B. E.

in

FOOD TECHNOLOGY

(APPLICABLE FOR STUDENTS ADMITTED FROM THE ACADEMIC YEAR 2021-2022 ONWARDS)

SCHEME & SYLLABUS

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

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)

1. To develop the ability to apply the knowledge of Science, Mathematics, Computing and basic Engineering fundamentals to make students capable to analyse, interpret and design.
2. To develop the capability to apply latest engineering tools and techniques in Food processing with respect to social and global framework.
3. To create competent Professionals inculcated with leadership qualities and ethical responsibilities.
4. To develop the ability to communicate proficiently and work in a multidisciplinary team and competitive environment.
5. 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 analyse 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 modelling 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, analyse 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.

Semester-I Group-B (FET)							
S No	**Sub Code**	**Subject Name**	**L**	**T**	**P**	**Hrs.**	**Credits**
1	BSMA-401	Engineering Mathematics I	3	1	0	4	4
2	BSCH-401	Applied Chemistry	3	1	0	4	4
3	ESME-401	Elements of Mechanical Engineering	2	1	0	3	3
4	ESME-402	Workshop Technology and Practice	1	0	0	1	1
5	HSMC-401	English Communication and Soft Skills	1	0	0	1	1
6	BSCH-402	Applied Chemistry Lab	0	0	2	2	1
7	ESME-403	Elements of Mechanical Engineering Lab	0	0	2	2	1
8	ESME-404	Engineering Drawing	0	0	4	4	2
9	ESME-405	Workshop Technology and Practice Lab	0	0	4	4	2
10	HSMC-402	English Communication and Soft Skills Lab	0	0	2	2	1
11	MCCH-401	Environmental Studies	3	0	0	3	0
		Total	13	3	14	30	20
Semester-II A Group-B (FET)							
S No	**Sub Code**	**Subject Name**	**L**	**T**	**P**	**Hrs.**	**Credits**
1	BSMA-402	Engineering Mathematics II	3	1	0	4	4
2	BSPH-401	Applied Physics	3	1	0	4	4
3	ESEE-401	Elements of Electrical Engineering	2	1	0	3	3
4	ESCS-401	Elements of Computer Engineering	2	0	0	2	2
5	ESEC-401	Elements of Electronics Engineering	2	0	0	2	2
6	BSPH-402	Applied Physics Lab	0	0	2	2	1
7	ESEE-402	Elements of Electrical Engineering Lab	0	0	2	2	1
8	ESCS-402	Elements of Computer Engineering Lab	0	0	4	4	2
9	ESEC-402	Elements of Electronics Engineering Lab	0	0	2	2	1
		Total	12	3	10	25	20
Semester-II B Group-B (FET)							
1	TPIN-421	Practical Training During Summer Vacations (In-house) 02 weeks				80	1 (S/US)
2	TPIN-422	Technical Competency					1 (S/US)

	Semester-III Group B (FET)						
S No	**Sub Code**	**Subject Name**	**L**	**T**	**P**	**Hrs.**	**Credits**
1	ESME-501	Engineering Mechanics	3	1	0	4	4
2	PCFT-511	Food Chemistry	3	1	0	4	4
3	PCFT-512	Food Microbiology	3	0	0	3	3
4	PCFT-513	Heat and Mass Transfer	3	1	0	4	4
5	HSMC-501	Principles of Management	3	0	0	3	3
6	PCFT-514	Heat and Mass Transfer Lab	0	0	2	2	1
7	PCFT-515	Food Chemistry and Microbiology Lab	0	0	2	2	1
8	MCMH-501	Indian Constitution	3	0	0	3	0
		Total	18	3	4	25	20
	Semester-IVA Group B (FET)						
S No	**Sub Code**	**Subject Name**	**L**	**T**	**P**	**Hrs.**	**Credits**
1	BSMA-501	Numerical and Statistical Methods	3	0	0	3	3
2	BSMA-502	Numerical and Statistical Methods Lab	0	0	2	2	1
3	BSBL-501	Biology for Engineers	2	0	0	2	2
4	PCFT-521	Food Biochemistry and Nutrition	3	1	0	4	4
5	PCFT-522	Food Biotechnology	4	0	0	4	4
6	PCFT-523	Food Engineering	3	1	0	4	4
7	PCFT-524	Food Engineering Lab	0	0	2	2	1
8	PCFT-525	Food Biochemistry and Nutrition and Biotechnology Lab	0	0	2	2	1
		Total	15	2	6	23	20
Semester-IVB (FET)							
1	TPID-521	Industrial Training 02 weeks				80	1 (S/US)
2	EAA-521+	Fractional credit course/Extra Academic Activity +GROUP A/B/C					1 (S/US)

Semester-V-A Group-B (FET)							
S No	**Sub Code**	**Subject Name**	**L**	**T**	**P**	**Hrs.**	**Credits**
1	PCFT-611	Technology of Animal Product	3	0	0	3	3
2	PCFT-612	Dairy Technology	3	0	0	3	3
3	PCFT-613	Animal Product Technology and Dairy Technology Lab	0	0	4	4	2
4	OEXX-611	Open Elective-I	3	0	0	3	3
5	OEXX-612	Open Elective-II	3	0	0	3	3
6	PEFT-611	Professional Elective-I	3	0	0	3	3
7	HSMC-603	Engineering Economics and Entrepreneurship	3	0	0	3	3
		Total	18	0	2	20	20
Semester-V-B Group-B (FET)							
1	EAA-611+	Fractional credit course/ Extra Academic Activity +GROUP A/B/C					1 (S/US)
Semester-VI-A Group-B (FET)							
S No	**Sub Code**	**Subject Name**	**L**	**T**	**P**	**Hrs.**	**Credits**
1	PCFT-621	Technology of Cereal, Pulses and Oilseeds Processing	3	1	0	4	4
2	PCFT-622	Technology of Fruits and Vegetable Products	3	0	0	3	3
3	PCFT-623	Plant Foods Lab	0	0	2	2	1
4	OEXX-621	Open Elective-III	3	0	0	3	3
5	OEXX-622	Open Elective-IV	3	0	0	3	3
6	PEFT-621	Professional Elective-II	3	0	0	3	3
7	HSMC-601	Technical Communication	2	0	0	2	2
8	HSMC-602	Technical Communication lab	0	0	2	2	1
		Total	17	1	4	22	20
Semester-VI B Group-B (FET)							
1	TPID-621	Industrial Training 04 weeks				160	2 (S/US)
2	EAA-621+	Fractional credit course/ Extra Academic Activity +GROUP A/B/C					1 (S/US)

Semester-VII Group-B (FET)							
S No	**Sub Code**	**Subject Name**	**L**	**T**	**P**	**Hrs.**	**Credits**
1	PCFT-711	Food Analysis and Quality Control	3	1	0	4	4
2	PCFT-712	Packaging Technology	3	0	0	3	3
3	PCFT -713	Food Analysis, Quality Control and Packaging Technology Lab	0	0	2	2	1
4	OEXX-711	Open Elective-V	3	0	0	3	3
5	PEFT-711	Professional Elective - III	3	1	0	4	4
6	PEFT-712	Professional Elective - IV	3	0	0	3	3
7	PRFT-711	Project Stage I and Seminar	0	0	4	4	2
		Total	15	2	6	23	20
	Semester-VIII Group B (FET)						
S No	**Sub Code**	**Subject Name**	**L**	**T**	**P**	**Hrs.**	**Credits**
1	PEFT-721	Professional Elective - V	3	0	0	3	3
2	PEFT-722	Professional Elective - VI	3	0	0	3	3
3	PRFT-721	Project Stage - II	0	0	12	12	6
		Total	6	0	12	18	12
OR							
S No	**Sub Code**	**Subject Name**	**L**	**T**	**P**	**Hrs.**	**Credits**
1	INID-721	Internship in Industry	0	0	40	40	6
2	PRFT-721	Project Stage - II	0	0	12	12	6
		Total	0	0	12	12	12

LIST OF OPEN ELECTIVES COURSES

S.NO.	Sub. Code	Subject Name	L	T	P	Hrs.	Credits
1	**OEFT-611**	**Open Elective-I**	3	0	0	3	3
a)	OEFT-611A	Separation Technology	3	0	0	3	3
b)	OEFT-611B	Biochemical Engineering	3	0	0	3	3
2	**OEFT-612**	**Open Elective-II**	3	0	0	3	3
a)	OEFT-612A	Principle of Food Processing	3	0	0	3	3
b)	OEFT-612B	Principle of Food Preservation	3	0	0	3	3
3	**OEFT-621**	**Open Elective-III**	3	0	0	3	3
a)	OEFT-621A	Food and Nutrition	3	0	0	3	3
b)	OEFT-621B	Unit Operations in Food Processing	3	0	0	3	3
4	**OEFT-622**	**Open Elective-IV**	3	0	0	3	3
a)	OEFT-622A	Fundamentals of Biotechnology	3	0	0	3	3
b)	OEFT-622B	Food Laws and Regulations	3	0	0	3	3
5	**OEFT-711**	**Open Elective-V**	3	0	0	3	3
a)	OEFT-711A	Flavor Technology	3	0	0	3	3
b)	OEFT-711B	Food Plant Sanitation and Waste Management	3	0	0	3	3

LIST OF PROFESSIONAL ELECTIVES COURSES

S.NO	Sub. Code	Subject name	L	T	P	Hrs	Credits
1	**PEFT-611**	**Professional Elective-I**	3	0	0	3	3
a)	PEFT-611A	Fluid Flow Operation	3	0	0	3	3
b)	PEFT-611B	Post-harvest Engineering	3	0	0	3	3
2	**PEFT-621**	**Professional Elective-II**	3	0	0	3	3
a)	PEFT-621A	Food Storage Engineering	3	0	0	3	3
b)	PEFT-621B	Technology of Bakery and Confectionary Products	3	0	0	3	3
3	**PEFT-711**	**Professional elective-III**	3	0	0	3	3
a)	PEFT-711A	Health and Functional Food	3	0	0	3	3
b)	PEFT-711B	Technology of Food Plant by Product Utilization	3	0	0	3	3
4	**PEFT-712**	**Professional Elective-IV**	3	0	0	3	3
a)	PEFT-712A	Technology of Beverages	3	0	0	3	3
b)	PEFT-712B	Industrial Microbiology	3	0	0	3	3
5	**PEFT-721**	**Professional Elective-V**	3	0	0	3	3
a)	PEFT-721A	Food Additives and Ingredients	3	0	0	3	3
b)	PEFT-721B	Technology of Fats and Oils	3	0	0	3	3
6	**PEFT-722**	**Professional Elective-VI**	3	0	0	3	3
a)	PEFT-722A	Food Processing Plant Layout and Design	3	0	0	3	3
b)	PEFT-722B	Innovative Techniques in Food Processing	3	0	0	3	3

LIST OF SUBJECTS TO BE OFFERED FOR HONOR DEGREE IN FOOD TECHNOLOGY

Semester	Sub. Code	Subject name	L	T	P	Hrs	Credits
V	HDFT-611	Enzymes in Food Processing	3	1	0	4	4
V	HDFT-612	Basic Agricultural Process Engineering	3	1	0	4	4
VI	HDFT-621	Instrumental Techniques in Food	3	1	0	4	4
VII	HDFT-711	Food Rheology	3	1	0	4	4
VIII	PHFT-721	Project Honors	0	0	8	8	4
		Total	12	4	8	24	20

