw material; Technology of manufacturing of toffee, chocolate, fruit drops, hard boiled candies, bars, chewing gums, bubble gums and special confectionary products; colour, flavour and texture of confectionary; standard and regulations	***12***
	Equipment used in bakery and confectionary industry	Construction and working of various equipments like Mixers, proofing chambers, dough dividers, moulder and sheeter, baking ovens, cooling chamber, sealing and packaging machines, Rolling and cutting machines project profile of bakery and confectionary unit	***10***

Books Recommended:

Author	**Title**
1. SB Arora	Hand Book of Bakery Products
2. Matz	Bakery Technology and Engineering
3. Dendy & Dobraszczyk	Cereal and Cereal Products.
4. Hoseney RS	Principles of Cereal Science and Technology
5. Kent NL	Technology of Cereals.
6. Kulp K & Ponte GJ.	Handbook of Cereal Science and Technology
7. Lorenz KL.	Handbook of Cereal Science and Technology

Mapping of Course Outcome and Program Outcome:

COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	1	1	1	2	1	0	0	0	3	0
CO2	3	3	2	2	1	1	1	2	1	0	0	0	3	0
CO3	3	3	2	2	1	1	1	2	1	0	0	0	3	0
CO4	3	3	2	2	1	1	1	2	1	0	0	0	3	0
CO5	3	2	3	2	1	1	1	2	1	0	0	0	3	0
Average	**3.00**	**2.80**	**2.20**	**2.00**	**1.00**	**1.00**	**1.00**	**2.00**	**1.00**	**0.00**	**0.00**	**0.00**	**3.00**	**0.00**

Title of the course	:	**Technology of Bakery and Confectionery Products Lab**	
Subject Code	:	**FTP-615A**	
Weekly load(hours)	:	**2**	**LTP 0-0-2**
Credit	:	**1**	

Course Objectives:

1. To make aware a student with knowledge and understanding of the analysis of raw material for checking the suitability for preparation of bakery products.
2. To make aware a student with knowledge and understanding of the basic and working of various equipment like Falling number, RVA, DSC etc for measuring the properties of flour and dough.
3. To make aware a student with knowledge and understanding in the basic steps and operation in preparation of Bread, Biscuits, cakes and other confectionary products.
4. To make aware a student with knowledge and understanding in the evaluation of various quality parameters of prepared bakery and confectionary products.

Course Outcomes:

On successful completion of the subject

1. Student will acquire knowledge on the analysis of raw material used for bakery and confectionary products.
2. Student will acquire knowledge on basic of rheological properties flour and dough by use of various rheological equipment like Falling number, RVA etc.
3. Student will acquire knowledge and learn about quality, safety, authenticity, etc. of raw materials, processes, various equipment and bakery products.
4. Student will acquire knowledge on process for development of various bakery products and their quality determination.
5. Student will acquire knowledge on processing and preparation of confectionary products like fruits drops, different gums and their quality evaluations.

List of Practicals:

1. Determination of dough relaxation constants and their interpretation
2. Effect of mixing method on the quality of baked product
3. Effect of mixing time on the textural characteristics of dough
4. Effect of mixing time on the crispness and firmness of biscuits
5. Effect of additives on the quality and textural characteristics of buns
6. Development and quality evaluation of baked products based on composite flour
7. Determination of chroma and hue of baked product
8. Preparation and quality evaluation of croissant
9. Preparation and quality evaluation of masala cake
10. Preparation and quality evaluation of rich and lean cake

11. Preparation and quality evaluation of doughnuts
12. Preparation and quality evaluation of pizza base
13. Effect of syrup consistency on the quality characteristics of hard-boiled sweets
14. Effect of temperature on the quality characteristics of hard-boiled sweets
15. Preparation and quality evaluation of chocolate
16. Visit to Bakery and confectionery industries

Mapping of Course Outcome and Program Outcome:

COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	2	1	1	1	2	1	0	0	0	3	0
CO2	3	2	2	2	3	1	1	2	2	0	0	0	3	0
CO3	1	3	2	2	1	1	3	2	1	0	0	0	3	0
CO4	3	3	2	2	3	1	1	2	1	0	0	0	3	0
CO5	2	2	3	2	1	1	3	2	2	0	0	0	3	0
Average	**2.20**	**2.60**	**2.20**	**2.00**	**1.80**	**1.00**	**1.80**	**2.00**	**1.40**	**0.00**	**0.00**	**0.00**	**3.00**	**0.00**

Title of the course	:	**Spices Technology**	
Subject Code	:	**FTT-615B**	
Weekly load (hours)	:	**3**	**LTP3-0-0**
Credit	:	**3**	

Course Objectives:

1.To provide basic understanding about major and minor spices regarding production, classification, processing.
2. To understand the concepts of spice essential oils and spice oleoresins with respect to method of extraction, isolation, and encapsulation.
3. To understand the spice quality evaluation.
4. To impart knowledge on effect of processing on spice quality.

Course Outcomes:

1. Students will acquire knowledge of major and minor spices regarding production, classification, processing and effect of processing on spice quality.
2. Student can understand the concept of spice essential oils and spice oleoresins with respect to method of extraction, isolation, and encapsulation.
3. They should be able to understand different criteria for assessment of spice quality evaluation.
4.Course will enhance their knowledge on processing methods; equipment's used in spice processing.
5. Course will enhance their technical competence or knowledge on processing technology of Spices.

UNIT	***MAIN TOPIC***	***DETAILED CONTENTS***	***LECTURES***
I	***Introduction***	Status and scope of spice processing industries in India; Spices, Herbs and seasonings: sources, production, selection criteria	***4***
	Major Spices	Post-Harvest Technology composition, processed products of following spices (1) Ginger (2) Chill (3) Turmeric (4) Onion and garlic (5) Pepper (6) Cardamom (7) Cashew nut, coco nut	***10***
	Minor spices, herbs and leafy vegetables	All spice, Annie seed, sweet Basil, Caraway seed, Cassia, Cinnamon, Clove, Coriander, cumin, Dill seed, nutmeg, mint, Rose merry, saffron, sage	***6***
	Processing technology of Spices	Chemical composition, processing methods, equipment's used; recent developments in processing	***6***

II	***Processing effect on spice quality***	Effect of processing on spice quality, contamination of spices with micro-organisms and insects	***6***
	Spice Essential Oils	Definition, methods of extraction, isolation, and encapsulation	***4***
	Spice Oleoresins	Definition, method of extraction, isolation, separation equipment	***4***
	Spices quality evaluation	Criteria for assessment of spice quality	***4***

Recommended Books:

Author	**Title**
1. NIIR	The Complete Book on Spices and Condiments
2. DR Tainter, AT Grenis	Spices and Seasoning: A Food Technology Handbook

<u>Mapping of Course Outcome and Program Outcome:</u>

COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	3	2	3	3	3	2	2	2	1	3	0
CO2	3	3	2	2	1	1	1	2	1	3	1	1	2	0
CO3	2	3	2	1	1	2	2	2	2	0	0	1	2	0
CO4	2	1	2	2	2	2	2	1	2	2	1	0	2	0
CO5	3	2	3	1	2	3	3	1	2	2	1	0	3	0
Average	**2.60**	**2.20**	**2.40**	**1.80**	**1.60**	**2.20**	**2.20**	**1.80**	**1.80**	**2.25**	**1.25**	**1.00**	**2.40**	**0.00**

Title of the course	:	**Spices Technology Lab**	
Subject Code	:	**FTP-615B**	
Weekly load (hours)	:	**2**	**LTP 0-0-2**
Credit	:	**1**	

Course Objectives:

1. To provide basic understanding about chemical analysis of spices, extraction of essential oil and oleoresins from different spices.
2. To understand steam distillations of spices, piperine estimation in pepper oleoresin and determination of curcumin content in turmeric.
3. To understand packaging study and standard specification of spices.
4. To impart knowledge on detection of adulteration in spices, preparation of curry powder and preparation of Indian masala for different foods.

Course Outcomes:

1. They can understand chemical analysis of spices with the extraction of essential oil and oleoresins from different spices.
2. They will be able to understand steam distillations of spices and course will enhance their technical competence or knowledge on piperine estimation in pepper oleoresin and determination of curcumin content in turmeric.
3. Students will acquire knowledge regarding detection of adulteration in spices, Packaging requirements and specification &standards of spices,
4. They can be able to create, select and apply appropriate techniques, resources and modern tool regarding extraction of essential oil and oleoresins from different spices with an understanding of the limitations.
5. They can be able to demonstrate knowledge and understanding of the spice technology and apply these on one's own work to manage projectsand develop the ability to engage in independent and lifelong learning in the broadest contexts of technological change.

List of Practicals:

1. Chemical analysis of spices: moisture, Volatile oil, specific gravity, refractive index, acid value
2. Extraction of oil from clove, pepper, cardamom-chili
3. Extraction of oleoresins-Turmeric, ginger, pepper, clove
4. Piperine estimation in pepper oleoresin
5. Steam distillations of spices
6. Determination of curcumin content in turmeric
7. Study of standard specification of spices
8. Packaging study of spices
9. Preparation of curry powder
10. Preparation of Indian Masala for different foods

11. Detection of adulteration in spices.
12. Visit to spice industry

Mapping of Course Outcome and Program Outcome:

COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	3	3	3	1	2	2	0	1	0
CO2	3	3	2	3	1	1	2	2	2	1	1	0	3	0
CO3	3	2	3	2	2	1	2	3	2	1	1	0	3	0
CO4	2	3	3	1	2	3	2	2	2	1	1	0	2	0
CO5	2	2	3	1	1	1	1	2	1	2	1	0	2	0
Average	**2.60**	**2.60**	**2.60**	**1.80**	**1.60**	**1.80**	**2.00**	**2.40**	**1.60**	**1.40**	**1.20**	**0.00**	**2.20**	**0.00**

Title of the course	:	**Separation Technology**	
Subject Code	:	**FTO-621A**	
Weekly load(hours)	:	**3**	**LTP 3-0-0**
Credit	:	**3**	

Course Objectives:

1. To understand the basics of separation of various types of components for various systems.
2. To familiarize the students with the separation of valuable components from the liquid, solid streams by contact equilibrium processes as well as distillation process
3. To acquaint the students with theory and basis of powder technology and their classification.
4. To familiar the students with new technologies of separation like super critical fluid extraction.

Course Outcomes:

On successful completion of the subject, the students will be able to

1. Understand the basis of various separation techniques.
2. Demonstrate strong appreciation in applying the concepts and skills towards exploiting the separation techniques for diverse applications
3. Find out the number of plates in the rectifying section, stripping section of the continuous distillation system.
4. Find out the optimum value of reflux ratio to achieve best quality product at minimum total cost in case of the continuous distillation system.
5. Understand the theoretical basics of powder technology.

UNIT	*MAIN TOPIC*	*DETAILED CONTENTS*	*LECTURES*
I	***Introduction to various separation processes***	Introduction to various separation processes; Gas-Liquid, Gas–Solid, Liquid-Liquid, Liquid-Solid separation; Concept of phase equilibrium, Stage equilibrium, Equilibrium concentration; Single stage contact equilibrium, counter-current multiple contact stages, Determination of optimum number of contact stages by analytical and graphical method; Rate of extraction, Construction and working mechanism of different extraction equipments like single stage extraction, Multiple stage static bed system, Bollmann extractor, Hildebrandt extractor, Rotocell extractor.	***8***

	Solid Separation Process	Introduction, Concept of size, Shape, Cut-size, Sieving, Magnetic separation, Eddy-current separation, Wet separation, Ballistic separation, Color separation.	***5***
	Wet separation process	Liquid-solid and liquid- liquid separation by hydroclones, Surface velocity classifier, Elutriators, Impingement separator, Electrostatic precipitation.	***4***
II	***Distillation***	Introduction, boiling point diagram, differential or simple distillation, Flash or equilibrium distillation, Continuous rectification with and without reflux, Reflux ratio, Optimum reflux ratio, Batch distillation, Application of distillation in food processing	***6***
	Powder Technology	Classification off powder, Separation of powder, Sieving, Effectiveness of screens, Fineness modulus, Air classification, Factors affecting air classification, Cyclone application, Air separation, Particle size distribution**.**	***7***
	Super Critical Fluid Extraction	Introduction, Properties of SCF, Food application, Application of SCFE in analytical technique, Pharmaceutical application	***4***

Books Recommended:

Author	**Title**
1. Grandison AS & Lewis MJ	Separation Process in the Food & Biotechnology Industries
2. Narayanan CM & Bhattacharyya BC	Mechanical Operations For Chemical Engineers
3. Dutta BK	Mass Transfer & Separation Process

Mapping of Course Outcome and Program Outcome:

COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	1	3	1	0	1	1	2	1	3	1
CO2	3	3	3	2	2	3	1	1	0	1	1	1	3	2
CO3	3	2	2	3	3	3	1	1	0	1	2	1	3	3
CO4	3	1	1	3	3	1	1	1	1	1	2	2	2	3
CO5	3	3	2	2	3	2	1	0	0	1	3	2	3	1
Average	**3**	**2.4**	**2**	**2.4**	**2.4**	**2.4**	**1**	**0.6**	**0.4**	**1**	**2**	**1.4**	**2.8**	**2**

Title of the course	:	**Statistical Quality Control**	
Subject Code	:	**FTO-621B**	
Weekly load(hours)	:	**3**	**LTP 3-0-0**
Credit	:	**3**	

Course Objectives:

1. To provide basic understanding about different statistical methods.
2. To understand the statistical basis of chart, control chart for variables and attributes, PCA.
3. To impart basic understanding of sampling and different sampling techniques.
4. To understand basics of design of experiments, process optimization and six sigma concept.