LIST OF SUBJECTS TO BE OFFERED FOR MINOR DEGREE IN FOOD TECHNOLOGY

Semester	Sub. Code	Subject name	L	T	P	Hrs	Credits
III	MDFT-511	Food Processing and Preservation	3	1	0	4	4
IV	MDFT-521	Food Biochemistry and Nutrition	3	1	0	4	4
V	MDFT-611	Plant Food Product Technology	3	1	0	4	4
VI	MDFT-621	Unit Operations in Food Engineering	3	1	0	4	4
VII	MDFT-711	Engineering Properties of Foods	3	1	0	4	4
		Total	15	5	0	20	20

Structure of BE (Food Technology) program in comparison with the model curriculum

Course Components	Curriculum Content (% of total number of credits of the program)	Total number of contact hours	Total number of credits	As Per AICTE
Basic Sciences	15.0	27	24	25
Engineering Sciences	15.0	33	24	24
Humanities and Social Sciences	6.9	13	11	12
Program core	31.9	57	51	48
Program Electives	11.9	19	19	18
Open electives	9.4	15	15	18
Projects	5.0	16	8	15
Practical/Industrial Training	3.1	4	5	
Extra Academic activities	1.9	11	3	
Total number of Credits			**160**	**160**

Title of the course : **Food Chemistry**

Subject Code : **PCFT - 511**

L	T	P	Credits	Weekly Load
3	1	0	4	4

Course Objective: Objective of this course is to impart knowledge about

- To develop an understanding of how individual food components contributes to the overall quality of foods during processing and storage.
- To provide an understanding of the chemical changes that takes place with food components during processing and storage and their effects on sensory and nutritional quality, functional properties, and safety of foods.
- To familiarize the student with common analytical and experimental methods used in the study of the food components, food safety and food control.
- To examine the basis of food chemistry-related issues in food safety, regulation and current events.

Course Outcomes:

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

CO1	Explain about chemical composition and structure of macro- and micro-constituents of food and their functions in foods quality control	Understanding
CO2	Describe physicochemical aspects of food constituents and their interaction with food	Understanding
CO3	Elaborate the role of nutrients in different food product stability, and effect of processing	Understanding
CO4	The students will be able to elaborate the role of nutrients in different food product stability, and effect of processing	Applying
CO5	Evaluate impact on food constituents during food processing along with analytical technique, principles and methodology for their estimation and quality analysis/control	Applying

Mapping of Course Outcome and Program Outcome:

CO/PO Mapping (No correlation (0) / Weak (1) / Medium (2) / Strong (3) indicates strength of correlation)														
COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	0	0	2	0	1	0	1	0	0	3	3	2
CO2	2	3	1	2	0	3	1	0	2	3	3	3	3	2
CO3	2	2	2	0	0	1	2	2	2	1	1	1	3	2
CO4	0	2	2	3	3	1	0	3	2	0	3	3	3	3
CO5	1	1	1	3	2	2	3	3	3	2	3	3	3	3
Average	**1.6**	**2**	**1.2**	**1.6**	**1.4**	**1.4**	**1.4**	**1.6**	**2**	**1.2**	**2**	**2.6**	**3**	**2.2**

Unit	Main Topics	Course Outlines	Lecture (s)
I	**Introduction**	Developments in food chemistry and role of food chemist in food processing and preservation, food control, safety and adulteration prevention.	**3**
	Water	Importance of water in foods. Structure of water & ice. Concept of bound & free water and their implications. Water activity: Principles, measurement, control, effects, related concepts, water migration and basis for food preservation, Sorption isotherms, Dispersed systems in food	**6**
	Proteins	Classification, structure, chemistry. Physical and chemical characteristics of amino acids and proteins. Isolation and purification of amino acids, peptides, proteins. Qualitative and quantitative analysis of amino acids and proteins. Effects of food processing: changes occurring in chemical, functional & nutritional properties of proteins. Roles of proteins in food structure, color, flavor, and texture	**12**
	Lipids	Structure, classification, physical and chemical properties, Utilization of fats and oils in margarine, shortenings, salad and cooking oils. Importance of fats and oils in food product development and diet. Roles of lipids in food structure, color, flavor, and texture.	**8**

II	**Carbohydrates**	Classification, structure. Physical and chemical properties and functions of saccharides (Sugar derivatives, oligosaccharides, starch, hemi-cellulose and pectic substances). Dietary fiber: components, properties, analysis. Changes in carbohydrates during processing. Roles of carbohydrates in food structure and texture.	**10**
	Browning reactions	Enzymatic and non-enzymatic browning reactions and their influence on color, flavor, and texture of raw and processed food, control of browning reactions.	**6**
	Vitamins	Sources, types, chemistry and functions. Effect of processing and control	**6**
	Plant pigments	Structure, sources, importance and properties of chlorophyll, anthocyanins, carotenoids, flavanoids, and myoglobin. Chemical changes during processing and control	**6**
	Flavor and aroma of foods	Theory of flavour and taste. Importance and techniques of retention of flavour and aroma in foods.	**5**
		Total	**61**

Books Recommended:

Author	**Title**
1. Meyer	Food Chemistry
2. Fenemma	Food Chemistry
3. Belitz	Food Chemistry
4. Lee	Basic Food Chemistry
5. Lehninger	Principles of Biochemistry

Title of the course : **Food Microbiology**

Subject Code : **PCFT - 512**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Objectives: Objective of this course is to impart knowledge about

- Food microbiology and microorganisms
- Various techniques in handling of microorganisms
- The role of microorganisms in the production of various food products
- The association of microorganisms in food spoilage and their control

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

CO1	Discuss the morphology, structure and reproduction of Microorganism	Understanding
CO2	Recognize the Microbial growth and death kinetics and apply the techniques of pure culture.	Applying
CO3	Explain the Microbiology and Microbial spoilage of Food products.	Understanding
CO4	Describe spoilage microorganism, toxin produced and there effect on Human.	Understanding
CO5	Implement the knowledge of various methods for Microbial Control	Applying

Mapping of Course Outcome and Program Outcome:

CO/PO Mapping

(No correlation (0) / Weak (1) / Medium (2) / Strong (3) indicates strength of correlation)

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

Unit	Main Topics	Course Outlines	Lecture (s)
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 pathogens-Salmonella, Bacillus, Listeria, E. coli, Shigella, Campylobacter.	**10**
	Microbial Control	Source of microorganisms, Physical and chemical agents used in microbial control, disinfected agents and its dynamics.	**4**
		Total=	**44**

Books Recommended:

Author	**Title**
1. M.J. Pelczar, E.C. Z. Chan, N.R. Krieg	Microbiology
2. George J Benwart	General Microbiology
3. Frazier & Westhoff	Food Microbiology
4. Jay, James M., Loessner, Martin J., Golden, David A	Modern Food Microbiology
5. Michael P. Doyle1, Francisco Diez-Gonzalez, Colin Hill	Food Microbiology: Fundamentals and Frontiers

Title of the course : **Heat and Mass Transfer**

Subject Code : **PCFT-513**

L	T	P	Credits	Weekly Load
3	1	0	4	4

Course Objectives: Objective of this course is to impart knowledge about

- The basic understanding to the various modes of heat transfer, mechanisms of boiling and condensation which are fundamental to food processing operations.
- The concepts of unsteady heat transfer, a predominant phenomena of heat transfer in food processing.
- The concepts of design of heat exchangers for a given heat load used in food industry.
- The concepts of steady and unsteady mass transfer, predominant phenomena in food processing operations.

Course Outcomes:

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

CO1	Interpret the principle of conduction and convection heat transfer in food processing.	Applying
CO2	Explain the boiling and condensation phenomenon on various geometrical surface.	Understanding
CO3	Describe the principle of radiation heat transfer.	Understanding
CO4	Execute the knowledge of heat transfer to design heat exchanger	Applying
CO5	Explain the concept of steady state and unsteady state mass transfer	Understanding

Mapping of Course Outcome and Program Outcome:

CO/PO Mapping (No correlation (0) / Weak (1) / Medium (2) / Strong (3) indicates strength of correlation)														
COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	1	0	1	0	1	1	1	1	3	2
CO2	3	3	2	2	1	0	1	0	1	1	1	1	3	2
CO3	3	3	1	2	1	0	1	0	1	1	1	1	3	2
CO4	3	3	1	2	1	0	1	0	1	1	1	1	3	2
CO5	3	3	3	2	1	0	1	0	1	1	1	1	3	2
Average	**3**	**3**	**2**	**2**	**1**	**0**	**1**	**0**	**1**	**1**	**1**	**1**	**3**	**2**

Unit	Main Topics	Course Outlines	Lecture (s)
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 in convective heat transfer, important correlations for free and forced convection	**5**
	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	**5**

		exchangers, effectiveness of parallel and counter flow heat exchanger by NTU method, Design of shell and tube heat exchanger.	
	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 equimolar 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
3. D.S. Kumar	Heat and Mass Transfer
4. R K Rajput	Heat and Mass Transfer
5. K A Gavhane	Unit Operations-II

Title of the course : **Heat and Mass Transfer Lab**

Subject Code : PC**FT - 514**

L	T	P	Credits	Weekly Load
0	**0**	**2**	**1**	**2**

Course Objectives: Objective of this course is to impart knowledge about

- The theory of heat transfer mechanisms during the heating/cooling of bio-materials.
- The concepts of unsteady heat transfer for determination of process time and temperature profiles in various geometries of the biomaterials.
- Designing calculations for various types of heat exchangers and their comparison in terms of effectiveness.
- 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

CO1	Demonstrate the different modes of modes of heat transfer in various processing operations.	Applying
CO2	Experiment to calculate various parameter in steady state heat transfer,	Analyzing
CO3	Demonstrate to the examine rate of heat transfer and effectiveness for the various heat transferring equipments like heat exchangers, HTST pasteurizer etc	Applying
CO4	Experiment the application of mass transfer in various processing operations	Analyzing
CO5	Conclude the findings of experiments	Analyzing

Mapping of Course Outcome and Program Outcome:

CO/PO Mapping (No correlation (0) / Weak (1) / Medium (2) / Strong (3) indicates strength of correlation)														
COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	3	1	1	1	1	1	1	2	3	3
CO2	3	3	3	2	3	1	1	0	1	1	1	2	3	3
CO3	3	3	3	2	3	1	1	0	1	1	2	3	3	3
CO4	3	3	3	2	3	1	1	0	1	1	1	2	3	3
CO5	3	3	3	2	3	1	1	2	1	1	2	2	3	3
Average	**3**	**3**	**3**	**2**	**3**	**1**	**1**	**0.6**	**1**	**1**	**1.4**	**2.2**	**3**	**3**

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

Title of the course : **Food Chemistry and Microbiology Lab**

Subject Code : **PCFT - 515**

L	T	P	Credits	Weekly Load
0	**0**	**2**	**1**	**2**

Course Objectives: Objective of this course is to impart knowledge about

- The chemistry underlying the properties and reactions of various food components.
- Principle working of food analytical and food microbiological equipments.
- The different analytical and microbiology techniques related to food testing and control
- The experimental handling of techniques of food quality and analysis on the basis of chemical and microbiological methods.