Course Outcomes:

1. Student will acquire basic concept and ideas of Statistical quality control and different Statistical methods and can understand link between quality and productivity and legal aspects of quality.
2. They can understand basics of control chart for variables and for attributes with its application, concept of Process Capability Analysis (PCA), and importance of six sigma chart for quality evaluation.
3. They should able to solve the problems regarding measures of central tendency and measures of dispersion and problems related to chi square test, analysis of variance, simple linear regression.
4. Course will enhance their knowledge regarding designing of experiments and optimization of process.
5. Student will be able to understand concept of sampling, sampling distribution and its application.

UNIT	*MAIN TOPIC*	*DETAILED CONTENTS*	*LECTURES*
I	***Introduction***	The meaning of quality and quality improvement, Statistical methods for quality control and improvement.	***2***
	Food Quality System	The link between quality and productivity, Quality costs, Legal aspects of quality, implementing quality improvement.	***3***
	Control Charts for Variables	Statistical basis of the charts, Development and use of x and R, Charts based on standard values, Interpretation of x and *R* charts, The effect of non-normality on *x* and *R* charts, Construction and operation of *x* and *S* charts, The *x* and *S* control charts with variable sample size, Application of variables control charts	***5***
	Process Capability Analysis (PCA	PCA using probability plot, Process capability ratios, PCA using a control chart, PCA using designed experiments	***6***
	Control Charts for Attributes	The control chart for fraction non-confirming, Control charts for non-conformities (defects), Procedures with constant	***5***

		sample size, Procedures with variable sample size, The operating-characteristic function	
II	***Sampling***	Population and sample proportions, Sampling techniques, Sampling and non-sampling errors, Shape of the sampling distribution of *x and p,* Applications of the sampling distribution	***4***
	Descriptive statistics	Methods to measure central tendency (mean, median and mode) and dispersion (mean deviation, standard deviation and variance),	***5***
	Inferential statistics	Hypothesis tests, Estimation and hypothesis testing: two populations, Chi-square tests, Analysis of Variance, Simple linear regression, Non-parametric methods	***3***
	Design of Experiments and Process Optimization	Guidelines for designing experiments, Factorial experiments, the 2^k factorial design, Fractional replication of the 2^k design, Response surface methods and designs.	***6***
	Six Sigma	Introduction, Six-sigma control chart, Six-sigma quality performance	***3***

Books Recommended:

Author	**Title**
1. D.C. Montgomery	Introduction to statistical quality control
2. P.S. Mann	Introductory Statistics
3. Jerome D. Braverman	Fundamentals of Statistical quality control

Mapping of Course Outcome and Program Outcome:

COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	1	1	3	2	3	2	0	0	3	2
CO2	3	3	3	3	2	2	1	2	1	0	2	2	3	0
CO3	3	2	2	2	1	1	2	3	2	2	0	0	3	1
CO4	3	3	3	2	2	1	1	2	1	0	1	1	3	0
CO5	3	3	3	3	1	1	3	1	2	0	0	0	3	3
Average	**3.00**	**2.80**	**2.60**	**2.40**	**1.40**	**1.20**	**2.00**	**2.00**	**1.80**	**2.00**	**1.50**	**1.50**	**3.00**	**2.00**

Title of the course	:	**Food Process Engineering**	
Subject Code	:	**FTO-621C**	
Weekly load (hours)	:	**3**	**LTP 3-0-0**
Credit	:	**3**	

Course Objectives:

1. To familiar the students to the concept of SI system and the conversion from one system to another.
2. Application of steady and unsteady state heat and mass transfer principles to analyze and design food processing operations
3. To familiar the students to the theory and application of basic engineering operations.
4. To familiar the students to the thermodynamic properties of the atmospheric air and its application to the drying and air conditioning processes.

Course Outcomes:

1. Apply the principles of mass and energy balance to food processing systems.
2. Determine heat loads and heat losses in heating and cooling food process systems.
3. The students will be able to use psychometric charts to analyze the thermodynamic properties of the atmospheric air and its applications in drying, humidification etc
4. Describe the construction , operation and design principles of evaporators, dryers, freezers using engineering terminology
5. They should be able to solve the problems related to material and energy balances, freezing, evaporation, drying etc. used in the food processing.

UNIT	*MAIN TOPIC*	*DETAILED CONTENTS*	*LECTURES*
I	***Units and conversions***	Fundamental and derived units; Systems of units, Conversions from other systems to SI system.	***2***
	Material balance	Introduction to material balance, Numerical problems on material balance related to food processing.	***4***
	Energy balance	Introduction to energy balance, Steam properties, Use of Steam tables, Numerical problems on material and energy balance related to food processing	***4***
	Evaporation	Boiling point of liquid, Boiling point elevation, Duhring rule, basic principles of evaporators; capacity and economy of evaporator; multiple effect evaporator: operation and various feeding systems, calculation of heat transfer area in single and multiple effect evaporators; Thermal vapour recompression and Mechanical vapour recompression system to improve evaporator economy	***8***

II	***Psychrometry***	Properties of air- water vapour mixture, psychometric chart, Humidification and dehumidification operations, Application of psychrometry to drying and air conditioning.	***4***
	Dehydration	Principles of drying and dehydration, constant and falling rate periods during convective drying, drying rate constant; Drum drying; Freeze drying and spray drying; calculations of convective drying, freeze drying and spray drying times.	***7***
	Food Freezing	Basic concepts, theories of crystallization; Depression in freezing point, Planks equation and other modified equations for prediction of freezing time, freezing time calculations for a product having uniform temperature (negligible internal resistance), different types of freezers.	***7***

Books Recommended:

Author	**Title**
1. R.T. Toledo	Fundamentals of Food Process Engineering
2. Brennan and Cowell	Food Engineering Operations
3. Heldman and Singh	Food Process Engineering
4. Smith, P G .	Introduction to Food Process Engineering
5. Geankoplis	Transport Process & Unit operations

Mapping of Course Outcome and Program Outcome:

COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	1	1	3	2	3	2	0	0	3	2
CO2	3	3	3	3	2	2	1	2	1	0	2	2	3	0
CO3	3	2	2	2	1	1	2	3	2	2	0	0	3	1
CO4	3	3	3	2	2	1	1	2	1	0	1	1	3	0
CO5	3	3	3	3	1	1	3	1	2	0	0	0	3	3
Average	**3.00**	**2.80**	**2.60**	**2.40**	**1.40**	**1.20**	**2.00**	**2.00**	**1.80**	**2.00**	**1.50**	**1.50**	**3.00**	**2.00**

Title of the course	:	**Technology of Animal Products**	
Subject Code	:	**FTT-621**	
Weekly load(hours)	:	**3**	**LTP3-0-0**
Credit	:	**3**	

Course Objectives:

1. Distinguish the important biochemical and ultra structural changes that take place post-mortem during conversion of muscle to meat.
2. Assess the factors that affect the safety and quality of meat products.
3. Critically evaluate the technological and commercial issues related to the processing of meat, egg and fish.
4. Evaluate the manufacture, handling and storage of fish and meat and products thereof assess safety and quality requirements for fish and meat products.

Course Outcomes:

On successful completion of the subject,

1. The student will able to understand to role of various compositional components in the development of various meat, poultry and fish products.
2. The students will able to learn slaughter techniques and hygienic handling of raw meat.
3. The students will able to prepare various value added meat products.
4. The student will able to understand various formulations and processing procedures to produce quality product.
5. The students will able to learn about the various food standards in relation to meat, fish and poultry.

UNIT	*MAIN TOPIC*	*DETAILED CONTENTS*	*LECTURES*
I	***Structure and Composition of Muscle and associated tissue***	Muscle tissue, skeletal muscle, skeletal muscle fiber, myofibrils, myofilaments, smooth muscle, cardiac muscle, epithelial tissue, nervous tissue. Connective tissues. Connective tissue proper, adipose tissue. Muscle bundles and associated connective tissues. Muscle and fiber types. Chemical composition of skeletal muscle.	***8***
	Conversion of muscle to meat	Homeostasis, Exsanguination, circulatory failure to muscle, postmortem pH decline, rigor mortis, Enzymatic degradation.	***7***
	Properties of fresh meat	Water holding capacity, chemical basis of water holding capacity, color, pigments. Chemical state of pigments**.**	***6***

II	***Principles of meat processing***	Curing, meat curing ingredients, methods for incorporation of cure ingredients, chemistry of cured color, Smoking of meat, comminution, blending and emulsification. Technology of sausages**.**	***7***
	Beef, mutton and pork	Slaughtering of cattle, sheep and pig. By products of meat industry**.**	***4***
	Poultry dressing and egg processing	Stunning, bleeding, scalding, evisceration, packaging and storage. Structure, composition and nutritive value of an egg. Functional properties of egg constituents, Interior quality of eggs and its preservation, Egg products.	***6***
	Fish processing	Selection of raw material for processing of streaking and filleting of fish; production of fish paste, fish oils, sauce, fish protein concentrates. By products of fish processing industry.	***8***

Books Recommended:

Author	**Title**
1. J.C. Forest, E.D. Aberle, H.B. Hedrick	Principles of meat science
2.B. Panda	Principles of meat science
3. Robert L. Henrickson	Meat, Poultry and Seafood Technology

Mapping of Course Outcome and Program Outcome:

COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	1	1	2	1	1	0	0	2	0
CO2	3	3	2	2	1	2	2	1	1	2	1	0	2	0
CO3	2	2	3	3	2	2	1	1	3	1	1	0	3	0
CO4	3	3	3	2	1	1	2	1	2	2	1	0	2	0
CO5	2	2	3	1	2	3	1	3	2	1	0	0	3	0
Average	**2.60**	**2.60**	**2.60**	**2.00**	**1.60**	**1.80**	**1.40**	**1.60**	**1.80**	**1.40**	**1.00**	**0.00**	**2.40**	**0.00**

Title of the course	:	**Technology of Animal Products Lab**	
Subject Code	:	**FTP-621**	
Weekly load(hours)	:	**2**	**LTP 0-0-2**
Credit	:	**1**	

Course Objectives:

1. Describe the structure of and composition of meat
2. Describe the processes that should be followed to obtain quality meat from animals.
3. Develop skills in processing and preservation of meat, fish and poultry products
4. Develop value added meat products of meat, fish and poultry.

Course Outcomes:

On successful completion of the subject,

1. The student will able to understand biological principles that influence composition, processing, preservation and quality of meat and meat products.
2. The students will able to learn concept of meat quality, the principle factors influencing it and its biochemical basis.
3. The students will able to understand Knowledge of manufacturing practices, product formulation, and quality control of fresh, frozen, and cured meats and fish.
4. The students will able to understand Quality control functions performed in meat and poultry processing.
5. The students will able to characteristics associated with the value of carcasses, primal and retail cuts from meat animals.

List of Practicals:

1. To study the effect of low and high oxygen atmosphere on meat colour.
2. To study the chemistry of myoglobin as it relates to the color of the molecule.
3. To understand and compare the action of two meat tenderizing enzymes by applying the technique of electrophoresis.
4. To study the structure of the muscle under compound microscope.
5. Perform the slaughtering of the poultry birds.
6. Identification of different internal organs of poultry birds and their utilization for product preparation.
7. Dressing of Fish.
8. Determination of total volatile acids in fish,
9. Determination of buffering capacity of fish muscle.
10. Rapid estimation of hypoxanthine concentration in chill stored fish.
11. Determination of glycine in fish muscle.
12. Determination of protein fractions in fresh fish.
13. Cut out test for canned fishery products.

14. Determination of glycogen in fish muscle.
15. Industrial visit to meat industry.

Mapping of Course Outcome and Program Outcome:

COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	1	2	2	2	1	1	0	0	3	0
CO2	3	2	2	2	2	1	2	1	2	0	0	0	2	0
CO3	2	3	3	3	2	1	3	2	1	1	0	0	2	0
CO4	2	3	2	2	2	1	1	1	2	0	0	0	3	0
CO5	3	2	3	1	1	2	3	1	1	1	0	0	2	0
Average	**2.60**	**2.60**	**2.40**	**2.00**	**1.60**	**1.40**	**2.20**	**1.40**	**1.40**	**1.00**	**0.00**	**0.00**	**2.40**	**0.00**

Title of the course	:	**Food Analysis and Quality Control**	
Subject Code	:	**FTT-622**	
Weekly Load(hours)	:	**3**	**LTP 3-0-0**
Credit	:	**3**	

Course Objectives:

1. To provide basic understanding about the quality, quality control and their applications in food industry.
2. To impart understanding about the instrumentals aspects of color and texture measuring instruments.
3. To give basic knowledge about the non-destructive methods and various types of chromatographic methods applied as quality control.
4. To impart knowledge of various food standards and regulations in food industry as quality control.

Course Outcomes:

On successful completion of the subject, the students will be able to

1. Acquire basic understanding about the quality control and its significance in processing.
2. Know basic understanding of physical characteristics of foods.
3. Learn the working of various color measuring and food texture measuring instruments in food industry.
4. Familiarize with non-destructive techniques and chromatographic techniques used for food analysis and quality control.
5. Familiarize about the food safety and standards, role of food regulations and their implementation in food industry

UNIT	*MAIN TOPIC*	*DETAILED CONTENTS*	*LECTURES*
I	***Introduction***	Quality control and its importance; functions of quality control department and quality control laboratories	***3***
	Colour	Importance and need of colour determination; methods of colour determination with Spectrophotometer, Colorimeter, Hunter Colour lab, CIE system, LovibondTintometer, Munsellcolour and colour difference meter, Disc colorometry and their applications	***9***
	Kinesthetics and Texture	Food texture; physical characteristics of food; working of texture measuring instruments such as Texture Analyzer, Instron Universal Testing machine, Fruit pressure tester, Puncture tester, Succulometer, Tenderometer, Texturometer, Maturometer and Fibrometer; Texture Profile Analysis (TPA)	***6***

II	***Non-destructive methods***	Near Infrared Spectroscopy (NIR); Nuclear Magnetic Resonance (NMR) and its application; Ultrasonic equipments; conductivity and resistivity meters	***9***
	Chromatography	Principle and working of Gas chromatography (GC); High Pressure Liquid Chromatography (HPLC); types of detectors used in GC and HPLC; Thin layer chromatography (TLC), chromatographic methods applied as quality control	***8***
	Food Safety and Regulations	Food Safety and Standards Act (2006); Codex Alimentarius; ISO series; Good Manufacturing Practices (GMP); Genetically Modified Foods (GMF)	***8***

Books Recommended:

Author	**Title**
1. Ronald S.	Pearson's Composition and Analysis of foods
2. Ranganna	Handbook of Analysis of Fruit and Vegetable and their Products
3. Pomeranz and Meloan	Food Analysis

Mapping of Course Outcome and Program outcome:

COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	1	1	3	2	3	2	0	0	3	2
CO2	3	3	3	3	2	2	1	2	1	0	2	2	3	0
CO3	3	2	2	2	1	1	2	3	2	2	0	0	3	1
CO4	3	3	3	2	2	1	1	2	1	0	1	1	3	0
CO5	3	3	3	3	1	1	3	1	2	0	0	0	3	3
Average	**3.00**	**2.80**	**2.60**	**2.40**	**1.40**	**1.20**	**2.00**	**2.00**	**1.80**	**2.00**	**1.50**	**1.50**	**3.00**	**2.00**

Title of the course	:	**Food Analysis and Quality Control Lab**	
Subject Code	:	**FTP-622**	
Weekly Load(hours)	:	**2**	**LTP0-0-2**
Credit	:	**1**	

Course Objectives:

1. To help the students to carry out different sampling techniques in food analysis.
2. To familiarize the students about the working of different equipments used for food analysis.
3. To help the students to carry out proximate analysis of different types of raw foods.
4. To enable the students to carry out physico-chemical analysis of processed foods.

Course Outcomes:

On successful completion of the subject, the students will be able to

1. Know about the sampling techniques followed for food analysis.
2. Proximate composition of raw and processed foods.
3. Analysis of different pigments, metalsand other compounds present in foods.
4. Operation and working of gas chromatography (GC) and high pressure liquid chromatographic (HPLC) techniques.
5. Working on texture and color measuring instruments.

List of Practicals:

1. Determination of acid soluble, water soluble, insoluble acid, ash fractions.
2. Determination of carotenoids.
3. Determination of colour value by using different methods
4. Determination of ascorbic acid by titrimetric and photometric methods.
5. Determination of lycopene content of tomato & its products.
6. Determination of iron, phosphorous &sulphur in foods.
7. Determination of pigment in food sample.
8. Determination of lead, arsenic, and tin content in food.
9. Analysis of canned and processed products available in the market
10. Cut out analysis of canned product.
11. Estimation of Vit A, D in desi ghee
12. Determination of viscosity liquid food
13. Determination of FFA and Acid value of given sample
14. Analysis of ice cream for fat, acidity, total solids, foreign fat

Mapping of Course Outcome and Program outcome:

Cos	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	3	3	2	2	3	3	0	0	3	2
CO2	3	3	1	2	1	1	3	3	3	0	2	0	3	2
CO3	3	2	2	3	3	3	1	2	1	0	0	1	3	0
CO4	3	3	2	2	3	2	2	2	3	0	0	0	3	0
CO5	3	2	3	2	3	1	1	3	1	0	1	0	3	0
Average	**3.00**	**2.60**	**2.00**	**2.20**	**2.60**	**2.00**	**1.80**	**2.40**	**2.20**	**3.00**	**1.50**	**1.00**	**3.00**	**2.00**

Title of the course	:	**Technology of Fruits and Vegetable Products**	
Subject Code	:	**FTT-623**	
Weekly load(hours)	:	**3**	**LTP 3-0-0**
Credit	:	**3**	

Course Objectives:

1. To make aware a student with knowledge and understanding of post harvest handling,minimizing the post-harvest losses and packaging of the fresh fruits and vegetables.
2. To make aware a student with knowledge and understanding of the basic post harvest biological, chemical, physiological and metabolic processes and changes in fruits and vegetables.
3. To make aware a student with knowledge and understanding in the basic steps, application and operation of selected technologies and principles used to preserve and extend shelf life of processed products from fruits and vegetables.
4. To make aware a student with knowledge and understanding in the basic steps, operation of thermal processing, dehydration and freezing of fresh fruits and vegetables.

Course Outcomes:

On successful completion of the subject

1. Student will acquire knowledge on post harvest losses and nutritional significance/importance and on basic physiological, metabolic processes and various changes in fruits and vegetables.
2. The students acquire insight into specific product and process related factors in the processing of fruits and vegetables.Student will acquire knowledge and learn about quality, safety, authenticity, etc. of raw materials, processes and products.
3. Student will acquire knowledge on Different operations like cleaning, grading, peeling concentration and different aroma recovery systems.etc involved in processing fruits and vegetables
4. Student will acquire knowledge on thermal processing which include types of cans, can formation, various operation involved in process and calculation of process time.
5. Student will acquire knowledge on Technology and process behind dehydration and freezing fruit and vegetable

UNIT	*MAIN TOPIC*	*DETAILED CONTENTS*	*LECTURES*
I	***Introduction***	Status, Post harvest losses, Composition of major fruits and vegetables. Post-harvest field operations, preservation treatments for freshly harvested fruits and vegetables, Packaging of whole fruits and vegetables for internal and export markets. General methods of preservation of whole fruits/Vegetables.	***7***

	Physiology	Respiration, transpiration, ripening, senescence, climacteric and non-climacteric fruits, factor effecting composition and quality of fruits and vegetables. Ripening index of different fruits and vegetables.	***5***
	Processing of fresh fruits and vegetables	Cleaning methods, sorting, grading, peeling and blanching. Extraction of fruits juices. Fruit juice concentrates. Fruit powders. Fruit juice aroma recovery and its importance. Definition and preparation of fruits beverages.	***6***
II	***Preservation with sugar***	Definition, constituents, pectin and related compounds, preparation of apple, plum, pineapple and mix fruit jam; preparation of guava jelly, marmalade, theory of jell formation, failure and remedies in jam and jelly making. Definition and preparation of preserves and candied fruits,	***8***
	Canning of fruits and vegetables	General comparison of fruits and vegetables canning. Containers used in canning of fruits and vegetables, types of cans, Base Box, lacquering Precautions in Canning operations. methods and equipment for processing, calculating TDT, Importance of blanching operations. Batch and continuous blanching. Hot water and Steam blanching. Different steps involved in canning of fruits; preparation of syrups and brines, testing of brines, processing methods and equipment, spoilage of canned foods, discolorations, corrosion.	***7***
	Pickles tomato products	Definition, manufacturing process, preparation of chutney, preparation of pickles. Manufacturing process of tomato based products like tomato juice, soup, puree, sauce, ketchup and paste; spoilage of products and their preventive measure.	***7***
	Freezing and dehydration	Pre-treatments of fruits and vegetables for freezing and dehydration; Individual Quick Freezing (IQF); dehydrated products.	***5***

Books Recommended:

Author	**Title**
1. Girdharilal and Sidappa	Preservation of Fruits and Vegetable
2. Shrivastava and Kunal	Fruit and Vegetable Preservation
3. N Shakuntalamanay	Foods, Facts and Principles
4. Luh and Wudruf	Commercial Fruit Processing
5. Wills, Lee	Post-Harvest Physiology & Handling of Fruits & Vegetables
6. Ranganna	Analysis of Fruits and Vegetables
7. Cruess	Commercial Fruit and vegetable products

Mapping of Course Outcome and Program Outcome:

COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	0	0	0	0	2	0	2	0	0	2	2	0
CO2	2	3	3	2	0	0	2	0	1	1	2	2	2	0
CO3	2	2	0	0	0	0	2	3	2	3	1	1	3	0
CO4	0	2	3	0	3	0	0	3	3	0	2	0	3	0
CO5	0	0	0	2	0	3	0	2	3	3	0	2	3	0
Average	**2.33**	**2.25**	**3.00**	**2.00**	**3.00**	**3.00**	**2.00**	**2.67**	**2.20**	**2.33**	**1.67**	**1.75**	**2.60**	**0.00**

Title of the course	:	**Technology of Fruits and Vegetable Products Lab**
Subject Code	:	**FTP-623**
Weekly load(hours)	:	**2** **LTP 0-0-2**
Credit	:	**1**

Course Objectives:

1. To make aware a student with knowledge and understanding of anatomy and quality fruits and vegetables.
2. To make aware a student with knowledge and understanding of the basic of pre process of handling of fruits and vegetables.
3. To make aware a student with knowledge and understanding in the basic steps for preparation of various products based on high sugar, beverage, pickle and tomato products from fruits and vegetables.
4. To make aware a student with knowledge and understanding the dehydration, freezing and canning of fruits and vegetables.

Course Outcomes:

On successful completion of the subject

1. Student will acquire knowledge on post-harvest losses and quality evaluation of fruits and vegetables.
2. The students acquire insight into specific process like peeling and blanching and learn about quality, safety, authenticity, etc. of raw materials and products.
3. Student will acquire knowledge on Different operations like cleaning, grading, peeling pulping, juice extraction fruit juices, concentration and different aroma recovery systems.etc involved in processing fruits and vegetables
4. Student will acquire knowledge on processes employed in the manufacture of fruit and vegetable based products like jam, jelly, beverages and tomato products.
5. Student will acquire knowledge on thermal processing and dehydration and freezing fruit and vegetable.

List of Practicals:

1. Anatomy and structure of fruits and vegetables
2. Quality evaluation of fruits and vegetables
3. Quantitative analysis of cut fruits and vegetable yield
4. Effects of pre-treatment on quality of cut fruits and vegetables
5. Determination of blanching time
6. Evaluation of peeling effectiveness
7. Preparation of fruit and synthetic beverages
8. End point determination in preparation of high sugar product (Mixed fruit jam)
9. Effect of pre-treatment and process variables on quality of preserve/candied fruits

10. Preparation of pickle using various techniques
11. Comparison of juice/pulp extraction methods on quality and yield of tomato pulp
12. Preparation of Tomato ketchup/Tomato soup
13. Canning and cut out analysis of fruit and vegetable
14. Dehydration and rehydration of common available vegetable
15. Freezing of papaya cubes in syrup
16. Visit to fruit and vegetable processing Industry

Mapping of Course Outcome and Program Outcome:

COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	0	2	0	0	0	0	2	0	1	2	0	3	2	0
CO2	1	3	1	1	3	0	2	0	0	3	1	2	2	0
CO3	2	0	0	0	2	0	2	3	0	1	0	0	3	0
CO4	0	2	2	2	3	0	0	1	3	0	2	0	3	0
CO5	0	0	0	0	0	2	0	0	2	2	1	2	3	0
Average	**1.50**	**2.33**	**1.50**	**1.50**	**2.67**	**2.00**	**2.00**	**2.00**	**2.00**	**2.00**	**1.33**	**2.33**	**2.60**	**0.00**

Title of the Course	:	**Technology of Beverages**	
Subject Code	:	**FTT-624A**	
Weekly load(hours)	:	**4**	**LTP 4-0-0**
Credit	:	**4**	

Course Objectives:

1. To provide information about importance of beverage and status of beverage industry in India
2. To familiarize the students with different types of beverages and their formulation.
3. To provide knowledge about the alcoholic beverages and their processing.
4. To impart knowledge about the changes occurring during processing of both alcoholic and non-alcoholic beverages.