Course Outcomes:

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

CO1	Handle the equipment independently	Applying
CO2	Learn principles behind analytical techniques associated with food.	Applying
CO3	Learn the techniques of microbiological study and culturing	Applying
CO4	Obtain knowledge about the various methods of analysis for food	Applying
CO5	Check the microbial load of food samples, learn to access the quality standard of food samples	Applying

Mapping of Course Outcome and Program Outcome:

CO/PO Mapping

(No correlation (0) / Weak (1) / Medium (2) / Strong (3) indicates strength of correlation)

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

List of Practicals:

1. To study the working of various equipments related to food chemistry and microbiology.
2. Qualitative estimation of carbohydrates in the given food sample.
3. Study of browning reaction and inhibition of browning reaction.
4. Determination of acid value, RM value and Polenske value of given oil or fat sample.
5. Estimation of amount of fat in the given food samples.
6. Estimation and study of protein by Kjeldhal, electrophoresis methods.
7. Estimation of pectic substances and pectin in fruit.
8. Determination of vitamins in foods.
9. To perform Gram staining technique of bacteria.
10. To measure the size of given microbial cell using micrometery.
11. To enumerate total viable count in a culture.
12. To study the growth curve of microorganisms.
13. To isolate pure culture using different techniques.
14. Quantitative analysis of food sample by standard plate count (SPC) method.
15. To study quality of milk by methylene blue reduction (MBRT) test.
16. To perform presumptive test for coliforms in milk.

Title of the course : **Biology for Engineers**

Subject Code : **BSBL - 501**

L	T	P	Credits	Weekly Load
2	0	0	2	2

Course Objectives: Objective of this course is to impart knowledge about

1. The basic organization of organisms and subsequent building to a living being.
2. The machinery of the cell functions that is ultimately responsible for various daily activities.
3. The application of engineering principles in biology.
4. Biological problems that requires engineering expertise to solve them.

Course Outcomes:

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

CO1	Explain biological engineering principles, procedures needed to solve real-world problems.	Understanding
CO2	Explain the fundamentals of living things, their classification, cell structure and biochemical constituents.	Understanding
CO3	Comprehend genetics and the immune system and learn the techniques of microbiology study, food spoilage and preservation.	Understanding
CO4	Classify the biomolecules as building blocks of biological subjects.	Applying
CO5	Define the role of enzymes in biological system and identify the application of enzymes in different food industry	Understanding

Mapping of Course Outcome and Program Outcome:

CO/PO Mapping (No correlation (0) / Weak (1) / Medium (2) / Strong (3) indicates strength of correlation)														
COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	2	2	1	0	1	0	2	0	2	0	1	1	2	1
CO2	1	3	2	2	0	2	0	0	0	2	1	0	1	0
CO3	1	1	3	2	1	1	2	2	2	2	0	2	0	0
CO4	0	2	0	2	0	2	3	2	2	0	1	1	1	1
CO5	0	0	0	2	0	1	2	2	2	0	0	0	0	0
Average	**0.8**	**1.6**	**1.2**	**1.5**	**0.4**	**1.2**	**1.8**	**1.2**	**1.6**	**0.8**	**0.6**	**0.8**	**0.8**	**0.4**

Unit	Main Topics	Course Outlines	Lecture (s)
I	**Introduction**	Importance of biology in engineering, development of technological subjects imitating nature's biological entity, major discoveries in biology, economic aspects of biology in exploitation.	**2**
	Classification	Concept of scientific classification of living entity, discuss the classification (with suitable example) based on: (a) cellularity- unicellular and multicellular (b) ultrastructure- prokaryotes and eukaryotes (c) energy and carbon utilization- autotrophs, heterotrophs and lithotrophs (d) ammonia excretion- aminotelic, uricotelic and ureotelic (e) molecular taxonomy- three major kingdoms of life, classification of microorganisms based on: (a) temperature (b) salt concentration (c) oxygen requirement	**3**
	Genetics	Concept of genetics, Mendel's laws, segregation and independent assortment, allele, meosis and mitosis, recessiveness and dominance, how genetic material	**4**

		passes from parent to offspring, difference between phenotypic and genotypic characteristics, DNA fingerprinting, exploitation of genetics in crop improvement and microbial potential towards fermentation/ fermented product.	
	Microbiology	Microorganisms, classification of microorganisms, techniques such as serial dilution, pour plating, streak plating, spread plating, nutrient agar and broth. Techniques for enumeration of bacteria, growth kinetics, concept of food spoilage and preservation technique.	**3**
II	**Biomolecules**	Biomolecules as building blocks of biological subjects, introductory information about carbohydrates, proteins, nucleotides, and DNA/RNA, structure of protein (primary, secondary, tertiary, quaternary), structure of selected monosaccharides (glucose, fructose), disaccharides (sucrose, maltose) and polysaccharides (starch, cellulose).	**4**
	Enzymes	Enzyme, enzymology, role of enzymes in biological system, mechanism of enzymatic action, role of prosthetic group, co-factor and co-enzymes in enzymatic reactions, classification of enzymes, application of enzymes in: (a) juice clarification (b) meat tenderization (c) enzymatic browning.	**4**
	Metabolism	Concept of thermodynamics and application in biological system, photosynthesis, glycolysis, Krebs cycle, exothermic and endothermic reactions, endergonic and exergonic reactions.	**4**

Books Recommended:

Author	Title
1. Neil A. Campbell	Biology: A global approach
2. Eric E Conn	Outlines of biochemistry
3. Prescott	Microbiology
4. Gunther S. Stent	Molecular genetics

Title of the course : **Food Biotechnology**

Subject Code : **PCFT - 522**

L	T	P	Credits	Weekly Load
4	0	0	4	4

Course Objectives: Objective of this course is to impart knowledge about

- The basic understanding about food biotechnology and its applications.
- The microbial production of the different food products.
- The fundamentals of gene cloning techniques and its applications.
- 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

CO1	Describe the importance of biotechnology in food technology and microbial production of Single cell Protein	Understanding
CO2	Discuss the microbial production of organic Acids, vitamins, and biopigments	Understanding
CO3	Explain about various enzyme, purification and their application in food industry	Applying
CO4	Discuss about basics and terms related to Plant tissue culture, Genetic Engineering and Genetically modified food.	Understanding
CO5	Describe the biotechnological methods used in food industry waste management.	Understanding

Mapping of Course Outcome and Program Outcome:

CO/PO Mapping (No correlation (0) / Weak (1) / Medium (2) / Strong (3) indicates strength of correlation)														
COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	2	1	1	2	1	0	1	1	2	3	3
CO2	3	3	3	2	2	1	0	0	1	1	3	2	3	2
CO3	2	3	3	1	1	2	3	0	0	1	2	2	3	2
CO4	3	3	3	3	2	1	1	0	2	1	1	2	2	2
CO5	2	3	3	1	2	2	3	1	0	1	3	2	2	2
Average	**2.6**	**2.8**	**3**	**1.8**	**1.6**	**1.4**	**1.8**	**0.4**	**0.6**	**1**	**2**	**2**	**2.6**	**2.2**

Unit	Main Topic	Course Outlines	Lecture (s)
I	**Introduction**	History, scope and present status of biotechnology in India in relation to food technology and its general applications.	**5**
	Microbial production of SCP	Single cell proteins, microorganisms involved, raw materials, advantages, materials, commonly used methods with special reference to substrates and optimum conditions for growth of microorganism, safety concerns	**6**
	Microbial production of organic Acids, vitamins, and biopigments	Biotechnological methods for the production of organic acids, vitamins and biopigments, with special reference to the microorganisms involved, substrates used, optimum process parameters and their applications	**5**
	Enzyme in food technology	Sources of enzymes, advantages of microbial enzymes, production, extraction and purification of enzymes, applications of enzymes in food industry.	**6**
II	**Plant Tissue culture**	Definition, cellular totipotency, somatic hybridization, protoplast fusion, applications in agriculture.	**6**
	Genetic engineering & GM Foods	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.	
	Bio-management of Food Industry Waste	Biochemical oxygen demand, chemical oxygen demand, aerobic and anaerobic methods for treatment of food industry wastes with special reference to methanogenesis. BIS standards for safer disposal of industrial waste water	**6**
		Total=	**42**

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

Title of the course : **Food Engineering**

Subject Code : **PCFT - 523**

L	T	P	Credits	Weekly Load
3	1	0	4	4

Course Objectives: Objective of this course is to impart knowledge about

- The concept of SI system and the conversion from one system to another.
- Application of the fluid flow, heat and mass transfer principles to analyze and design food processes
- The theory and application of basic engineering operations.
- Engineering principles and practical applications of food processing techniques useful for increase shelf life of food products

Course Outcomes:

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

CO1	Apply the principles of mass and energy balance to food processing systems.	Applying
CO2	Determine thermal processing time for pasteurization / sterilization.	Applying
CO3	Interpret psychometric charts to determine seven properties of air and its applications in drying, humidification, etc operations.	Applying
CO4	Explain types, construction, designs and working principle of evaporators.	Understanding
CO5	Determine the freezing time of food and discuss different types of freezer.	Applying

Mapping of Course Outcome and Program Outcome:

CO/PO Mapping (No correlation (0) / Weak (1) / Medium (2) / Strong (3) indicates strength of correlation)														
COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	3	2	1	0	0	1	3	2	3	3
CO2	3	3	3	2	1	1	1	0	0	1	1	2	3	3
CO3	3	3	1	3	2	2	1	0	0	1	1	1	3	3
CO4	3	3	3	1	3	1	1	0	0	1	1	2	3	3
CO5	2	3	3	3	3	1	2	0	0	1	1	1	3	3
Average	**2.8**	**3**	**2.4**	**2.2**	**2.4**	**1.4**	**1.2**	**0**	**0**	**1**	**1.4**	**1.6**	**3**	**3**

Unit	Main Topic	Course Outlines	Lecture (s)
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; 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.	**7**

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**
		Total=	**39**

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.	Intro to Food Process Engineering
5. Geankoplis	Transport Process & Unit operations

Title of the course : **Food Engineering Lab**

Subject Code : **PCFT - 524**

L	T	P	Credits	Weekly Load
0	0	2	1	2

Course Objectives: Objective of this course is to impart knowledge about

- Applications of fundamentals of food engineering operations
- The practical application of processes involving simultaneous heat and mass transfer operations.
- The concepts involved in the preservation of food materials by the application of heat, cooling, freezing operations.
- 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

CO1	Demonstrate the thermal process time and freezing time calculation of a given food material.	Applying
CO2	Experiment to determine air properties after drying and air conditioning.	Analyzing
CO3	Examine the drying and dehydration behavior of different bio-materials with different geometries.	Applying
CO4	Determine various characteristics Thermal processing, Freezing, Evaporation, drying and dehydration.	Analyzing
CO5	Conclude experiment result and present clearly through reports.	Analyzing

Mapping of Course Outcome and Program Outcome:

CO/PO Mapping (No correlation (0) / Weak (1) / Medium (2) / Strong (3) indicates strength of correlation)														
COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	3	1	1	1	1	1	1	2	3	3
CO2	3	3	3	2	3	1	1	0	1	1	1	2	3	3
CO3	3	3	3	2	3	1	1	0	1	1	2	3	3	3
CO4	3	3	3	2	3	1	1	0	1	1	1	2	3	3
CO5	3	3	3	2	3	1	1	2	1	1	2	2	3	3
Average	**3**	**3**	**3**	**2**	**3**	**1**	**1**	**0.6**	**1**	**1**	**1.4**	**2.2**	**3**	**3**

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

Title of the course : **Food Biochemistry and Nutrition and Biotechnology Lab**

Subject Code : **PCFT - 525**

L	T	P	Credits	Weekly Load
0	**0**	**2**	**1**	**2**

Course Objectives: Objective of this course is to impart knowledge about

- The understanding about the basic equipments used in biotechnology lab.
- The growth pattern of the microorganisms and microbial production of the different products.
- The nutritional components of food.
- The determination of pollution load of food industry waste.