Course Outcomes:

On successful completion of the subject, the students will be able to

1. Learn about different water treatment techniques.
2. Become familiar with technology of carbonated soft drinks.
3. Learn about the processing of different types of tea and coffee and cocoa beans.
4. Understand the technology of production of alcoholic beverages.
5. Gain information about the physical, chemical and biological changes occurring in the processing and storage of both alcoholic and non-alcoholic beverages.

UNIT	*MAIN TOPIC*	*DETAILED CONTENTS*	*LECTURES*
I	***Introduction***	Beverage and its importance in modern life; current status of beverage industry in India	***1***
	Bottled Water	Water treatment before its utilization in beverages; mineral water; bottled water; quality standards of water	***5***
	Soft drinks	Technology of carbonated soft drinks; role of various ingredients of soft drinks; carbonation of soft drinks	***6***
	Tea	Tea plantation; processing of black tea, green and semi fermented tea; grading of tea; chemical and biochemical changes during processing of tea	***8***
II	***Coffee***	Structure of coffee bean; processing of green coffee beans (dry and wet processes); conversion of green coffee into beverage; manufacturing of instant and decaffeinated coffee; chemical changes during coffee processing	***8***
	Cocoa	Cocoa plantation; processing of raw bean and role of fermentation; roasting procedure; processing of roast bean; chemical changes during various stages of processing	***8***

	Alcoholic beverages	Production of Beer; role of yeast in Beer and other alcoholic beverages; ale beer; lager beer; technology of brewing process; Wine and related beverages; Distilled spirits	***6***

Books Recommended:

Author **Title**

1. Varnam and Sutherland Beverages - Technology, Chemistry and Microbiology
2. Lea and Piggot Fermented Beverage Production

Mapping of Course Outcome and Program outcome:

COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	2	3	2	2	1	1	1	3	0
CO2	3	3	3	1	2	2	2	1	2	1	1	1	2	0
CO3	2	3	2	2	1	1	2	1	1	2	3	0	3	0
CO4	3	2	2	1	1	1	1	2	1	2	3	1	2	0
CO5	2	2	3	1	3	3	1	2	3	2	0	0	2	0
Average	**2.60**	**2.60**	**2.40**	**1.40**	**1.80**	**1.80**	**1.80**	**1.60**	**1.80**	**1.60**	**2.00**	**1.00**	**2.40**	**0.00**

Title of the course	:	**Technology of Beverages Lab**		
Subject Code	:	**FTP-624A**		
Weekly load(hours)	:	**2**	**LTP**	**0-0-2**
Credit	:	**1**		

Course Objectives:

1. To provide information about the composition of different types of beverages.
2. To impart the knowledge about the preparation of beverages.
3. To give the knowledge about various types of tests conducted for beverages.
4. To give the technical knowhow to the students for beverage unit.

Course Outcomes:

On successful completion of the subject, the students will be able to

1. Have thorough knowledge about the composition of beverages.
2. Have knowledge about the preparation of carbonated beverages.
3. Have thorough understanding about processing of non-carbonated beverages.
4. Start their own manufacturing beverage unit.
5. Have knowledge about quality control techniques of beverages.

List of Practicals:

1. Determination of alkalinity of potable water
2. Determination of chloride content of potable water
3. Determination of hardness of potable water by EDTA method
4. Study the process of fermentation
5. Study the process of distillation
6. Estimation of alcoholic content of alcoholic beverages
7. Estimation of caffeine content of tea
8. Estimation of caffeine content of coffee
9. Preparation of grape wine
10. Preparation of cider
11. Study the process of malting
12. Study the process of carbonation
13. Visit to bottling plant
14. Visits to beverages plants

Mapping of Course Outcome and Program outcome:

Cos	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	2	2	2	1	2	0	0	0	3	0
CO2	3	3	2	2	3	1	1	2	1	2	1	0	1	0
CO3	2	2	3	1	1	3	2	1	1	1	0	0	2	0
CO4	2	3	3	2	2	1	2	2	2	1	1	0	2	0
CO5	3	2	3	1	2	2	2	3	2	0	0	0	3	0
Average	**2.60**	**2.60**	**2.60**	**1.80**	**2.00**	**1.80**	**1.80**	**1.80**	**1.60**	**1.33**	**1.00**	**0.00**	**2.20**	**0.00**

Title of the course	:	**Post Harvest Engineering**	
Subject Code	:	**FTT-624B**	
Weekly load(hours)	:	**4**	**LTP 4-0-0**
Credit	:	**4**	

Course Objectives:

1.To provide basic understanding on handling of agricultural produce soon after harvesting.
2. To make student aware on various types of storage system for agricultural produce
3. To make student aware on design of storage system for both perishable and non-perishable agricultural produce.

Course Outcomes:

1. Student will acquire basic concept and idea of different factors affecting postharvest loss.
2. Student will acquire basic concept crop process engineering.
3. Student will acquire basic concept of design of grain handling system.
4. Student will acquire knowledge on various unit operation involved in post harvest treatment given to increase the shelf life of the produce.
5. Student will acquire knowledge on advance system of food storage of perishable agricultural produce.

UNIT	*MAIN TOPIC*	*DETAILED CONTENTS*	*LECTURES*
I	***Introduction to Postharvest Food Systems***	Internal and External Factors Affecting Quality of Fresh Produce, Grain Type and End-use Quality Determining Factors, Fruit and Vegetable Handling Systems	***8***
	Grain Post-Harvest Storage, Drying, Handling	Concept of Aeration System, identification of design parameter of aeration system. Drying theory and its application drying of food grains. Identification of design parameter for designing of food grain drier. Design of food grain Handling System.	***11***
II	***Handling and Storage of Horticultural Crops***	Understanding of various losses due to physiological changes, mechanical damage, pests and diseases. Understanding the concept of quality assessment of horticultural crops and conservation techniques.	***8***
	Design and Operation of Cooling Systems for Fresh Produce	Concept of Refrigeration System, Heat load calculation and selection other parameters for design. Definition, concept understanding of Controlled Atmosphere and Modified Atmosphere Storage system. Identification of various parameters, and its application in designing of CA and MA storage system.	***8***

	Pretreatment and Handling Operation for Fruits and Vegetables	Effect of Pre-Cooling on Produce Quality. Hot Water and Vapor Treatment for Disease and Insect Control, Grading, Waxing and Packaging, Packing House design	***8***

Books Recommended:

Author	**Title**
1. H. W. Von Loesecke	Drying and Dehydration of Foods
2. S. T. Beckett	Physicochemical Aspect of Food Processing
3. Brooker D.B., Bakker F.W., Hall C.W.	Drying and storage of grains and oilseeds
4. K. PelegProduce	Handling Packaging and Distribution
5. R. L. Shewfelt and S. E. Prussia	Postharvest Handling: A System Approach
6. O. J. Loewer, T. C. Bridges and R. A. Bucklin	On-farm Drying and Storage Systems
7. Henderson S.M., R.L. Perry, and J.H. Young	Principles of Process Engineering
8. Mujumdar A.S.	Handbook of Industrial Drying

Mapping of Course Outcome and the Program Outcome:

COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	1	2	2	2	1	1	1	1	3	0
CO2	3	2	3	3	2	2	1	1	1	2	1	0	2	0
CO3	2	3	2	2	3	1	2	2	2	2	0	1	2	0
CO4	3	3	3	2	2	3	1	3	1	1	1	0	3	0
CO5	3	3	2	3	1	2	3	1	2	1	1	1	1	0
Average	**2.80**	**2.80**	**2.40**	**2.40**	**1.80**	**2.00**	**1.80**	**1.80**	**1.40**	**1.40**	**1.00**	**1.00**	**2.20**	**0.00**

Title of the course	:	**Post Harvest Engineering Lab**	
Subject Code	:	**FTP-624B**	
Weekly load (hours)	:	**2**	**LTP 0-0-2**
Credit	:	**1**	

Course Objectives:

1.To provide basic understanding on handling of agricultural produce soon after harvesting.

2. To provide hand on training in management of both perishable and perishable non agricultural produce.

Course Outcome:

1. Student will able to identify different factors affecting postharvest loss.
2. Student will be able to determine moisture content of the grain and critical moisture content considered safe for storage.
3. Student will have hands on training and able to identify different unit operation involved in post harvest treatment given (Hot Water and Vapor Treatment for Disease and Insect Control, Grading, Waxing and Packaging) to increase the shelf life of the produce.
4. Student will able to design suitable Controlled Atmosphere, Modified Atmosphere and pre-cooling storage system for perishable.
5. Student will be able to have information about the handling equipments.

List of Practicals:

1. Experiment on determination of surface area and true volume at various levels of moisture content/ water activities
2. Experiment on determination of porosity of food grains at various levels of moisture content/ water activities.
3. Experiment on determination of co efficient of friction, Filling and emptying Angle of repose at various levels of moisture content/ water activities
4. Graphical interpretation/mapping food grain based on data obtained above experiments.
5. Experiment on low cost pre-cooling system for storage of perishable.
6. Experiment on MAP for few seasonal fruits and vegetables
7. Experiment on CA storage of grains.
8. Experiment on the process of Hot water treatment and waxing of fruits.
9. Visit of industry

Books Recommended:

Author	**Title**
1. Kader, A.A. (editor)	Postharvest Technology of Horticultural Crops

2. Postharvest Management of Fruit and Vegetables in the Asia-Pacific Region, Food and Agriculture Organization of the United Nations Agricultural and Food Engineering Technologies Service,VialedelleTerme di Caracalla, Rome, Italy.

Mapping of Course Outcome and the Program Outcome:

COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	3	2	2	3	1	0	0	0	2	2	2	2	0
CO2	3	2	3	2	3	2	2	2	0	0	2	2	2	1
CO3	2	3	2	2	2	1	3	3	0	2	2	3	3	0
CO4	3	3	2	2	2	2	2	3	0	3	3	1	3	0
CO5	3	3	2	1	2	1	2	0	0	3	1	2	3	0
Average	**2.40**	**2.80**	**2.20**	**1.80**	**2.40**	**1.40**	**2.25**	**2.67**	**0.00**	**2.50**	**2.00**	**2.00**	**2.60**	**1.00**

Title of the course	:	**Membrane Technology**	
Subject Code	:	**FTO-711A**	
Weekly load(hours)	:	**3**	**LTP 3-0-0**
Credit	:	**3**	

Course Objectives:

1. To understand the basics of mass transfer.
2. To familiar the students with the basic terms related to the membrane technology.
3. To familiarize the students with the basic principles for the separation by membranes like RO, Ultrafiltration, microfiltration etc.
4. To acquaint the students with theory and basis of separation techniques like Electrodialysis, pervaporisation etc.

Course Outcomes:

On successful completion of the subject, the students will be able to

1. Understand the basis of various membrane separation techniques.
2. Demonstrate strong appreciation in applying the concepts and skills towards exploiting the separation techniques for diverse applications.
3. Understand the theoretical basics of membrane separation techniques like Reverse Osmosis, Ultrafiltration, microfiltration, Electrodialysis, pervaporisation etc.
4. Design the Reverse Osmosis for a desired capacity.
5. Solve the numerical and design problems for membrane separation process.

UNIT	*MAIN TOPIC*	*DETAILED CONTENTS*	*LECTURES*
I	***Introduction to Mass Transfer***	Important terms related to mass transfer, Mass transfer rate and mass transfer coefficient, Steady state molecular diffusion in solids liquids and gases, Relations between mass transfer coefficients, Interphase mass transfer	***10***
	Various terms related to membrane technology	Recovery or Conversion Factor, Permeate Flux or Transport Flux, Mass Transfer Resistance, Global or Total Flux, Darcy's Law for Pure Solvent Flux, Solute Partition coefficient; Permeance or Pressure Normalized flux or Hydraulic Permeability or Permeability Constant; Trans-membrane Pressure; Salt or solute Passage; Solute Rejection Factor; Sieving Coefficient, Retention Factor; Concentration Factor; Enrichment Factor; Tortuousity; Porosity; Chemical potential; Activity Coefficient; Osmosis; Osmotic Pressure; Partial Molar Volume of Solvent;	***7***
II	***Types of membrane***	Types of membrane separation process, Major advantages of membrane separation, Major disadvantages of membrane	***4***

	separation process and concept of Polarization layer by concentration and fouling	separation, Polarization layer by concentration and fouling, Models for concentration polarization and fouling, Factors affecting the concentration polarization	
	Mathematical analysis of separation processes based on Pressure Gradient	Mathematical analysis of reverse osmosis or hyperfiltration, Mathematical analysis of ultrafiltration, Mathematical analysis of microfiltration, Membrane modules configurations, Design of reverse osmosis and ultrafiltration system	***10***
	Other separation processes	Dialysis, Electrodialysis, Pervaporation	***2***
	Applications of membrane separation	Applications of membrane separation	***2***

Books Recommended:

Author	**Title**
1. Grandison AS & Lewis MJ	Separation Process in The Food & Biotechnology Industries
2. KaushikNath	Membrane Separation process
3. Narayanan CM & Bhattacharyya BC	Mechanical Operations For Chemical Engineers
4. Dutta BK	Mass Transfer & Separation Process
5. Anantharaman N & Begum KMMS	Elements of Mass Transfer

Mapping of course Outcome and Program outcomes:

COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	0	0	0	0	0	3	3	3	0	0	0	3	1	2
CO2	3	3	2	0	0	2	3	2	0	0	2	2	2	1
CO3	3	3	2	2	0	2	2	2	0	0	0	2	2	2
CO4	3	3	2	2	0	2	0	2	0	0	0	2	3	3
CO5	3	3	3	3	0	2	3	3	0	0	0	2	1	3
Average	**2.4**	**2.4**	**1.8**	**1.4**	**0**	**2.2**	**2.2**	**2.4**	**0**	**0**	**0.4**	**2.2**	**1.8**	**2.2**

Title of the course : **Nano Technology**
Subject Code : **FTO-711B**
Weekly load(hours) : **3** **LTP3-0-0**
Credit : **3**

Course Objectives:

1. To provide the fundamental understanding about nano technology.
2. To understand the concept of concept and fabrication of nanostructures
3. To impart basic understanding of nano sensors and smart nano materials.
4. To understand the concept of application of nano materials in active food packaging, nutrient and drug delivery.

Course Outcomes:

1. Student will acquire basic concept and ideas of nano technology.
2. They can understand link between fundamental sciences behind nano technology, nutritional and drug requirement of human being with the concept of nutrient and drug delivery.
3. They can able to get the knowledge of nano materials fabrication, restructuring and measuring nano structures,
4. They can understand the concept behind nano sensors, smart nano materials and their application in food packaging
5. They can enhance their knowledge regarding safety issues of nano materials.

UNIT	*MAIN TOPIC*	*DETAILED CONTENTS*	*LECTURES*
I	***Introduction***	Nanotechnology – Definition and Examples, Lessons from Nature (Biomimetics), various issues, applications in Different Fields.	***4***
	Fundamental science behind nanotechnology	Introduction to electrons, atoms and ions, molecules, metals, other materials, biosystems, quantum concept and optics.	***10***
	Fabrication of nanostructures	Concept of top down and bottom up approach, Molecular synthesis, self-assembly, crystal growth and polymerization.	***6***
	Measuring nanostructures	Scanning probe instruments, spectroscopy, electrochemistry, electron microscopy.	***6***
II	***Nano Sensors***	Concept of natural nanoscale sensors, electromagnetic sensors, biosensors and electronic nose.	***6***

	Smart materials	Concept of nano catalyst, nano emulsion and nano materials encapsulations	***4***
	Food packaging	Concept of packaging, packaging materials and active packaging using nano materials.	***4***
	Nutrient and drug delivery	Concept of nutrient and drug requirement, drug delivery system and nano material application. Safety issues of nano materials.	***4***

Books Recommended:

Author	**Title**
1. Yury Gogotsi	Nanomaterials Handbook
2. Pradeep T	Nano: The Essentials
3. Bharat Bhusan	Hand book of Nano Technology

Mapping of Course Outcome and Program Outcome:

COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	2	2	2	2	2	2	1	3	1	1
CO2	3	3	3	3	3	2	2	2	3	3	1	3	2	1
CO3	3	3	3	3	2	2	2	2	3	2	1	3	2	2
CO4	3	3	3	3	3	2	2	2	2	2	2	3	2	3
CO5	2	2	2	2	2	3	3	2	2	2	2	2	1	1
Average	**2.8**	**2.6**	**2.4**	**2.4**	**2.4**	**2.2**	**2.2**	**2**	**2.4**	**2.2**	**1.4**	**2.8**	**1.6**	**1.6**

Title of the course : **Spices and Flavour Technology**
Subject Code : **FTO-711C**
Weekly load(hours) : **3** **LTP 3-0-0**
Credit : **3**

Course Objectives:

1. To provide basic understanding about flavors regarding commercially available materials, classification on the basis of origin, physical characteristic.
2. To understand the liquid and solid flavor production; flavoring remixing: flavor intensifiers: synthetic flavors; effect of processing on flavor quality.
3. To understand changes in food flavor due to processing,flavor release from foods.
4. To impart knowledge on flavor quality evaluation and flavor applications.

Course Outcomes:

1. Students will acquire knowledge regarding basic concepts flavor technology.
2. They can understand recent developments in processing, retention and recovery of flavor.
3. They will be able to understand effect of processing on flavor quality.
4. Course will enhance their technical competence or knowledge on flavor release from food.
5. Student can understand flavor quality evaluation and flavor applications.

UNIT	*MAIN TOPIC*	*DETAILED CONTENTS*	*LECTURES*
I	***Introduction***	Status and scope of flavor processing industries in India; flavors: commercially available materials, classification on the basis of origin, physical characteristic.	***4***
	Flavor Technology	Liquid and solid flavor production; flavoring remixing: flavor intensifiers: synthetic flavors; effect of processing on flavor quality	***10***
	Changes in Food Flavor due to Processing	General overview of the Maillard reaction, pathways for flavor formation via the Maillard reaction	***6***
II	***Flavor Release from Foods***	Lipid/flavor interactions, carbohydrate: flavor interaction, protein: flavor interaction, retention and recovery of flavor	***6***
	Flavor quality evaluation	Criteria for assessment of flavor quality; methods of flavor evaluation (chemical, instrumental, sensory); Indian standards for flavoring materials and flavors	***4***
	Flavor Applications	Specific flavor applications culinary and meat products, sauces, seasonings, and marinade, meat products, baked goods and bakery Products, snack foods	***4***

Books Recommended:

Author	**Title**
1. Reineccius G	Flavor Chemistry and Technology
2. Reineccius G	Source Book of Flavor:
3. Morton ID and Macleod AJ	Food Flavors:

Mapping of Course Outcome and Program Outcome:

COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	3	2	3	3	3	2	2	2	1	3	0
CO2	3	3	2	2	1	1	1	2	1	3	1	1	2	0
CO3	2	3	2	1	1	2	2	2	2	0	0	1	2	0
CO4	2	1	2	2	2	2	2	1	2	2	1	0	2	0
CO5	3	2	3	1	2	3	3	1	2	2	1	0	3	0
Average	**2.60**	**2.20**	**2.40**	**1.80**	**1.60**	**2.20**	**2.20**	**1.80**	**1.80**	**2.25**	**1.25**	**1.00**	**2.40**	**0.00**

Title of the course	:	**Technology of Fats and Oils**	
Subject Code	:	**FTT-711**	
Weekly load(hours)	:	**3**	**LTP 3-0-0**
Credit	:	**3**	

Course Objectives:

1. To provide basic knowledge about composition of fats/oils and their importance and functions in foods.
2. To understand different methods of extraction of fat/oil and different types of extractors.
3. To understand different refining methods, used for oils/fats and techniques to minimize losses.
4. To understand hydrogenation and effect of different processing parameters on the process of hydrogenation and manufacturing technology of different fat products.
5. To understand different chemical reactions and quality parameters to control the quality of different fats.

Course Outcomes:

1. The students will be able to know the importance and compositions of different fats
2. Students will also know different methods of extraction and different types of extractors
3. Student shall be able to understand different methods of refining and techniques to minimizes refining losses
4. Students will know effect the process of hydrogenation and manufacturing technology of different fats and fat rich products
5. Students will have knowledge of different chemical reactions and quality parameters in controlling the quality of fat.

UNIT	*MAIN TOPIC*	*DETAILED CONTENTS*	*LECTURES*
I	***Introduction***	Importance and functions of fats and oils in foods and health, composition of fats/oils from different animal sources and oilseeds	***4***
	Oil extraction	Different methods of oil extraction, oil expression from oilseeds like, mustard/rapeseed, coconut, sunflower, groundnut, sesame, cotton. Machines (Mechanical expellers and solvent extractors) used in the expression of oils, Calculations based on the extraction processes	***10***
	Oil/fat purification	Refining techniques, bleaching, refining losses and deodorization, Batch and continuous refining losses.	***6***
	Hydrogenation	Chemistry of hydrogenation, Effect of process conditions, Hydrogenation in Practice, Catalysts and catalysis.	***6***

II	***Chemistry of fats and oils***	Lipolysis, auto-oxidation, thermal decomposition, chemistry of frying oils, effects of ionizing radiation in fats, inter-esterification, reversion	***6***
	Technology of individual fat products	Butter, Margarine, Shortening, Lard, Salad, cooking and frying oil.	***4***
	Different quality parameters	Peroxide value, Saponification value, Iodine value, acid value, TBA, RM value, P-value, Kries value, Adulteration in oils and fats.	***4***
	Soap processing	Chemistry, physical properties of soap, processing and finishing, different types of soaps, soaps in cosmetics and toiletries.	***4***

Books Recommended:

Author	**Title**
1. Chrysam, Erickson and others	Bailey's Industrial Oil and Fat Products
2. Fennema	Food Chemistry
3. Meyer	Food Chemistry
4. Lawson	Food oils and fats
5. Maran	Fats in food products
6. Acharya	Oilseeds and Oil Milling in India

Mapping of Course Outcome and Program Outcome:

COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	2	1	0	2	2	3	2	1	0	2	2	3
CO2	0	2	1	3	2	2	0	1	2	0	3	1	0	2
CO3	3	0	2	1	0	1	3	0	1	0	2	1	3	0
CO4	2	0	1	3	2	0	3	0	3	1	0	2	3	1
C05	3	1	0	2	3	1	0	2	1	0	2	1	2	3
Average	**2.50**	**1.33**	**1.50**	**2.00**	**2.33**	**1.50**	**2.67**	**2.00**	**1.80**	**1.00**	**2.33**	**1.40**	**2.50**	**2.25**

Title of the course	:	**Technology of Fats and Oils Lab**		
Subject Code	:	**FTP-711**		
Weekly load(hours)	:	**2**	**LTP**	**0-0-2**
Credit	:	**1**		

Course Objectives:

1. To provide basic knowledge about quality and processing parameters of fats/oils.
2. To understand determination of quality parameters for different fats and fat rich products.
3. To understand the effect of different processing parameters on the quality and yield of the fats.
4. To develop a skill to understand processing of different products.

Course Outcomes:

1. The students will be able to control the quality of different fats
2. Students will also know the effect of different parameters on the quality of fats
3. Student shall be able to control the processing of fats
4. Students will have a skill to develop different norms of quality for the different products
5. Students will have knowledge to develop processing methodology of fats

List of Practicals:

1. Determination of moisture content in fat.
2. Determination of melting point of fat.
3. Determination of specific gravity of fat.
4. Determination of % impurities / gum in fat.
5. Qualitative checking of various adulterants in labs.
6. Extraction of oil from rice brain, pellets and spent wash.
7. Determination of iodine value.
8. Determination of saponification value.
9. Determination of free fatty acids.
10. Determination of unsaponifiable matter.
11. Colour measurement of fat.
12. Determination of RM &P valve.
13. Determination of refractive index of fat.
14. Effect of particle size on the amount of oil extracted
15. Effect of alkali on the free fatty acids
16. Effect of time and temperature on the extraction of fat
17. Preparation of methyl esters
18. Preparation of Candles
19. Preparation of soap
20. To visit fat processing industry

Mapping of Course Outcome and Program Outcome:

COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	2	0	3	0	2	1	0	2	1	3	3	2
CO2	0	2	3	1	2	3	1	0	1	0	2	2	0	2
CO3	2	0	1	3	0	1	2	3	0	2	3	1	2	0
CO4	3	2	1	0	2	0	1	0	2	0	2	1	3	0
C05	2	2	1	2	1	3	2	1	0	2	0	3	3	0
Average	**2.50**	**1.75**	**1.60**	**2.00**	**2.00**	**2.33**	**1.60**	**1.67**	**1.50**	**2.00**	**2.00**	**2.00**	**2.75**	**2.00**

Title of the course	:	**Food Processing Plant Layout and Design**	
Subject Code	:	**FTT-712**	
Weekly load(hours)	:	**4**	**LTP3-1-0**
Credit	:	**3.5**	

Course Objectives:

1. To enable the student to understand the various factors involved in the site selection and design of food plant.
2. To understand the processes involved in layout design.
3. To enable the students learn the concept of preparing cost estimate and economics
4. To understand the development and design consideration in different food industries.

Course Outcomes:

On successful completion of the subject, the students will be able to:

1. apply the concepts, principles and theories for the selection of location of food processing plant.
2. use the tools and techniques in plant layout, and project planning and scheduling.
3. tounderstand different costs and depreciation methods.
4. Understand the hygienic design concepts for food processing building.
5. apply knowledge to design and setting up of new food processing plant as entrepreneur and/or consultant.