Course Outcomes:

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

CO1	Competent in handling the equipments single handily.	Applying
CO2	Demonstrate preparation of culture and microbial production of Enzymes, Ethanol, organic acid etc	Analyzing
CO3	Estimate the bio constituent of food such as protein, ascorbic acid, protein etc	Analyzing
CO4	Determine nutritive value and calorific value of any food and BOD & COD value of given sample	Analyzing
CO5	Conclude the result of experiments and present clearly through reports,	Analyzing

Mapping of Course Outcome versus Program Outcome

CO/PO Mapping (No correlation (0) / Weak (1) / Medium (2) / Strong (3) indicates strength of correlation)														
COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	1	1	1	0	1	1	0	2	3	3
CO2	3	2	2	1	2	1	1	0	1	1	0	2	3	3
CO3	3	2	2	1	1	1	1	0	1	1	0	2	3	3
CO4	3	2	2	1	1	1	1	0	1	1	0	2	3	3
CO5	3	2	2	1	1	1	1	0	1	1	0	2	3	3
Average	**3**	**2**	**2**	**1**	**1.2**	**1**	**1**	**0**	**1**	**1**	**0**	**2**	**3**	**3**

List of Practicals

1. To study different equipments related to biotechnology.
2. Preparation of various media for culturing of microbes.
3. To study the effect of pH on the growth of microorganisms.
4. To study the production of an enzyme by given organism.
5. To study the disruption of cells using mechanical method.
6. Estimation of enzymatic activity of given enzyme.
7. To study the production of ethanol by given organism.
8. Microbial production of organic acid.
9. Estimation of total sugars and reducing sugars in a given food sample.
10. Estimation of ascorbic acid in a given food sample.
11. Estimation of protein by Lowry method.
12. Estimation of phosphatase activity in a milk sample.
13. Estimation of nutritive value of given food sample.
14. Estimation of calorific value by Bomb calorimeter.
15. To determine Biochemical Oxygen Demand of a given sample.
16. To determine Chemical Oxygen Demand of a given sample.

Title of the course : **Technology of Animal Products**

Subject Code : **PCFT - 611**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Objectives: Objective of this course is to impart knowledge about

- The important biochemical and ultra structural changes that take place post-mortem during conversion of muscle to meat.
- The factors that affect the safety and quality of meat products.
- The technological and commercial issues related to the processing of meat, egg and fish.
- 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, the students will be able to

CO1	Describe the role of various compositional components in the development of various meat, poultry and fish products.	Understanding
CO2	Discuss slaughter techniques and hygienic handling of raw meat	Understanding
CO3	Use the knowledge to develop various value-added meat products.	Applying
CO4	Explain various formulations and processing procedures to produce quality product.	Understanding
CO5	Discuss about the various food standards in relation to meat, fish and poultry.	Understanding

Mapping of Course Outcome and Program Outcome:

CO/PO Mapping (No correlation (0) / Weak (1) / Medium (2) / Strong (3) indicates strength of correlation)														
COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	3	3	1	1	1	3	2	1	1	2	3	3
CO2	1	2	2	3	0	1	1	2	1	1	3	2	1	3
CO3	3	1	1	2	2	3	1	1	0	1	3	1	2	3
CO4	0	2	2	3	0	1	1	1	2	1	1	2	2	2
CO5	1	3	3	2	1	0	0	1	1	2	2	2	2	3
Average	**1.4**	**2**	**2.2**	**2.6**	**0.8**	**1.2**	**0.8**	**1.6**	**1.2**	**1.2**	**2**	**1.8**	**2**	**2.8**

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**
	Slaughtering Techniques, Cuts and by products	Various slaughtering techniques in large animals. 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**
		Total=	**46**

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

Title of the course : **Dairy Technology**

Subject Code : **PCFT - 612**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Objectives: Objective of this course is to impart knowledge about

- Milk composition and its various properties and different adulterants.
- Working of equipment and process technology for various milk products.
- Process technology for milk powder and fermented milk products
- Cleaning and sanitation of dairy industry.

Course Outcomes:

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

CO1	Discuss about current status of dairy industry in India and composition & properties of milk.	Understanding
CO2	Implement the technology of fluid milk and manufacturing fat rich milk-based products.	Applying
CO3	Interpret the technological aspects in manufacturing of frozen, concentrated and dried milk products.	Applying
CO4	Use the technology to manufacture the fermented milk based and indigenous products.	Applying
CO5	Explain the cleaning & sanitization procedures and working principles of related operations and equipments.	Understanding

Mapping of Course Outcome and Program Outcome:

CO/PO Mapping (No correlation (0) / Weak (1) / Medium (2) / Strong (3) indicates strength of correlation)														
COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	3	1	2	2	1	0	1	1	2	3	2
CO2	3	2	2	3	3	3	2	0	1	2	2	1	2	1
CO3	3	3	2	3	3	2	1	1	0	1	2	1	3	3
CO4	3	1	3	2	1	3	0	1	0	1	2	2	3	2
CO5	2	3	2	2	3	3	2	1	1	2	2	2	3	3
Average	**2.6**	**2**	**2**	**2.6**	**2.2**	**2.6**	**1.4**	**0.8**	**0.4**	**1.4**	**1.8**	**1.6**	**2.8**	**2.2**

Unit	Main Topics	Course Outlines	Lecture (s)
I	**Introduction**	Status of dairy industries in India, Milk and Types of Milk**,** Factors affecting composition, quality and yield of milk, Adulterations in milk and its detection.	**3**
	Dairy Chemistry & Microbiology:	Composition and milk properties, Roles of lipids, proteins, carbohydrates, minerals, vitamins and enzymes, importance of psychrophilic, mesophilic and thermophilic spoilage organisms in storage, pasteurization and sterilization.	**4**
	Cream Separation and Homogenization	Principles of cream separation, equipment, effectiveness, Cream and its types, pasteurization. Homogenizers: principle of operation, technology of homogenized milk production.	**6**
	Pasteurization and Sterilization	Process and equipment for milk pasteurization, direct and indirect sterilization; Ultra - High - Temperature (UHT) sterilization. Fouling of pasteurizers and sterilizers. Aseptic packaging. Technology and standards of commercial liquid milk products: toned, double toned products, flavoured, reconstituted, recombined milk etc.	**6**
II	**Concentration, Evaporation,**	Process and equipment for evaporation and concentration of liquid milk, spray drying of liquid milk, energy consumption in spray drying, instantization methods, cyclone separation	**7**

	drying and freezing	principle. Technology and standards of dried and condensed milk products. Process and equipment for Ice-cream, Partial freezing, final freezing and hardening, freezing time calculation.	
	Dairy Products Manufacturing	Process Technology and standards of manufacturing of butter, butter oil/ghee, cheese, malted milk drinks, infant foods, fermented milk, traditional Indian dairy products and other milk products (casein, whey proteins, lactose etc.).	**7**
	Cleaning and sanitation	Selection and use of dairy cleaners and sanitizers, Cleaning and sanitization of dairy equipment and plant, clean in place system	**3**
		Total=	**36**

Books Recommended:

Author	**Title**
1. Su Kumar De	Outlines of Dairy Technology
2. Marth and Eteele	Applied Dairy Microbiology
3. Walstra	Dairy Technology
4. Spreer	Milk and Dairy Product Technology
5. Eckles, Comb and Macy	Milk and Milk Products
6. Kessler	Food Engineering and Dairy technology
7. Hui	Dairy Science and Technology Handbook

Title of the course : **Animal Product and Dairy Technology Lab**

Subject Code : **PCFT - 613**

L	T	P	Credits	Weekly Load
0	**0**	**2**	**2**	**4**

Course Objectives: Objective of this course is to impart knowledge about

- The different in structure of various animal tissues
- The various physico-chemical, platform test of milk, and analysing the milk and meat products for their quality.
- Various unit operation / working of different milk and meat processing equipments.
- Preparation of various milk and meat products.

Course Outcomes:

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

CO1	Estimate various physico-chemical properties of milk and meat.	Applying
CO2	Estimate the platform test of milk to judge the milk quality at reception	Applying
CO3	Handle various equipments involved in milk and meat processing and develop products	Applying
CO4	Examine effect of processing on quality of milk and meat product	Analyzing
CO5	Conclude the experimental result and present clearly through reports	Analyzing

Mapping of Course Outcome and Program Outcome:

CO/PO Mapping (No correlation (0) / Weak (1) / Medium (2) / Strong (3) indicates strength of correlation)														
COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	1	1	1	0	1	1	1	2	3	3
CO2	3	2	2	1	2	1	1	0	1	1	1	2	3	3
CO3	3	2	2	1	1	1	1	0	1	1	1	2	3	3
CO4	3	2	2	1	1	1	1	0	1	1	1	2	3	3
CO5	3	2	2	1	1	1	1	0	1	1	1	2	3	3
Average	**3**	**2**	**2**	**1**	**1.2**	**1**	**1**	**0**	**1**	**1**	**1**	**2**	**3**	**3**

List of Practicals:

1. To analyze milk sample for following parameters.
   Percent Acidity & pH, Specific gravity, Total solids & SNF, Fat, 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 effect of temperature and pressure on homogenization.
5. To observe the effect of pasteurization on milk quality
6. To analyze milk powder sample for various parameters.
7. To analyze condensed milk for various parameter.
8. To prepare paneer and to examine their quality parameters
9. Preparation of ice-cream.
10. To analyze the butter for its quality.
11. To study the effect of low and high oxygen atmosphere on meat colour.
12. To study the structure of the muscle under compound microscope.
13. Perform the slaughtering of the poultry birds.
14. Identification of different internal organs of poultry birds and their utilization for product preparation.
15. Dressing of Fish.
16. Determination of total volatile acids in fish products

Title of the course : **Technology of Cereal, Pulses and Oilseeds Processing**

Subject Code : **PCFT-621**

L	T	P	Credits	Weekly Load
3	1	0	4	4

Course Objectives: Objective of this course is to impart knowledge about

- Basic understanding of cereals, pulses and oilseeds after harvesting.
- Various types of processing methods of cereals, pulses and oilseeds
- various products and by-products of cereals, pulses and oilseeds
- 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

CO 1	Understand the composition, structure and storage of food grains	Understanding
CO 2	Understand the technology of paddy processing and its products	Understanding
CO 3	Understand the traditional and modern milling operations of wheat and technology of bakery and extruded products	Understanding
CO 4	Understand the processing of coarse cereals and legume-pulses and their value-added products	Understanding
CO 5	Understand the processing of oil & oilseeds and utilization of their by-products	Understanding

Mapping of Course Outcome and Program Outcome:

CO/PO Mapping (No correlation (0) / Weak (1) / Medium (2) / Strong (3) indicates strength of correlation)														
COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	3	1	1	1	1	3	2	1	1	2
CO2	3	2	3	3	3	3	1	1	0	1	2	2	1	2
CO3	2	1	1	1	3	3	1	0	1	3	1	1	1	3
CO4	2	1	1	1	3	3	3	1	0	1	1	3	3	1
CO5	3	1	2	1	2	0	3	0	1	3	2	3	3	1
Average	**2.6**	**1.4**	**1.8**	**1.4**	**2.8**	**2**	**1.8**	**0.6**	**0.6**	**2.2**	**1.6**	**2**	**1.8**	**1.8**

Unit	Main Topics	Course outlines	Lecture (s)
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**
		Total=	**48**

Books Recommended:

Author	**Title**
1. Mathews, R.H. Ed. 1989.	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

Title of the course : **Technology of Fruits and Vegetable Products**

Subject Code : **PCFT - 622**

L	T	P	Credits	Weekly Load
3	**0**	**0**	**3**	**3**

Course Objectives: Objective of this course is to impart knowledge about

- Post-harvest changes in fruits and vegetables, causes of post-harvest losses of fruits and vegetables for effective handling and minimizing the post-harvest losses.
- The unit operations and calculations involved in the processed fruits and vegetable products
- The technology of processed fruits and vegetable products
- The problems involved in processed fruits and vegetable products line and able to solve the associated problems.