UNIT	*MAIN TOPIC*	*DETAILED CONTENTS*	*LECTURES*
1	***Introduction***	Plant design concepts, General design considerations for food processing industries, stages of plant design	***3***
	Plant location	Introduction, factors involved in plant location decision, Territory and site specific factors, Influence of location on plant layout, Subjective, qualitative and semi-quantitative techniques for evaluating plant location alternatives: equal weights method, variable weights method, weight-cum-rating method, locational break-even analysis, Bridgeman's dimensional analysis, composite measure method and median model of location problem	***8***
	Plant Layout	Types of manufacturing process, Plant layout problem, objectives and principles of layout; classical types of layout Viz. product layout, process layout and stationary layout; plant layout tools and techniques like process charts, process flow diagram, Travel chart, machine data cards, material movement patterns, visualization of layout by templates, machine models and sketches, general guidelines for plant layout, space requirement for machines, work stations and	***11***

		storage, symbols used for plant design and layout plant layout procedures	
2	***Project Management***	Project planning, Techniques of project planning, Project scheduling, Methods of project scheduling: Gantt charts and Network scheduling, Basic terms, objectives and advantages of Network analysis, various Network techniques like PERT and CPM and related numerical problems	***6***
	Cost Analysis	Classification of costs, analysis of production costs, depreciation and different method of calculating it, break-even analysis	***5***
	Plant Equipment and Buildings	Materials of construction of food equipment: Characteristics of suitable construction material like Stainless steel, Aluminum, Nickel and Plastic Materials; Hygienic construction and design concepts; Types of factory buildings; Consideration in building design, drainage, ventilation and illumination in food processing industries	***5***
	Layout of different industries	Considerations in the layout of different types of food industries like cereal, pulses and oilseed industry, dairy Bakery, soft drinks, canning, dairy, rice and wheat mill.	***6***

Recommended Books:

Author	**Title**
1. O.P. Khanna	Production Engg. and Industrial Management
2. Moore	Plant Layout and Design
3. Mart and Telsang	Industrial engineering and production management
4. Peterse and Timmerhaus	Plant Design for Chemical Engg.
5. Rase and Barrow	Project Engg. of Process Plant
6. Farrall	Engg. for Dairy and Food Products

Mapping of Course Outcome and Program Outcome:

COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	0	0	0	0	0	0	0	0	1	0	3	2
CO2	3	2	0	1	0	0	0	0	2	0	2	0	3	2
CO3	3	2	0	0	0	0	0	0	0	0	0	0	3	2
CO4	1	0	0	1	0	0	1	0	0	0	0	0	3	3
CO5	0	0	1	0	0	0	0	0	2	0	2	1	3	3
Average	**2.50**	**2.00**	**1.00**	**1.00**	**0.00**	**0.00**	**1.00**	**0.00**	**2.00**	**0.00**	**1.67**	**1.00**	**3.00**	**2.40**

Title of the course	:	**Biochemical Engineering**	
Subject Code	:	**FTT-713A**	
Weekly load(hours)	:	**3**	**LTP 3-0-0**
Credit	:	**3**	

Course Objectives:

1. To provide the basic knowledge about the growth of the microorganisms in different culture systems.
2. To provide the basic understanding about the media formulation and sterilization techniques used.
3. To understand the design and working of the bioreactor.
4. To impart basic knowledge about the enzyme kinetics and methods of purification of microbial products.

Course Outcomes:

On successful completion of the subject, the students will be able to

1. Acquaint themselves with the fundamentals of biochemical engineering.
2. Get knowledge about the various biochemical processes used in industry.
3. Identify, analyze, design and calculate the equations to achieve the maximum sterilization conditions.
4. Get insight about the design and working of the bioreactor and its parts.
5. Efficiently carry out the kinetic studies related to microbial growth as well as of the enzymatic controlled biochemical reaction.

UNIT	*MAIN TOPIC*	*DETAILED CONTENTS*	*LECTURES*
I	***Introduction***	Introduction to biochemical engineering, its scope and area covered, Microbiological and biochemical aspects related to biological processes	***2***
	Media sterilization	Medium formulation, Thermal sterilization, Sterilization by filtration, Design criteria and design equations for sterilization process, Temperature-time profile and design calculations, Methods of air sterilization, Interception, diffusion and combined mechanism	***6***
	Microbial growth and death kinetics	Microbial growth kinetics under batch and continuous process, Thermal death kinetics of microorganism, measuring and monitoring growth processes, influence of temperature on specific growth and death rates, relationship between growth and substrate utilization.	***12***

II	***Enzyme kinetics***	Concepts of free energy and activation energy, simple enzyme reaction kinetics, complex enzyme kinetics, Michaelis-Menten equation, Briggs–Halden approach, evaluation of parameters, enzyme inhibition (competitive and non-competitive), Methods of enzyme immobilization.	***12***
	Bioreactor & its control system	Bioreactor design and analysis in view of microbial reaction process, operation of batch and continuous fermentation system, oxygen supply and demand in microbial processes, mass transfer resistances, critical value of oxygen concentration and oxygen uptake rate, aeration system in fermenter, types and design of sparger.	***12***

Books Recommended:

Author	**Title**
1.Aiba S, Humphrey A.E. and Millis N.	Biochemical Engineering
2.Bailey J.E and Ollis D.F.	Biochemical Engineering Fundamentals
3.James M. Lee	Biochemical Engineering
4.Stanbury P.F, Whitaker A., Hall S.J	Principles of Fermentation Technology

Mapping of Course Outcome versus Program Outcome

Cos	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	1	1	2	2	1	1	1	1	3	0
CO2	3	2	3	3	2	2	1	1	1	2	1	0	2	0
CO3	2	3	2	2	2	1	2	2	2	2	0	1	2	0
CO4	3	3	3	1	2	1	1	3	1	1	1	0	3	0
CO5	2	2	3	3	1	2	3	1	2	1	1	1	1	0
Average	**2.60**	**2.60**	**2.60**	**2.20**	**1.60**	**1.40**	**1.80**	**1.80**	**1.40**	**1.40**	**1.00**	**1.00**	**2.20**	**0.00**

Title of the course	:	**Biochemical Engineering Lab**		
Subject Code	:	**FTP-713A**		
Weekly load(hours)	:	**4**	**LTP**	**0-0-4**
Credit	:	**2**		

Course Objectives:

1. To provide the basic knowledge about the various equipments related to biochemical engineering.
2. To impart basic knowledge about the growth and enzyme kinetics.
3. To understand the basic concepts of downstream processing.
4. To provide knowledge about the design and working of fermenter.

Course Outcomes:

On successful completion of the subject, the students will be able to

1. Acquaint themselves with the principles and functions of the various equipments and their parts.
2. Get practical knowledge about the microbial production processes.
3. Gain knowledge about the different downstream processing techniques.
4. Analyze the rate of any enzyme catalyzed biochemical reaction.
5. Get exposure about the different parts and working of the lab scale fermenter.

List of Practicals:

1. To acquaint with various equipments and their principle commonly used in biochemical engineering.
2. Growth kinetic study of *Aspergillusniger* using incubator and incubator shaker.
3. To study the effect of temperature and pH on enzyme activity.
4. To determine reaction rate and MichaelisMenten equation for enzyme.
5. Extraction and characterization of enzymes.
6. Immobilization of enzyme by using $cacl_2$.
7. To study the effect of substrate on enzyme production.
8. Filtration and centrifugation of enzyme for purification.
9. Cell homogenization and extracellular enzyme content.
10. Temperature effect on denaturation of enzyme.

Mapping of Course Outcome versus Program Outcome

Cos	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	1	3	1	1	2	0	0	0	3	0
CO2	2	2	1	2	2	1	2	1	0	0	0	0	2	0
CO3	3	2	2	3	1	2	3	2	3	0	0	0	2	0
CO4	1	2	1	2	3	2	3	3	1	0	0	0	1	0
CO5	3	2	3	2	1	1	1	3	0	0	0	0	3	0
Average	**2.40**	**2.20**	**1.80**	**2.40**	**1.60**	**1.80**	**2.00**	**2.00**	**2.00**	**0.00**	**0.00**	**0.00**	**2.20**	**0.00**

Title of the course	:	**Industrial Microbiology**	
Subject Code	:	**FTT-713B**	
Weekly load(hours)	:	**3**	**LTP 3-0-0**
Credit	:	**3**	

Course Objectives:

1. To provide the basic knowledge about the industrially important microorganisms.
2. To understand the basics of fermenter and different types of fermentation processes.
3. To understand the principles of secondary metabolite production.
4. To impart basic understanding of the utilization of the industrial waste.

Course Outcomes:

On successful completion of the subject, the students will be able to

1. Get exposure about the industrially important microorganisms.
2. Acquaint themselves with the basic principles of genetic engineering and its application in improving the characteristics of microorganisms for any industrial process.
3. Get knowledge about the design and working of fermenter.
4. Analyze and understand the industrial microbial processes in a better way.
5. Apply the knowledge for carrying out the microbial production of different products as well as its extraction and purification.

UNIT	***MAIN TOPIC***	***DETAILED CONTENTS***	***LECTURES***
I	***Introduction***	Introduction, scope and historical developments; Isolation screening and genetic improvement of industrially important organisms.	***10***
	Fermenter	Fermenter design and various types of fermentation systems (submerged, surface and solid state); Fermentation substrates, principles and production of amino acids, enzymes, nucleotides, organic acids, food colours, Baker's yeast, alcoholic beverages, vinegar.	***10***
II	***Secondary metabolites***	Principles and production of microbial proteins, lipids, polysaccharides and vitamins – properties and applications; mushroom cultivation.	***10***
	Industrial waste disposal and utilization	Utilization and disposal of industrial wastes through microorganisms; use of genetically modified microorganisms in food processing.	***10***

Books Recommended:

Author	Title
1. W.C. Frazier	Food Microbiology
2. H.J. Pleczar	Microbiology
3. J. Heritage	Introductory Microbiology
4. K.S. Bilgrami	Essentials of Microbiology
5. Casida	Industrial Microbiology
6. Stanbury P.F, Whitaker A., Hall S.J	Principles of Fermentation Technology

Mapping of Course Outcome versus Program Outcome

COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	0	0	1	3	0	0	2	1	1	2	1	3	2	0
CO2	3	2	3	3	1	3	2	2	0	2	3	2	2	3
CO3	0	0	3	3	3	0	3	0	0	1	3	2	2	3
CO4	0	3	3	3	0	0	2	2	0	1	1	2	3	3
CO5	2	2	1	3	2	3	3	1	1	1	1	3	2	3
Average	**2.50**	**2.33**	**2.20**	**3.00**	**2.00**	**3.00**	**2.40**	**1.50**	**1.00**	**1.40**	**1.80**	**2.40**	**2.20**	**3.00**

Title of the course	:	**Industrial Microbiology Lab**		
Subject Code	:	**FTP-713B**		
Weekly load (hours)	:	**4**	**LTP**	**0-0-4**
Credit	:	**2**		

Course Objectives:

1. To provide the basic understanding of the equipments used in the industrial microbiology lab.
2. To understand the working of the fermenter.
3. To gain knowledge about the microbial processes.
4. To understand the basic concepts of downstream processing for the recovery of the products.

Course Outcomes:

On successful completion of the subject, the students will be able to:

1. Gain knowledge about the different parts and working of the fermenter.
2. Identify, analyze, solve any problems associated during handing of the fermenter and carry out scale up studies of any fermentative process.
3. Gain practical knowledge about the utilization of various agro-industrial wastes for the various microbial processes.
4. Get insights about the fermentative processes and apply the microbiological skills for the microbial production of different products.
5. Get exposure about the downstream processes for the recovery of the products.

List of Practicals:

1. To study the different equipments used in the lab.
2. To study the working of the fermenter.
3. Preparation of various media for the growth of microorganisms.
4. To study the various techniques for the isolation of the pure culture.
5. To study the microbial production of enzymes.
6. To study the microbial production of beer.
7. To study the fermentation process of wine.
8. To study alcohol fermentation by *Saccharomyces cerevisae*.
9. To study the production of baker's yeast.
10. To study the production of vinegar by fermentation.
11. Production of biopigments.

Mapping of Course Outcome versus Program Outcome

COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	0	0	0	3	0	0	0	0	0	0	3	1	2
CO2	0	3	3	3	3	3	3	0	0	0	0	0	2	1
CO3	0	0	3	3	3	3	3	0	0	0	0	3	2	2
CO4	0	0	0	0	3	3	3	3	3	3	0	3	3	3
CO5	3	3	3	0	3	3	0	3	0	0	0	3	1	3
Average	**2.40**	**2.80**	**2.20**	**1.80**	**2.40**	**1.40**	**2.25**	**2.67**	**0.00**	**2.50**	**2.00**	**2.00**	**2.60**	**1.00**

Title of the course	:	**Numerical Computations in Food Processing**	
Subject Code	:	**FTO-721A**	
Weekly load(hours)	:	**3**	**LTP 3-0-0**
Credit	:	**3**	

Course Objectives:

1. To impart basic understanding of food process design requirements.
2. To apply different formulae to compute problems of iterative technique, basic numerical methods.
3. To analyze and solve food process engineering problems.
4. To understand computer modeling of selected food processing operation.

Course Outcomes:

1. Students will be able to understand food process design requirements.
2. They should able to solve the problems related to Basic Numerical Methods, errors in numerical computation, and the problems related to iterative technique.
3. Students will be able to solve out the problems regarding Fluid Flow in Pipes, System Resistance and Pump Selection
4. They can understand Psychrometric Processes and Drying Simulation Fluid-Particle Interactions in Separation and Transport Processes and Heat and Moisture Transfer in Food.
5. Course will enhance their technical competence of modeling of diffusion process, thermal processing of food and problems of heating and cooling operation, drying and aeration system.

UNIT	*MAIN TOPIC*	*DETAILED CONTENTS*	*LECTURES*
I	***Introduction***	Food Process Design Requirements and Numerical Computations, Algorithms and Iterative Techniques, Errors in Numerical Computations, Basic Numerical Methods	***10***
	Analyzing and Solving Food Process Engineering Problems	Fluid Flow in Pipes, System Resistance and Pump Selection Heat and Moisture Transfer in Food, Psychrometric Processes and Drying Simulation Fluid-Particle Interactions in Separation and Transport Processes	***15***
II	***Computer Modeling of Selected Food Processing Operations***	Analysis of Drying Data, Drying and Aeration Systems, Heating and Cooling Operations, Thermal Processing of Foods, Diffusion Processes	***15***

Books Recommended:

Author	**Title**
1. P.K. Chandra and R. P. Singh	Applied Numerical Methods for Food and Agricultural Engineers
2. S. C. Chapra and R. P. Canale	Numerical Methods for Engineers
3. R. T. Toledo	Fundamentals of Food Process Engg.

Mapping of Course Outcome and Program Outcome:

COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	3	2	2	3	1	0	0	0	2	2	2	2	0
CO2	3	2	3	2	3	2	2	2	0	0	2	2	2	1
CO3	2	3	2	2	2	1	3	3	0	2	2	3	3	0
CO4	3	3	2	2	2	2	2	3	0	3	3	1	3	0
CO5	3	3	2	1	2	1	2	0	0	3	1	2	3	0
Average	**2.40**	**2.80**	**2.20**	**1.80**	**2.40**	**1.40**	**2.25**	**2.67**	**0.00**	**2.50**	**2.00**	**2.00**	**2.60**	**1.00**

Title of the course	:	**Instrumental Techniques in Foods**	
Subject Code	:	**FTO-721B**	
Weekly load(hours)	:	**3**	**LTP3-0-0**
Credit	:	**3**	

Course Objectives:

1. Understand the fundamentals of chromatography and spectroscopy principles, instrumentation and advantages and disadvantages of the techniques
2. Perform data acquisition, interpret measurements and perform qualitative and quantitative analysis on selected foods.
3. Understand matrix effects.
4. Evaluate the performance of these techniques for rapid and routine analysis as compared to reference methods.

Course Outcomes:

Students will attain/acquire knowledge about ability to

1. define key terms related to qualitative and quantitative physical and chemical food analysis.
2. describe approaches necessary in sampling of food prior to its analysis.
3. describe the basic principles underlying analytical techniques associated with food analysis.
4. describe physical and chemical techniques necessary for chromatographic analysis and analytical instrumentation of food constituents.
5. demonstrate practical proficiency in a food analysis laboratory and critique the advantages and disadvantages of one method of food analysis versus another and select the appropriate instrumental procedure and course of action for a food analysis problem.

UNIT	*MAIN TOPIC*	*DETAILED CONTENTS*	*LECTURES*
I	**Introduction**	instrumental analysis in quality control, uses of instruments for quantitative and qualitative analysis, Refractometry and its application in foods, Specific gravity, polarimeter	***5***
	Sampling	Acceptance sampling: operational characteristics, risks, attribute sampling plans, administration of attribute, sampling error	
	Chromatography	General principles. Types and application, Partition and adsorption chromatography, Paper, thin layer, gas liquid, ion exchange and affinity chromatography. High Pressure Liquid Chromatography.	***6***
	Electrophoresis	Types, principles and application, Paper and gel electrophoresis. Polyacrylamide gel electrophoresis.	***2***
II	***Spectroscopy***	Beers and Lambert's Law. Extinction coefficient. General principles of colorimeters and spectrophotometers, AAS,	***6***

		Emmission spectroscopy, IR spectroscopy: NMR, FTIR. Flourimetry, Spectroflourometers.	
	Rheology, Morphology	Rheological properties of food by Viscometer, RVA, XRD, DSC, Thermogram	***6***

Books Recommended:

Author	**Title**
1. R. Wood, L. Foster, A. Damant and P. Key	Analytical Methods for Food Additives
2. Y. Pomeranz and C.E. Meloan	Food Analysis: Theory and Practice
3. Otles S	Handbook of food analysis instruments
4. Nielson	Food analysis

Mapping of Course Outcome and Program Outcome:

COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	0	0	0	0	1	0	0	0	2	3	2
CO2	3	2	3	0	0	0	0	1	0	0	0	2	2	3
CO3	3	2	2	0	0	0	0	1	0	0	0	2	2	2
CO4	3	2	3	0	0	0	0	1	0	0	0	2	3	3
CO5	3	2	2	0	0	0	0	1	0	0	0	2	1	3
Average	**3**	**2**	**2.6**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**2**	**2.2**	**2.6**

Title of the course	:	**Drying Technology**	
Subject Code	:	**FTO-721C**	
Weekly load (hours)	:	**3**	**LTP 3-0-0**
Credit	:	**3**	

Course Objectives:

1. To provide basic understanding about Water activity, Sorption isotherms and Hysteresis in sorption isotherms, its types and method.
2. To understand the concepts of drying of food, drying rate characteristic curve approach to correlate drying rates, Diffusion theories of drying and Biological changes during food drying processes.
3. To impart knowledge on Spray drying, Freeze and vacuum drying of foods.
4. To understand Post-drying aspects for meat and horticultural products and Food drier process control.

Course Outcomes:

1. Students will acquire knowledge of Water activity, Sorption isotherms and Hysteresis in sorption isotherms, its types and method.
2. They can be able to understand the drying of food, drying rate characteristic curve approach to correlate drying rates, Diffusion theories of drying.
3. They should be able to understand biological changes during food drying processes.
4. Course will enhance their knowledge on Spray drying, Freeze and vacuum drying of foods.
5. Course will enhance their technical competence or knowledge on Post-drying aspects for meat and horticultural products and Food drier process control.

UNIT	*MAIN TOPIC*	*DETAILED CONTENTS*	*LECTURES*
I	***Food processing and preservation***	Definition and significance, Sorption isotherms and Hysteresis in sorption isotherms, Types of sorption isotherms and hysteresis in isotherms, Determination of sorption isotherms	***4***
	Food drying fundamentals	Introduction to food materials, Drying of food, Physical properties of foods, Drying rate characteristic curve approach to correlate drying rates – Van Meel's method, Diffusion theories of drying, Different types of driers	***10***
	Biological changes during food drying processes	Introduction to drying and food quality, Post-drying problems, In-drying problems, Food bio-deterioration by drying – a sub-cell level approach	***6***

II	***Spray drying of food materials – process and product characteristics***	Introduction, Basic concepts of spray drying, Components of a spray drying system, drying of droplets, Mass and heat balances over a spray drier, drier efficiency, Powder characterization, Spray drying of various food products	***6***
	Freeze and vacuum drying of foods	Vacuum drying: principles and dehydration Models, Freeze drying: principles and dehydration models, Advances in vacuum and freeze drying of foods	***4***
	Post-drying aspects for meat and horticultural products	Introduction, State diagram and stability concepts of dried products, controlling quality attributes	***4***
	Food drier process control	Reason of process control, Manipulated and controlled variables, Control strategy, Control philosophy, Fundamental control methods, Advanced control methods	***4***

Books Recommended:

Author	**Title**
1. Xiao Dong Chen, Arun S. Mujumdar	Drying Technologies in Food Processing
2. Nema P.K., Kaur B., Mujumdar A.	Drying Technology for Foods: Fundamentals and Applications

Mapping of Course Outcome and Program Outcome:

COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	2	3	2	1	2	1	3	3	2
CO2	3	3	3	3	2	2	2	2	2	2	3	3	2	3
CO3	3	2	2	2	2	3	3	2	1	1	1	3	2	2
CO4	3	3	3	3	3	2	2	2	3	3	3	3	3	3
CO5	3	2	2	2	2	3	3	2	2	1	1	3	1	3
Average	**3**	**2.6**	**2.6**	**2.6**	**2.4**	**2.4**	**2.6**	**2**	**1.8**	**1.8**	**1.8**	**3**	**2.2**	**2.6**

Title of the course	:	**Food Biotechnology**	
Subject Code	:	**FTT-721**	
Weekly load(hours)	:	**3**	**LTP 3-0-0**
Credit	:	**3**	

Course Objectives:

1. To provide the basic understanding about food biotechnology and its application.
2. To gain knowledge about the microbial production of the different food products.
3. To provide the knowledge about the mutations and gene cloning techniques and its applications.
4. To impart understanding about the different wastes generated from the food industry and its treatment.

Course Outcomes:

On successful completion of the subject, the students will be able to

1. Get exposure about the food biotechnology and its multidisciplinary approach.
2. Identify, analyze and solve problems regarding the different microbial processes.
3. Get insight with various important terms and techniques such as gene cloning and DNA fingerprinting.
4. Acquaint themselves with the fundamentals of plant tissue culture techniques.
5. Get knowledge about the different types of wastes generated from food industry and their treatment techniques.

UNIT	*MAIN TOPIC*	*DETAILED CONTENTS*	*LECTURES*
I	***Introduction***	History, scope and present status of biotechnology in India in relation to food technology and its general applications.	***5***
	Microbial production of products	Single cell proteins, organic acids (lactic and citric acid), antibiotics and vitamins with special reference to substrates and optimum conditions for growth of microorganism.	***6***
	Enzyme technology	Sources of enzymes, advantages of microbial enzymes, extraction and purification of enzymes, applications of enzymes in food industry.	***6***
	Tissue culture technology	Definition, cellular totipotency, somatic hybridization, protoplast fusion, applications.	***5***
II	***Mutation and repair mechanisms***	Mutation, mutagens, types of mutations, repair mechanisms, photo-reactivation repair and excision repair, applications of mutations in strain improvement.	***6***
	Techniques of genetic engineering	Gene cloning procedures-general outline, recombinant DNA technology, different vectors involved plasmids,	***8***

		cosmids&phagemids, transfer of recombinant molecules into host organisms, genetically modified foods.	
	Environmental biotechnology	Biochemical oxygen demand, chemical oxygen demand, aerobic and anaerobic methods of treatment of food industry wastes with special reference to methanogenesis. BIS standards for safer disposal of industrial waste water	***6***

Books Recommended:

Author	**Title**
1. PS Panesar, SS Marwaha	Biotechnology in Agriculture & Food Processing
2. P.K. Gupta	Biotechnology
3. PS Panesar, SS Marwaha, HK Chopra	Enzymes in Food Processing
4.SS Marwaha	Food Processing: Biotechnological Applications
5.Crueger and Crueger	Biotechnology

Mapping of Course Outcome versus Program Outcome

COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	0	0	0	0	0	0	0	0	0	0	3	3	2
CO2	0	3	3	3	3	0	0	0	0	0	0	0	2	3
CO3	3	0	0	0	3	3	3	3	0	0	0	3	2	2
CO4	0	0	0	0	3	3	0	0	0	0	0	3	3	3
CO5	3	0	0	0	0	3	3	0	0	0	0	0	1	3
Average	**1.8**	**0.6**	**0.6**	**0.6**	**1.8**	**1.8**	**1.2**	**0.6**	**0**	**0**	**0**	**1.8**	**2.2**	**2.6**

Title of the course	:	**Food Biotechnology Lab**		
Subject Code	:	**FTP-721**		
Weekly load(hours)	:	**2**	**LTP**	**0-0-2**
Credit	:	**1**		

Course Objectives:

1. To provide the basic understanding about the basic equipments used in biotechnology lab.
2. To understand about the growth pattern of the microorganisms.
3. To gain knowledge about the microbial production of the different products.
4. To impart understanding about the determination of pollution load of food industry waste.

Course Outcomes:

On successful completion of the subject, the students will be able to

1. Competent in handling the equipments single handily.
2. Get knowledge about the microbial growth pattern of the microorganisms and how environmental factors affect the growth of microorganisms
3. Gain practical knowledge about the various fermentation processes.
4. Apply the knowledge for the fermentation of the different products (enzymes, lactic acid, ethanol, etc.).
5. Get practical knowledge about BOD as well as COD content of the waste water and its application in food industry.

List of Practicals:

1. To study different equipments related to Biotechnology.
2. Preparation of various media for culturing of microbes.
3. To enumerate the cells in the given sample by using haemocytometer.
4. To study the effect of pH on the growth of microorganisms.
5. To study the %age viability of the inoculum.
6. To study the disruption of cells using mechanical method.
7. To study the production of ethanol by bacterial fermentation.
8. To study the production of ethanol by yeast fermentation.
9. To study the production of an enzyme by given organism.
10. To study the production of ethanol by bacterial fermentation
11. Microbial production of citric acid.
12. Microbial production of lactic acid.
13. To determine Biochemical Oxygen Demand of a given sample
14. To determine Chemical Oxygen Demand of a given sample.
15. Demonstration of mutagenesis using UV radiations method.