Course Outcomes:

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

CO1	Describe the physiological changes in fruits after harvesting	Understanding
CO2	Explain the factors affecting the shelf life of fresh fruits and vegetables	Understanding
CO3	Explain the role and importance of preservation techniques to improve the shelf life of seasonal fruits	Understanding
CO4	Calculate the requirement of raw materials for processing of fruits and vegetables	Applying
CO5	Discuss the technology behind processing of fruits and vegetable products	Applying

Mapping of Course Outcome and Program Outcome:

CO/PO Mapping (No correlation (0) / Weak (1) / Medium (2) / Strong (3) indicates strength of correlation)														
COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	1	3	3	1	1	2	2	1	3	1
CO2	3	2	3	3	1	3	1	0	1	2	1	2	3	2
CO3	3	1	1	3	1	2	1	1	0	1	2	2	2	3
CO4	2	3	3	2	3	3	1	1	3	1	2	1	1	3
CO5	3	1	1	3	2	2	1	0	0	1	2	1	1	3
Average	**2.8**	**2**	**2.2**	**2.6**	**1.6**	**2.6**	**1.4**	**0.6**	**1**	**1.4**	**1.8**	**1.4**	**2**	**2.4**

Theory

Unit	Main Topics	Course Outlines	Lecture (s)
I	**Introduction, pre and post-harvest technology**	Status of production and processing of fruits and vegetables. Structure and nutritional composition; pre and post-harvest changes; pre-harvest factors affecting postharvest quality; desirable characteristics of fruits and vegetable for processing; possible causes of post-harvest losses and conservation of fruits and vegetable. Role of plants growth regulators in relation to extension of storage life; physical and chemical treatment to increase the shelf-life.	**8**
	Preservation of fresh fruits and vegetables	Respiration, transpiration, ripening, senescence, climacteric and non-climacteric fruits, preservation of fruits and vegetables using low temperature preservation, use of novel packaging, hypobaric storage, controlled and modified atmosphere storages.	**8**
II	**Process calculation**	Unit operations and calculations involved in the processing of fruits and vegetables to produce canned foods, dehydrated foods, high sugar products, juices, concentrates, powders, beverages, pickles and tomato products. Use of psychometrics, steam table in calculation. Problems related to the	**8**

		determination of selected active components from used ingredient or preservatives.	
	Process technology	Technology for the manufacturing of intermediate moisture foods, jam, jelly, marmalade, preserve and candy; canning of fruits and vegetables, tomato puree, paste, ketchup, sauce and soup; pickles, drying/ dehydration of fruits and vegetables; fruit Juices, pulps, concentrates, powders, squashes, cordials and RTS beverages. Critical points to consider in the production of different processed fruits and vegetable products and solving the associated problems.	**8**
		Total=	**45**

Books Recommended:

Author	**Title**
D. S. Smith, J. N. Cash and W K. Nip, Y.H. Hui	Processing Vegetables: Science and Technology
S. Ranganna	Handbook of Analysis and Quality Control for Fruits and Vegetable Products
L. Somogyi	Processing Fruits: Science and Technology, Vol. I, Biology Principles and Applications
Y. H. Hui, S.Ghazala, D.M. Graham, K.D. Murrell and W.K. Nip	Handbook of Vegetable Preservation and Processing
D.M. Barrett, L. Somogyi and H.S. Ramaswamy	Processing Fruits: Science and Technology

Title of the course : **Plant Foods Lab**

Subject Code : **PCFT - 623**

L	T	P	Credits	Weekly Load
0	**0**	**2**	**1**	**2**

Course Objectives: Objective of this course is to impart knowledge about

- Basic understanding of fruits, vegetables, cereals, pulses and oilseeds
- Various analysis of fruits, vegetables, cereals, pulses and oilseeds
- Various products and by-products of fruits, vegetables, cereals, pulses and oilseeds
- Manufacturing technologies of fruits, vegetables, cereals, pulses and oilseeds consumed in daily life.

Course Outcomes:

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

CO1	Determine the physico-chemical properties cereal, pulses and oil seeds.	Applying
CO2	Relate the pre-treatments used in pulse milling process to achieve high grade pulses.	Analyzing
CO3	Demonstrate the fruit and vegetable-based products and their quality evaluation	Applying
CO4	Relate experimental work to large scale production	Applying
CO5	Conclude the results and present clearly through reports.	Analysing

Mapping of Course Outcome and Program Outcome:

CO/PO Mapping (No correlation (0) / Weak (1) / Medium (2) / Strong (3) indicates strength of correlation)														
COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	1	1	3	3	1	1	3	2	1	2	1
CO2	3	1	1	2	1	1	3	1	0	1	2	1	3	2
CO3	1	3	3	2	2	1	2	1	3	1	2	1	2	3
CO4	0	1	3	3	1	1	2	2	1	1	2	2	3	2
CO5	2	1	1	3	1	3	2	0	1	3	2	2	3	3
Average	**1.6**	**1.8**	**2**	**2.2**	**1.2**	**1.8**	**2.4**	**1**	**1.2**	**1.8**	**2**	**1.4**	**2.6**	**2.2**

List of Practical's:

1. Physical properties of pulses and oil seeds
2. Determination of dry and wet gluten of a given flour sample.
3. Determination of Hagberg's Falling number.
4. Determination of percentage impurities in grain by aspirator and seed blower.
5. Pretreatments for milling of pulses
   a) Application of water
   b) Application of oil
   c) Application red earth slurry.
   d) Application of steam
6. Preparation of noodles and its quality evaluation.
7. Solvent extraction of selected oilseeds.
8. Anatomy and structure of fruits and vegetables
9. Quantitative analysis of cut fruits and vegetable yield
10. Preparation of fruit and synthetic beverages
11. End point determination in preparation of high sugar product (Mixed fruit jam)
12. Effect of pre-treatment and process variables on quality of preserve/candied fruits
13. Comparison of juice/pulp extraction methods on quality and yield of tomato pulp, ketchup/Tomato soup
14. Canning and cut out analysis of fruit and vegetable
15. Dehydration and rehydration of common available vegetable
16. Visit to fruit, vegetable and cereal processing Industry

Title of the course : **Food Analysis and Quality Control**

Subject Code : **PCFT - 711**

L	T	P	Credits	Weekly Load
3	1	0	4	4

Course Objectives: Objective of this course is to impart knowledge about

- The quality, quality control and their applications in food industry.
- The instrumental aspects of color and texture measuring instruments.
- The non-destructive methods and various types of chromatographic methods applied as quality control.
- 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

CO1	Discuss about the quality control and its significance in processing.	Understanding
CO2	Execute the knowledge of physical characteristics of food in food industries	Applying
CO3	Explain the working principle of instruments which are used to measure the physical characteristics of food such as Food Texture, fruit pressure, color etc	Understanding
CO4	Describe principle and working of non-destructive techniques and chromatographic techniques used for food analysis and quality control.	Understanding
CO5	Execute the knowledge of food safety and standards, role of food regulations and their implementation in food industry	Applying

Mapping of Course Outcome and Program outcome:

CO/PO Mapping (No correlation (0) / Weak (1) / Medium (2) / Strong (3) indicates strength of correlation)														
COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	3	3	1	0	1	1	0	2	1	2	3	1
CO2	2	3	3	1	1	3	1	1	0	2	1	2	3	3
CO3	3	2	2	3	3	1	3	1	0	2	2	1	3	2
CO4	3	1	1	1	1	3	2	1	0	1	2	1	1	2
CO5	1	3	1	2	2	3	1	1	0	1	2	2	3	2
Average	**2.2**	**2**	**2**	**2**	**1.6**	**2**	**1.6**	**1**	**0**	**1.6**	**1.6**	**1.6**	**2.6**	**2**

Unit	Main Topic	Detailed Contents	Lectures
I	**Introduction**	Quality control and its importance; Functions of quality control department and quality control laboratories	**4**
	Colour	Importance and need of colour determination; Methods of colour determination with Spectrophotometer, Colorimeter, Hunter Colour lab, CIE system, Lovibond Tintometer, Munsell colour 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	**8**

		detectors used in GC and HPLC; Thin layer chromatography (TLC); Chromatographic methods applied as quality control	
	Food Safety and Regulations	Food Safety and Standards Act (2006); Codex Alimentarius; ISO series; Good Manufacturing Practices (GMP); Genetically Modified Foods (GMF)	**8**
		Total=	**44**

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

Title of the course : **Packaging Technology**

Subject Code : **PCFT - 712**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Objectives: Objective of this course is to impart knowledge about

- Functions of packaging and familiarize them with different types of food packaging materials and their properties.
- Theory of permeability and barrier properties of different food packaging materials.
- Different food packaging equipment and machinery.
- Selecting and finalizing 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

CO1	Describe the objectives, functions of packaging and select the packaging material based on requirement and properties of material.	Understanding
CO2	Discuss the manufacturing and characteristics of various packaging materials viz paper, glass, metal, and plastic	Understanding
CO3	Predict shelf life of different food materials	Applying
CO4	Discuss the packaging equipment and machinery and packaging systems for various types of food.	Understanding
CO5	Explain specialized techniques in food packaging such as Active, aseptic, controlled & modified atmospheric packaging etc.	Understanding

Mapping of Course Outcome and Program outcome:

CO/PO Mapping (No correlation (0) / Weak (1) / Medium (2) / Strong (3) indicates strength of correlation)														
COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	2	2	1	0	1	0	1	2	3	2	1
CO2	2	2	1	1	2	3	1	3	3	2	3	2	2	1
CO3	3	2	2	1	1	2	1	3	1	0	3	3	2	3
CO4	2	1	3	3	1	3	1	1	0	1	3	1	2	1
CO5	3	3	3	2	1	3	1	2	3	1	2	2	3	2
Average	**2.6**	**2**	**2**	**1.8**	**1.4**	**2.4**	**0.8**	**2**	**1.4**	**1**	**2.6**	**2.2**	**2.2**	**1.6**

Unit	Main Topic	Detailed Contents	Lectures
I	**Introduction**	Definitions; Objectives and functions of packaging and packaging materials. Labeling types; Functions and regulations.	**4**
	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 (c) Metals: Tinplate containers; tinning process; components of tinplate; tin free steel (TFS); types of cans; aluminium containers; lacquers	**8**

		(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 systems 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**
		Total=	**40**

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

Title of the course : **Food Analysis, Quality Control and Packaging Technology Lab**

Subject Code : **PCFT - 713**

L	T	P	Credits	Weekly Load
0	**0**	**2**	**1**	**2**

Course Objectives: Objective of this course is to impart knowledge about

- Carrying out proximate and physic-chemical analysis of different types of raw and processed foods.
- Different tests performed on packaging materials and filled packages.
- Calculating the shelf life of foods inside packaging materials and selection of suitable packaging materials.
- Different food packaging equipment and machinery.