Mapping of Course Outcome versus Program Outcome

COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	0	0	0	0	0	0	0	0	0	0	3	3	2
CO2	3	0	0	0	0	3	3	0	0	0	0	0	2	3
CO3	0	3	3	0	3	3	3	3	0	0	0	0	2	2
CO4	0	3	3	0	3	3	3	0	3	0	0	3	3	3
CO5	3	0	0	0	0	3	3		0	0	0	3	1	3
Average	**1.8**	**1.2**	**1.2**	**0**	**1.2**	**2.4**	**2.4**	**0.75**	**0.6**	**0**	**0**	**1.8**	**2.2**	**2.6**

Title of the course	:	**Innovative Techniques in Food Processing**
Subject Code	:	**FTT-722**
Weekly load(hours)	:	**3** **LTP 3-0-0**
Credit	:	**3**

Course Objectives:

1.To provide basic understanding on the concept of various novel food preservation techniques.

2. To make student aware on design of novel process equipments.

3. To make student aware on application of novel processing techniques in the preservation of foods.

Course Outcomes:

1. Student will acquire basic concept and idea of various novel food processing and preservation techniques
2. Student will acquire knowledge on design of novel process equipments.
3. Student will acquire knowledge of application of novel processing of food preservation.
4. Student will acquire knowledge on the application of novel processing techniques on the survival of pathogenic/food spoilage microorganism.
5. Student will acquire knowledge on the application of electrical properties in food processing and preservation.

UNIT	*MAIN TOPIC*	*DETAILED CONTENTS*	*LECTURES*
I	***Membrane technology***	Understanding the concept of pressure activated membrane processes: microfiltration, UF, NF and RO Identification of parameters for designing of UF, NF and RO modules. Application of UF, NF and RO modules in food processing industrial.	***6***
	Supercritical fluid extraction	Understanding the concept near critical fluids NCF and super critical extraction. Identification of parameters for designing NCF and super critical extraction equipment. Application of NCF and super critical extraction process in food processing.	***4***
	Microwave and radio frequency processing	Definition, advantages, mechanism of heat generation in microwave and radio frequency technology. Identification of parameters for designing microwave and radio frequency heating equipment.	***6***

		Application of microwave and radio frequency technology process in food processing.	
II	***Hurdle technology***	Types of preservation techniques and their principles, concept of hurdle technology and its application.	***4***
	High Pressure processing	Understanding the concept of high pressure processing technology with reference to the mechanism of microbial inactivation . Identification of parameters for designing of HPP equipment. Application of HPP application in food processing.	***4***
	Ultrasonic processing	Understanding the concept of ultrasonic processing technology with reference to the mechanism of microbial inactivation. Identification of parameters for designing of ultrasonic process equipment. Application of ultrasonication in food processing.	***4***
	Newer techniques in food processing	Understanding the concept of high intensity light, pulse electric field, ohmic heating, IR heating, inductive heating and pulsed X-rays technology with reference to the mechanism of microbial inactivation. Identification of parameters for designing of process equipment based on concept of high intensity light, pulse electric field, ohmic heating, IR heating, inductive heating and pulsed X-rays. . Application of high intensity light, pulse electric field, ohmic heating, IR heating, inductive heating and pulsed X-rays in food processing and preservation.	***12***
	Nanotechnology	Principles and applications in foods with special reference to nano-composite packaging films and nano-emulsion as carrier of biomolecules while developing functional food products.	***4***

Books Recommended:

Author **Title**

1. G. W. Gould New Methods of Food Preservation
2. R.P.Singh Introduction to Food Engineering
3. Barbosa-Canovas Novel Food Processing Technologies

Mapping of Course Outcome and Program Outcome:

COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	1	1	1	2	1	0	0	0	3	2
CO2	3	2	1	2	1	1	1	2	1	0	0	0	3	1
CO3	3	2	1	2	1	1	1	2	1	0	2	0	3	1
CO4	2	2	2	2	1	1	1	2	1	0	2	1	3	2
CO5	3	0	3	2	1	1	1	2	1	0	0	0	3	2
Average	**2.80**	**2.00**	**1.80**	**1.80**	**1.00**	**1.00**	**1.00**	**2.00**	**1.00**	**0.00**	**2.00**	**1.00**	**3.00**	**1.60**

Title of the course	:	**Health and Functional Foods**	
Subject Code	:	**FTT-723A**	
Weekly load(hours)	:	**3**	**LTP 3-0-0**
Credit	:	**3**	

Course Objectives:

1. To provide basic knowledge on various food bioactive components showing health benefits
2. To make aware on various sources of bioactive components showing health benefits
3. To make student aware on use bioactive components exhibiting nutraceutical and functional food in alleviating disease/disorder.
4. To know about selection of raw material and their processing, storage and packaging of bioactive components and functional foods

Course Outcomes:

Students will attain/acquire knowledge about

1. various bioactive components showing health benefits.
2. various physiological and biochemical aspects of life threatening and chronic diseases and effect of various bioactive components on such diseases.
3. selection of raw material, processing and packaging requirements and changes during storage of bioactive components.
4. safety and legal aspects of nutraceutical and functional food.
5. factors affecting marketing of functional foods and nutraceutical.

UNIT	*MAIN TOPIC*	*DETAILED CONTENTS*	*LECTURES*
I	***Introduction***	Definition, status and scope of health and functional foods in India, Definition of nutraceuticals and their importance.	***5***
	Types of functional foods	Types of health and functional foods and their properties	***5***
	Food constituents	Various food constituents responsible for functional effects -Anti-carcinogenic, hypocholesterolemic and hypoglycemic foods - Dietatic foods, anti-ageing foods - Fortified foods, diabetic foods - Biofedic, prebiotics and probiotic foods	***10***
II	***Processing and selection criteria***	Processing of health and functional foods, criteria for selection of raw materials, and their processing.	***6***
	Storage, packaging and labeling	Storage, packaging and labeling of health and functional food.	***4***
	Marketing aspects	Marketing aspects of health and functional foods	***4***

	Safety aspects	Safety / Legal aspects of health and functional foods.	***4***
	Organic and GM foods	Organic foods and Genetically Modified (GM) foods in relation to health	***4***

Books Recommended:

Author	**Title**
1. Chadwick, Henson, Moseley	Functional Foods
2. W. Jeffrey Hurst	Methods of Analysis for Functional Foodsand Nutraceuticals
3. Mazza	Functional Foods
4. Robert E.C. Wildman	Handbook of Nutraceuticals and Functional Foods

Mapping of Course Outcome and Program Outcome:

COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	0	2	1	1	1	2	1	0	0	0	3	0
CO2	3	2	2	2	1	1	1	2	1	0	0	0	3	1
CO3	3	2	2	2	1	1	1	2	1	0	2	0	3	1
CO4	3	2	2	2	1	1	1	2	1	0	2	1	3	2
CO5	3	0	3	2	1	1	1	2	1	0	0	1	3	2
Average	**3.00**	**2.00**	**2.25**	**2.00**	**1.00**	**1.00**	**1.00**	**2.00**	**1.00**	**0.00**	**2.00**	**1.00**	**3.00**	**1.50**

Title of the course	:	**Health and Functional Foods Lab**	
Subject Code	:	**FTP-723A**	
Weekly load(hours)	:	**2**	**LTP0-0-2**
Credit	:	**1**	

Course Objectives:

1. To enable the students to estimate different bioactive components present in various foods.
2. To facilitate the students to know antioxidative capacity of various bioactive components
3. To enable the students to know application of chromatography for estimation of bioactive constituents.
4. To help the students to know changes in bioactive components during processing.

Course Outcomes:

It will enable the students to

1. Estimate various bioactive components present in the foods
2. Estimate the antioxidative capacity of various bioactive components
3. Various analytical techniques involved in estimation of antioxidative properties
4. Know effect of processing on bioactive components
5. Select type of packaging systems and effect of storage on quality of functional foods and nutraceutical

List of Practicals:

1. Determination of antioxidant activity of given food sample.
2. Determination of total phenolic content of given food sample.
3. Estimation of dietary fibers of given food sample.
4. Estimation of lycopene in tomato.
5. Estimation of carotenoids of given food sample.
6. Determination of total flavonoid content of given food sample
7. Determination of vitamins A and Vitamin C.
8. Determination of beta carotene of given food sample.
9. To determine gas chromatography for bioactive components analysis.
10. To study the effect of drying on bioactive components of food sample
11. Packaging requirement of functional foods.
12. To study the storage kinetics of nutraceutical.

Mapping of Course Outcome and Program Outcomes:

COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	0	0	0	0	0	1	0	0	0	2	3	0
CO2	3	2	2	0	0	0	0	1	0	0	0	2	3	1
CO3	3	2	2	0	0	0	0	1	0	0	0	2	3	1
CO4	3	2	2	0	0	0	0	1	0	0	0	2	3	2
CO5	3	0	3	0	0	0	0	1	0	0	0	2	3	2
Average	**3.00**	**2.00**	**2.25**	**0.00**	**0.00**	**0.00**	**0.00**	**1.00**	**0.00**	**0.00**	**0.00**	**2.00**	**3.00**	**1.50**

Title of the course	:	**Food Additives and Ingredients**	
Subject Code	:	**FTT-723B**	
Weekly load(hours)	:	**3**	**LTP 3-0-0**
Credit	:	**3**	

Course Objectives:

1. To know about food additives
2. To learn about role of food additives in food quality control
3. To understand the techniques of best use of food additives
4. To understand the role of food additives in health maintenance and cure of diseases

Course Outcomes:

On successful completion of the subject, the students will be able to

1. It will help to understand about the use of food additives in food formulations
2. The students can best understand the suitable application of food ingredients in health foods and convenience food preparation
3. Students can learn the techniques of food additives stability and use level, familiarize various naturally occurring food additives
4. Familiarize various aspects of food production and application of food additives
5. It helps to learn the students about the techniques used to in the preparation of natural food additives

UNIT	*MAIN TOPIC*	*DETAILED CONTENTS*	*LECTURES*
I	***Food additives***	Definitions, classification and functions, Preservatives, antioxidants, colors and flavors (synthetic and natural), emulsifiers, sequesterants, humectants, hydrocolloids, sweeteners, acidulants, buffering salts, anticaking agents, etc. - chemistry, food uses and functions in formulations; indirect food additives; toxicological evaluation of food additives	***12***
	Flavour technology	Types of flavors, flavors generated during processing – reaction flavors, flavor composites, stability of flavours during food processing, analysis of flavours, extraction techniques of flavours, flavour emulsions; essential oils and oleoresins; authentication of flavours etc.	***12***
II	***Proteins, starches and lipids as***	Isolation, modification, specifications, functional properties and applications in foods and as nutraceuticals	***10***

	functional ingredient		
	Applications	Manufacturing and applications of fibres from food sources, fructo-oligosaccharides.	***8***

Books Recommended:

Author	**Title**
1. S.N. Mohindru	Food Additives (Vol I&II)
2. Pomeranz	Food Analysis

Mapping of Course Outcome and Program Outcomes:

COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	3	1	1	2	2	1	2	2	1	2	1
CO2	1	2	2	1	1	2	2	3	2	2	1	1	3	1
CO3	2	2	1	1	1	3	2	1	2	3	2	2	1	3
CO4	1	3	3	2	2	1	2	1	0	2	1	1	3	1
CO5	3	2	2	1	2	2	3	1	0	1	2	2	3	2
Average	**1.8**	**2**	**1.8**	**1.6**	**1.4**	**1.8**	**2.2**	**1.6**	**1**	**2**	**1.6**	**1.4**	**2.4**	**1.6**

Title of the course	:	**Food Additives and Ingredients Lab**	
Subject Code	:	**FTP-723B**	
Weekly load(hours)	:	**2**	**LTP 0-0-2**
Credit	:	**1**	

Course Objectives:

1. To know about practical methods involved in food additives analysis
2. To practically determine the role of food additives in food quality control
3. To know about practical methods involved in food additives analysis
4. To practically determine the role of food additives in food quality control

Course Outcomes:

On successful completion of the subject, the students will be able to

1. It will help to understand about the use of food additives in food formulations
2. Students can learn the techniques of food additives stability and use
3. Determine functional properties of protein, carbohydrates
4. Determine functional properties of lipids
5. To learn extraction methods of essential oils and other components

List of Practicals:

1. Estimation of preservatives
2. Estimation of sweeteners
3. Estimation of fibers
4. Estimation of colors
5. Estimation of antioxidants
6. Estimation of flavour enhancers
7. Isolation, modification, and functional properties of native proteins
8. Isolation, modification, and functional properties of modified proteins
9. Isolation, modification, and functional properties of starches
10. Isolation, modification, and functional properties of lipids
11. Extraction of essential oil
12. Extraction of oleoresins
13. Applications of additives and ingredients in foods.

Mapping of Course Outcome and Program Outcome:

COs	Programme Outcomes (POs)												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	0	0	0	0	2	0	1	2	0	3	2	0
CO2	1	3	1	1	3	0	2	0	0	1	1	2	2	0
CO3	1	1	1	0	2	0	2	3	0	1	0	0	1	0
CO4	1	2	2	2	3	0	0	1	3	0	2	0	1	0
CO5	1	0	0	0	0	2	0	0	2	2	1	2	3	0
Average	**1.50**	**2.33**	**1.50**	**1.50**	**2.67**	**2.00**	**2.00**	**2.00**	**2.00**	**2.00**	**1.33**	**2.33**	**2.60**	**0.00**