Course Outcomes:

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

CO1	Determine the proximate composition of raw and processed foods	Analyzing
CO2	Demonstrate the estimation of different pigments, metals and other compounds present in foods.	Applying
CO3	Use testing methodology to determine the characteristics of tin plates, aluminium, glass, paper and plastic used for making packages.	Applying
CO4	Explain the working and construction of different package filling and testing machinery	Understanding
CO5	Conclude the data of experiments and present clearly in reports.	Understanding

Mapping of Course Outcome and Program outcome:

CO/PO Mapping (No correlation (0) / Weak (1) / Medium (2) / Strong (3) indicates strength of correlation)														
COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	3	1	1	1	1	1	1	2	3	3
CO2	3	3	3	2	3	1	1	1	1	1	1	2	3	3
CO3	3	3	3	2	3	1	1	1	1	1	2	3	3	3
CO4	3	3	3	2	3	1	1	1	1	1	1	2	3	3
CO5	3	3	3	2	3	1	1	1	1	1	2	2	3	3
Average	**3**	**3**	**3**	**2**	**3**	**1**	**1**	**1**	**1**	**1**	**1.4**	**2.2**	**3**	**3**

List of Practicals:

1. Determination of carotenoids in food sample.
2. Determination of colour value by using different methods.
3. Determination of ascorbic acid by titrimetric and photometric methods.
4. Determination of iron, phosphorous and sulphur in foods.
5. Determination of different pigments in food samples.
6. Analysis of canned and processed products available in the market.
7. Determination of FFA and acid value of given sample
8. To determine the bursting strength of a carton board.
9. To determine the amount of tin coating in a tin plate.
10. To determine Tensile strength and Young's Modulus of given material.
11. Testing of lacquered tin plate steel for following: -
    i) Continuity of tin layer
    ii) Resistance of lacquer to acid.
12. Determination of iron content in canned foods.

Title of the course : **Separation Technology**

Subject Code : **OEFT - 611A**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Objectives: Objective of this course is to impart knowledge about

- Basic understanding of the separation of various types of components for various systems.
- Familiarize the students with the separation of valuable components from the liquid, solid streams by contact equilibrium processes as well as distillation process
- Acquaint the students with theory and basis of powder technology and their classification.
- 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

CO1	Describe the basic of various separation techniques	Understanding
CO2	Demonstrate strong appreciation in applying the concepts and skills towards exploiting the separation techniques for diverse applications	Applying
CO3	Determine the number of plates in the rectifying section, stripping section of the continuous distillation system	Applying
CO4	Determine the optimum value of reflux ratio to achieve best quality product at minimum total cost in case of the continuous distillation system.	Applying
CO5	Describe the theoretical basics of powder technology	Understanding

Mapping of Course Outcome and Program Outcome:

CO/PO Mapping (No correlation (0) / Weak (1) / Medium (2) / Strong (3) indicates strength of correlation)														
COs	Programme Outcomes (POs)												Program Specific Outcomes (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**

Unit	Main Topics	Course Outlines	Lecture (S)
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	**6**

		reflux ratio, Batch distillation, Application of distillation in food processing	
	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**
		Total=	**32**

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

Title of the course : **Biochemical Engineering**

Subject Code : **OEFT-611B**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Objectives: Objective of this course is to impart knowledge about

- The growth of the microorganisms in different culture systems.
- The media formulation and sterilization techniques used.
- The design and working of the bioreactor.
- The enzyme kinetics and methods of purification of microbial products.

Course Outcomes:

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

CO1	Describe the basic of various separation techniques	Understanding
CO2	Demonstrate strong appreciation in applying the concepts and skills towards exploiting the separation techniques for diverse applications	Applying
CO3	Determine the number of plates in the rectifying section, stripping section of the continuous distillation system	Applying
CO4	Determine the optimum value of reflux ratio to achieve best quality product at minimum total cost in case of the continuous distillation system.	Applying
CO5	Describe the theoretical basics of powder technology	Understanding

Mapping of Course Outcome and Program Outcome:

CO/PO Mapping (No correlation (0) / Weak (1) / Medium (2) / Strong (3) indicates strength of correlation)														
COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	2	1	1	1	0	1	2	2	2	3	2
CO2	3	3	3	3	1	3	2	0	1	1	2	1	3	2
CO3	3	1	3	1	3	3	1	3	3	3	2	1	2	3
CO4	3	3	2	3	3	3	1	1	0	1	2	1	3	3
CO5	3	3	1	2	2	3	1	0	0	2	1	2	3	2
Average	**3**	**2.4**	**2.4**	**2.2**	**2**	**2.6**	**1.2**	**0.8**	**1**	**1.8**	**1.8**	**1.4**	**2.8**	**2.4**

Unit	Main Topics	Course Outlines	Lecture (s)
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**
		Total=	**44**

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

Title of the course **: Principle of Food Processing**

Subject Code **: OEFT – 612A**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Objectives: Objective of this course is to impart knowledge about

- The basic concept of food processing and preservation.
- Contribution of nutrients from different food groups.
- The aspects of processing of different food groups.
- The manufacturing process of plant foods
- Emerging technologies applied to food processing

Course Outcome:

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

CO1	Develop the basic concept of food processing, causes of spoilage and preservation of food.	Understanding
CO2	Have a concept of role of nutrients in food and human health	Applying
CO3	Get an overview on principles, mechanism and application of processing methods on different food groups.	Applying
CO4	Apply their knowledge on effect of processing on the characteristics of different food groups.	Applying
CO5	Understand the concepts related to emerging food processing technologies.	Understanding

Mapping of Course Outcome and Program Outcome:

CO/PO Mapping (No correlation (0) / Weak (1) / Medium (2) / Strong (3) indicates strength of correlation)														
COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2	2	2	1	0	1	3	3	3	2
CO2	3	2	2	2	2	2	2	2	0	1	3	3	3	3
CO3	3	2	2	2	2	2	2	2	0	1	3	3	3	3
CO4	3	2	2	2	2	2	2	2	0	1	3	3	3	3
CO5	3	3	2	3	1	3	1	1	1	0	2	1	3	3
Average	**3**	**2.2**	**2**	**2.2**	**1.8**	**2.2**	**1.8**	**1.6**	**0.2**	**0.8**	**2.8**	**2.6**	**3**	**2.8**

Unit	Main Topics	Course Outlines	Lecture (s)
I	**Introduction**	Objective and concept of food processing, Classification of food in relation to shelf life, food spoilage, preservation methods. effects of processing on food constituents.	**5**
	Nutrients	Basic concept of food, nutrients, nutrition, Definition, classification, properties and requirements of carbohydrates, lipids, proteins, water, minerals and vitamins for humans.	**5**
	Fruits and vegetables	Peeling, size reduction, processing and processed products of fruits and vegetables. Minimal processing of fruits and vegetables	**5**
II	**Cereals and millets**	Concept of milling, Processed products of wheat and rice. Types of millets and food uses.	**5**
	Legume	Types, milling, germination and processed products.	**5**
	Oilseeds	Use of oilseeds, processing and oil extraction and food uses.	**5**
	Emerging food processing technologies	Concept of high pressure, pulsed electric fields, radio frequency and ultrasound processing.	**6**
		Total=	**36**

Books Recommended:

Author	Title
1. Mathews RH	Legumes: Chemistry, Technology and Human Nutrition
2. Hoseney RS	Principles of Cereal Science and Technology
3. Kent NL	Technology of Cereals
4. ChakravertyA	Handbook of Post-Harvest Technology
5. Shukla BD	Oil Seed Processing Technology
6. Fellows P	Food processing technology: principles and practice
7. Kyzlink V	Principles of Food Preservation
8. Potter NN	Food Science

Title of the course **: Principle of Food Preservation**

Subject Code **: OEFT – 612B**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Objectives: Objective of this course is to impart knowledge about

- The basic concept of food preservation.
- The factors affecting the shelf lives of commodities and different preservation techniques.
- The role of modern packaging techniques in food preservation.
- Novel technologies for food preservation.

Course Outcome:

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

CO1	Discuss fundamental principles of food preservation	Understanding
CO2	Describe the principles of low temperature preservation by refrigeration, freezing and freeze drying	Understanding
CO3	Explain thermal processing and execute high temperature processing in food industry	Applying
CO4	Explain the concept of water activity and preservation by Drying & Dehydration	Understanding
CO5	Implement the knowledge of preservatives, fermentation and non thermal technology in food preservation.	Applying

Mapping of Course Outcome and Program Outcome:

CO/PO Mapping (No correlation (0) / Weak (1) / Medium (2) / Strong (3) indicates strength of correlation)														
COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2	2	2	1	1	1	3	3	2	2
CO2	3	2	2	2	2	2	2	1	1	2	3	3	2	3
CO3	2	2	2	2	2	2	2	1	1	2	3	3	3	1
CO4	3	2	2	2	2	2	2	1	1	1	3	3	3	2
CO5	3	3	2	1	3	3	1	0	1	1	2	3	3	3
Average	**2.8**	**2.2**	**2**	**1.8**	**2.2**	**2.2**	**1.8**	**0.8**	**1**	**1.4**	**2.8**	**3**	**2.6**	**2.2**

Unit	Main Topics	Course Outlines	Lecture (s)
I	**Introduction**	Introduction to food preservation – Objectives and techniques of food preservation, Factors affecting shelf of food material during storage, and concept of water activity.	**5**
	Thermal preservation techniques	High temperature based-Pasteurization, sterilization, drying, canning. Low temperature based- freezing and cold storage.	**8**
	Bio-preservation techniques	Fermentation: principles and microorganisms, curing and pickling.	**5**
II	**Use of preservative**	Chemical preservative, bio-preservatives, antibiotics, antioxidant, antimicrobials	**4**
	Packaging as Preservation Technique	Concept of food packaging, major packaging materials, Active and Intelligent packaging. Control/Modified Atmosphere packaging.	**6**
	Emerging preservation techniques	Concept of high pressure processing, pulsed electric fields, ultrasound, irradiation and hurdle technology.	**8**
		Total=	**36**

Books Recommended:

Author	**Title**
1. Zeuthen P.	Food Preservation Techniques
2. Rahman MS	Handbook of food preservation
3. Barbosa-Canovas GV	Pulsed Electric Fields in Food Processing
4. Hui YH	Handbook Vegetable of Preservation and Processing
5. Kyzlink V	Principles of Food Preservation
6. Potter NN	Food Science

Title of the course **: Food and Nutrition**

Subject Code **: OEFT - 621A**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Objectives: Objective of this course is to impart knowledge about

- Various aspects of food and nutrition
- Functions of food and nutrients.
- The dietary requirements and fulfilling the requirement from the consumption of food
- The concept behind the development of balance diet.

Course Outcome:

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

CO1	Describe the basic concept of food, nutrients, nutrition, health and fitness	Understanding
CO2	Explain the fate of food on ingestion to the body.	Understanding
CO3	Interpret the role of macro & micro nutrients in human health	Applying
CO4	Develop a dietary chart for different age groups of Indian considering RDA and interpret the effect processing on food component	Applying
CO5	Discuss the nutrition and alternative systems for physical fitness	Understanding

Mapping of Course Outcome and Program Outcome:

CO/PO Mapping

(No correlation (0) / Weak (1) / Medium (2) / Strong (3) indicates strength of correlation)

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	2	1	1	3	1	2	2	1	2	3	1
CO2	3	3	2	2	3	3	0	1	1	2	2	1	2	2
CO3	2	2	1	1	0	1	0	1	1	1	2	1	3	3
CO4	2	2	3	3	2	0	1	2	2	3	2	2	3	3
CO5	0	1	3	3	0	0	1	2	1	1	2	1	3	3
Average	**1.8**	**2**	**2**	**2.2**	**1.2**	**1**	**1**	**1.4**	**1.4**	**1.8**	**1.8**	**1.4**	**2.8**	**2.4**

Unit	Main Topics	Course Outlines	Lecture(s)
I	**Introduction**	Basic concept of food, nutrients, nutrition, health and fitness. Interrelationship between nutrition and health.	**2**
	Basics of human body and nutrition	Basics of Body composition and changes during life span. Concept of a desirable diet for optimum nutrition, health and fitness	**3**
	Metabolism	Digestion, absorption and metabolism of foods, Basal and resting metabolism and influencing factors.	**6**
	Classification	Functions of food and classification of food and nutrients	**3**
	Macronutrients	Carbohydrates- Occurrence and physiological functions. Role of dietary fiber in health and disease. Disorders related to carbohydrate metabolism. Glycemic index of foods and its uses Lipids – Concepts of visible and invisible fats. Saturated, unsaturated and essential fatty acids- sources and physiological functions. Proteins- Concepts of essential and non-essential amino acids- their role in growth and development. Physiological functions of proteins. Protein energy malnutrition.	**10**
	Micronutrients	Occurrence and physiological functions of vitamins and minerals	**2**
II	**Basic principles of planning diet**	Nutritional assessment and RDA for Indians	**3**
	Nutrition and effect of processing	Food groups, dietary guidelines and balanced diets. Selection, nutritional contribution of different food groups. Effects of processing on properties and nutritional value of foods.	**4**
	Nutrition and physical fitness	Approaches to the management of fitness and health in weight management. Alternative systems for health and fitness – Ayurveda, yoga and meditation.	**3**
		Total=	**36**

Recommended Books

Author	Title
1. Mudambi, SR and Rajagopal, MV	Fundamentals of Foods, Nutrition and Diet Therapy
2. Mudambi, SR, Rao SM and Rajagopal, MV	Food Science
3. Srilakshmi B	Nutrition Science
4. Swaminathan M	Handbook of Foods and Nutrition
5. Bamji MS, Rao NP, and Reddy V	Text Book of Human Nutrition
6. Manay MS, Shadaksharaswamy	Food-Facts and Principles

Title of the course : **Unit Operations in Food Processing**

Subject Code : **OEFT - 621B**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Objectives: Objective of this course is to impart knowledge about

- The theory and application of basic unit operations performed in various food processing industries.
- The size reduction, and mixing operations of different types of foods necessary in the processing of foods.
- Application of the engineering principles to analyze and design the various unit operations and equipments.
- 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:

CO1	Describe the processing of foods in terms of common unit operations like size reduction, mixing, and separation	Understanding
CO2	Execute his computational skills in calculating the energy required in size reduction, mixing operations	Applying
CO3	Discuss the construction, working and applicability of various size reduction, mixing and separation equipments.	Understanding
CO4	Interpret the optimum value of reflux ratio to achieve best quality product at minimum total cost in case of the continuous distillation system.	Applying
CO5	Explain the principle and application of leaching and extraction process.	Understanding

Mapping of Course Outcome and Program Outcome:

CO/PO Mapping (No correlation (0) / Weak (1) / Medium (2) / Strong (3) indicates strength of correlation)														
COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	3	1	3	1	0	0	2	1	1	3	2
CO2	3	1	3	2	2	3	0	1	2	1	1	2	3	1
CO3	3	1	2	3	1	3	3	0	1	2	3	1	3	1
CO4	2	2	1	1	1	1	0	0	1	3	1	2	2	2
CO5	3	3	2	1	3	3	1	1	1	1	2	2	2	3
Average	**2.8**	**1.8**	**2**	**2**	**1.6**	**2.6**	**1**	**0.4**	**1**	**1.8**	**1.6**	**1.6**	**2.6**	**1.8**

Unit	Main Topics	Course Outlines	Lecture (s)
I	**Introduction**	Definition and application in food processing.	**2**
	Size reduction	Theory of communition, 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 process, Fineness modules and particle size distribution	**6**
	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

Title of the course : **Fundamentals of Biotechnology**

Subject Code : **OEFT-622A**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Objectives: Objective of this course is to impart knowledge about

- The basic understanding of biotechnology and its applications.
- The fundamentals of the microbial production of scp, organic acids, vitamins, enzymes and antibiotics.
- The different techniques such as tissue culture, mutations and genetic engineering.
- The different treatment techniques for the disposal of industry waste.

Course Outcomes:

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

CO1	Recognize the scientific advancements in biotechnology and its multidisciplinary nature, and its application in an industry	Understanding
CO2	Describe different fermentation technologies for the production of SCP, enzymes, organic acids, vitamins and antibiotics.	Understanding
CO3	Explain the techniques of tissue culture technique its, types of mutations, its repair mechanisms and their potential applications.	Understanding
CO4	Explain basic techniques used in recombinant DNA technology.	Understanding
CO5	Discuss the types of wastes generated from the industry and different treatment techniques applied for its disposal.	Understanding

Mapping of Course Outcome and Program Outcome:

CO/PO Mapping (No correlation (0) / Weak (1) / Medium (2) / Strong (3) indicates strength of correlation)														
COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	1	3	3	1	1	2	2	1	3	1
CO2	3	2	3	3	1	3	1	0	1	2	1	2	3	2
CO3	3	1	1	3	1	2	1	1	0	1	2	2	2	3
CO4	2	3	3	2	3	3	1	1	3	1	2	1	1	3
CO5	3	1	1	3	2	2	1	0	0	1	2	1	1	3
Average	**2.8**	**2**	**2.2**	**2.6**	**1.6**	**2.6**	**1.4**	**0.6**	**1**	**1.4**	**1.8**	**1.4**	**2**	**2.4**

Unit	Main Topics	Course Outlines	Lecture (s)
I	**Introduction**	History, scope and present status as well as scope of biotechnology in India and its general applications.	**5**
	Fermentation techniques and bioreactor	Fermentation, Types of fermentation: solid, surface and submerged fermentation. Advantages and disadvantages, applications, bioreactor design	**5**
	Fermentative 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, production of enzymes, applications of enzymes in industry	**5**
II	**Tissue culture technology**	Definition, medium used, cellular totipotency, somatic hybridization, applications.	**5**
	Mutation and its applications	Structure of DNA and RNA, Mutation, mutagens, types of mutations and applications of mutations in strain improvement.	**5**

	Genetic engineering and applications	Gene cloning procedures- different vectors and plasmids involved, general outline and applications of gene cloning in different areas	**5**
	Environmental biotechnology	Types of waste, different aerobic and anaerobic methods for treatment of industrial waste with special reference to methanogenesis.	**6**
		Total=	**42**

Reference books

Author	**Title**
1. P.K. Gupta	Biotechnology
2. PS Panesar and SS Marwaha	Biotechnology in agriculture and food processing
3. Crueger and Crueger	Biotechnology
4. B.D. Singh	Biotechnology

Title of the course : **Food Laws and Regulations**

Subject Code : **OEFT-622B**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Objectives: Objective of this course is to impart knowledge about

- The food quality, being affected from the adulterants, hazards etc and its safety.
- Different food laws and standards in India and their requirements and importance in controlling the quality
- Different international laws and regulatory agencies and their requirements and importance in controlling the quality.
- Food safety regulations and their implementation in food industry to ensure the quality and safety of the foods.
- Retail standards and other regulatory agencies and their importance in controlling the operations.

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

CO1	Know different food laws and their importance	Understanding
CO2	Discuss different adulterants and hazards and their safety measures	Understanding
CO3	Implement different safety tools and regulation in food industry to produce safe products	Applying
CO4	Gain knowledge of international food laws and safety regulations and their implementation criteria	Applying
CO5	Gain knowledge of international food laws and safety regulations and their implementation criteria	Applying

Mapping of Course Outcome and Program Outcome:

CO/PO Mapping (No correlation (0) / Weak (1) / Medium (2) / Strong (3) indicates strength of correlation)														
COs	Programme Outcomes (POs)												Program Specific Outcomes (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	0	3	2	2	2
CO2	1	2	1	2	2	1	0	2	0	1	2	1	2	2
CO3	3	0	2	2	3	3	1	3	1	2	1	3	3	2
CO4	2	2	2	1	2	1	2	3	1	2	2	3	3	2
CO5	1	0	0	2	0	3	1	1	2	1	2	3	3	3
Average	**1.6**	**1.1**	**1**	**2**	**1.6**	**1.6**	**1**	**1.8**	**0.8**	**1.2**	**2**	**2.4**	**2.6**	**2.1**

Unit	Main Topics	Course Outlines	Lecture (s)
I	**Introduction**	Concept and meaning trends in Food quality and food Safety, food adulteration, food hazards, Natural toxins. Concept, need and importance of food laws, standards and regulations.	**6**
	Food Laws and Standards in India and their requirements	Food Safety and Standards (FSS) Act, 2006, FSSA-2008 FSSA Rules and Regulations-2011. Agricultural Produce (Grading and Marketing) Act, 1937, Sugar cane control order-2006 (Under ECA), Export (Quality Control & Inspection) Act, 1963, Bureau of Indian Standards (BIS). (implementation criteria, requirements, structure, jurisdiction, specific importance and applications)	**12**
	International food laws and regulatory agencies.	International Organizations – FAO (Food & Agriculture Organization), WHO (World Health Organization), Codex Alimentarius Commission (CAC), ISO-9000-01 certification.	**10**
II	**Food Safety regulations**	Hazard Analysis Critical Control Points (HACCPs), ISO- 22000, ISO-14000, GHP, planning, application,	**8**

		Implementation criteria, case study, requirements, benefits, structure etc.	
	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.	**8**
	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). WTO. Role of these agencies in trade, food control, food supply managements, tariff etc.	**8**
		Total=	**52**

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
4. I.S.A	HACCP & ISO-22000. ISO9000-01

Title of the course : **Flavour Technology**

Subject Code : **OEFT -711A**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Objectives: Objective of this course is to impart knowledge about

- Flavors regarding available materials, classification on the basis of origin, physical characteristic.
- Flavor perception on tongue and in nose;
- Flavour generation in plants and during processing
- Various analytical techniques for flavour evaluation

Course Outcomes:

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

CO1	Describe current status of flavor industry and basic concepts flavor technology.	Understanding
CO2	Explain the changes in food flavor due to processing: Maillard rxn	Understanding
CO3	Discuss the interaction of flavor from lipid, carbohydrate and protein matrix in terms of retention and release	Understanding
CO4	Describe the criteria and methods for flavor evaluation considering the Indian standards.	Understanding
CO5	Select the flavor for particular food matrices	Understanding

Mapping of Course Outcome and Program Outcome:

CO/PO Mapping (No correlation (0) / Weak (1) / Medium (2) / Strong (3) indicates strength of correlation)														
COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	2	2	0	2	2	3	3	3	1
CO2	3	3	2	3	3	3	2	2	0	2	1	3	3	3
CO3	3	3	3	2	3	2	1	2	0	2	1	3	2	2
CO4	3	3	3	3	3	3	2	2	1	2	2	3	1	2
CO5	3	2	2	2	3	2	2	2	3	2	3	3	2	3
Average	**3**	**2.8**	**2.6**	**2.6**	**3**	**2.4**	**1.8**	**1.6**	**1.2**	**2**	**2**	**3**	**2.2**	**2.2**

Unit	Main Topic	Detailed Contents	Lectures
I	**Introduction**	Definition of Flavour, Classification of Food Flavours, Chemical compounds for flavors, Natural vs Artificial flavours	**4**
	Anatomy of flavour	Perception of taste and aroma, Gustation and Olfaction, gustatory receptors, Types of taste and their perception, perception of odour in mouth and nose	**8**
	Biogenesis of flavours	Generation of flavors by carbohydrate, Lipids and protein metabolism, role of secondary metabolites in flavor generation in fruits and vegetables	**10**
II	**Flavour development during food processing**	Sugar Thermal Breakdown, General overview of the Maillard reaction, pathways for flavor formation via the Maillard reaction, Lipid breakdown, Lignin degradation	**6**
	Analytical techniques in flavour technology	Various types of Chromatography Techniques, Mass spectroscopy, Solid phase micro extraction	**6**

	Flavor generation in Foods and its encapsulation	Bakery products fermented dairy products, meat products. Fruits and vegetable products, Microcapsule system, Encapsulation techniques for flavours	**8**
		Total=	**42**

Books Recommended:

Author	**Title**
1. Reineccius G	Flavor Chemistry and Technology
2. Andrew J. Taylor , Robert S. T. Linforth	Food Flavour Technology
3. Morton ID and Macleod AJ	Food Flavors

Title of the course **: Food Plant Sanitation and Waste Management**

Subject Code **: OEFT - 711B**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Objectives: Objective of this course is to impart knowledge about

- The basics of contamination and sanitation in food plant.
- Basic principles and types of cleaning and disinfection in food processing plant.
- Waste water treatment and solid waste disposal and management.
- Cleaning and sanitation procedure in dairy and meat industry.
- Monitoring food plant sanitation and HACCP.

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

CO1	Provide sanitation information needed to ensure hygienic practices in food processing and preparation operations	Understanding
CO2	Develop a working knowledge in plant and equipment design and materials, cleaners and cleaning techniques, sanitizers, monitoring cleanliness, pests and their control, HACCP and personal hygiene	Understanding
CO3	Develop ability in selecting, establishing and maintaining a suitable program of sanitation	Understanding
CO4	Explain the cleaning and sanitation procedures of different food processing plants.	Understanding
CO5	Implement water and solid waste management in food industry.	Understanding

Mapping of Course Outcome and Program Outcome:

CO/PO Mapping (No correlation (0) / Weak (1) / Medium (2) / Strong (3) indicates strength of correlation)														
COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	1	3	2	0	1	1	2	1	3	2
CO2	3	1	1	2	1	1	3	1	1	2	1	2	2	2
CO3	2	3	3	2	1	3	1	2	3	1	2	2	2	3
CO4	2	2	3	1	3	3	1	2	1	1	1	2	3	3
CO5	3	2	2	2	1	3	1	2	2	2	1	1	2	2
Average	**2.6**	**2**	**2.2**	**1.6**	**1.4**	**2.6**	**1.6**	**1.4**	**1.6**	**1.4**	**1.4**	**1.6**	**2.4**	**2.4**

Unit	Main Topics	Course outlines	Lecture (s)
I	**Introduction**	Common terms used in sanitation, Role of sanitation in food plant. Sources of contamination in a food plant.	**4**
	Principles of cleaning and disinfection	Methods of cleaning and practical applications, Factors influencing cleaning, Types of soil and cleaning compounds, Handling and storage precautions of cleaning compounds, Guided tour to DFST pilot plant for demonstration	**6**
	Water resources	Types of sources of water for food processing, purification & treatment, Water treatment methods, Waste-water components and analysis, Microorganisms of importance in waste-water treatment Field trip to National Water and Sewerage cooperation	**6**
	Waste disposal and treatment	Strategy of waste disposal, Solid-waste disposal, Liquid-waste disposal	**4**
II	**Dairy processing sanitation**	Major pathogens, Plant construction, Sanitation management, Cleaning equipment	**6**
	Meat and poultry plant sanitation, Sea	Common pathogens, Sanitation management, Sanitizers for meat & poultry plants, Sources of sea food contamination	**4**

	food plant sanitation		
	Legislation and cost-benefit analysis in waste management	Total quality management, Hazard Analysis Critical Control Points (HACCP), Development of a HACCP program, Cost benefit mathematical models, Individual assignment presentations	**4**
		Total=	**34**

Books Recommended:

Author	**Title**
Troller, J.A.	Sanitation in Food Processing. 2nd ed. ACADEMIC PRESS, INC.
Marriot, N.G.	Essentials of Food Sanitation/ Robertson, G., Consulting editor. International Thomson Publishing

Marriot, N.G., Gravani, R.B. Principles of Food Sanitation, 5th ed. Springer Science Business Media, Inc.

Title of the course : **Fluid Flow Operation**

Subject Code : **PEFT-611A**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Objectives: Objective of this course is to impart knowledge about

- The theoretical concepts and application related to behaviour of fluids with respect to foods.
- With various pressure, flow and viscosity measuring devices.
- The engineering principles to understand the fluid dynamics
- With fluidization process and its application in conveyors and driers.

Course Outcomes:

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

CO1	Implement the basic concepts of fluid-flow phenomena in food processing.	Understanding
CO2	Discuss various fluid flow theorems and implement in various flow measuring devices.	Applying
CO3	Explain the laminar viscous fluid flow behavior in pipes.	Understanding
CO4	Describe the requirements, working principle and construction of various pumps.	Understanding
CO5	Discuss about viscometry and determine pressure drop in fluidized bed	Applying

Mapping of Course Outcome and Program Outcome:

CO/PO Mapping (No correlation (0) / Weak (1) / Medium (2) / Strong (3) indicates strength of correlation)														
COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	3	1	0	2	1	0	1	1	1	3	2
CO2	3	3	2	1	1	3	1	0	1	1	2	1	3	1
CO3	3	1	3	1	3	3	2	2	1	1	2	2	2	2
CO4	3	2	3	3	2	3	1	0	1	2	2	1	1	2
CO5	3	3	2	3	3	1	1	0	1	1	1	3	2	1
Average	**3**	**2.2**	**2.4**	**2.2**	**2**	**2**	**1.4**	**0.6**	**0.8**	**1.2**	**1.6**	**1.6**	**2.2**	**1.6**

Unit	Main Topics	Course Outlines	Lecture (s)
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 venturi meter, orifice meter, pitot tube, rotameter. Numerical problems.	**6**
	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 contract, entrance and exit losses; Stokes law (laminar flow around a sphere); laminar flow through porous media; pressure drop in flow through porous media.	**8**
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.	**5**

	Viscometry	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.	**6**
	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.	**9**
		Total=	**40**

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

Title of the course **: Post-harvest Engineering**

Subject Code **: PEFT-611B**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Objectives: Objective of this course is to impart knowledge about

- Handling of agricultural produce soon after harvesting.
- Various types of storage system for agricultural produce.
- Design of storage system for perishable and non-perishable produce.
- Food sensing technology and its use in post-harvest management.

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

CO1	Describe the design and principle of post harvesting handling systems and factors affecting postharvest losses.	Understanding
CO2	Discuss the physiological changes and concept of crop process engineering.	Applying
CO3	Implement the concept of unit operations used in storage of fresh produces.	Understanding
CO4	Explain pre-treatments to control disease of fresh produces	Understanding
CO5	Interpret the principle of various operation used in storage of food commodities.	Applying

Mapping of Course Outcome and Program Outcome:

CO/PO Mapping (No correlation (0) / Weak (1) / Medium (2) / Strong (3) indicates strength of correlation)														
COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	3	2	2	1	3	1	1	2	1	1	3	1
CO2	3	1	2	2	2	3	1	3	3	1	2	2	3	2
CO3	2	2	3	3	3	3	1	0	1	2	1	2	2	2
CO4	2	1	3	3	2	3	1	1	0	1	2	1	3	2
CO5	3	1	1	2	2	3	1	1	0	1	1	2	1	2
Average	**2.6**	**1.2**	**2.4**	**2.4**	**2.2**	**2.6**	**1.4**	**1.2**	**1**	**1.4**	**1.4**	**1.6**	**2.4**	**1.8**

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**

	Pre-treatment 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**
		Total=	**43**

Recommended Books:

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 Agriculture processing

Title of the course : Food Storage Engineering

Subject Code : PEFT- 621A

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course objectives: Objective of this course is to impart knowledge about

- Spoilage mechanism of perishables and non-perishables and its requirements.
- Different types of handling equipments and their design.
- Design of storage structures for both perishables and non-perishables.
- Different management practices followed in storage systems.

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

CO1	Describe the engineering properties of biological materials and their importance in design of handling and storage equipments.	Understanding
CO2	Discuss the storage environment and its interaction with stored products.	Understanding
CO3	Describe the design of various handling equipments and storage structures like silos and bins.	Understanding
CO4	Execute the theories associated with storage structures of perishable & non-perishable food	Applying
CO5	Interpret the management practices followed for storage structures and godowns.	Applying

Mapping of Course Outcome and Program Outcome:

CO/PO Mapping (No correlation (0) / Weak (1) / Medium (2) / Strong (3) indicates strength of correlation)														
COs	Programme Outcomes (POs)												Program Specific Outcomes (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**

Unit	Main Topics	Course Outlines	Lecture (s)
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**
		Total=	**44**

Reference Books and Suggested Readings:

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 Agricultural processing

Title of the course : **Technology of Bakery and Confectionery Products**

Subject Code : **PEFT-621B**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Objectives: Objective of this course is to impart knowledge about

- Selection of the raw material used for preparation of various bakery and confectionary products.
- Basics of various rheological properties and use of various equipment like Mixograph, RVA, Extensograph etc for measuring the properties of flour and dough.
- The basic steps and operation in preparation of Bread, Biscuits, cakes and other confectionary products..
- Basic operation and working of various equipments involved in bakery and confectionary technology.

Course Outcomes:

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

CO1	Discuss the current status and raw material of bakery industry, relate the rheological properties to the quality of baked product.	Applying
CO2	Explain the working principle of various rheological equipment like Falling number, RVA etc.	Understanding
CO3	Execute the knowledge for development of various bakery products and their quality determination.	Applying
CO4	Describe the processing and preparation of confectionary products like fruits drops, different gums and their quality evaluations	Understanding
CO5	Discuss the construction and working of various equipments involved in manufacturing of bakery and confectionary products.	Understanding

Mapping of Course Outcome and Program Outcome:

CO/PO Mapping (No correlation (0) / Weak (1) / Medium (2) / Strong (3) indicates strength of correlation)														
COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	3	1	1	1	1	3	2	1	1	2
CO2	3	2	3	3	3	3	1	1	0	1	2	2	1	2
CO3	2	1	1	1	3	3	1	0	1	3	1	1	1	3
CO4	2	1	1	1	3	3	3	1	0	1	1	3	3	1
CO5	3	1	2	1	2	0	3	0	1	3	2	3	3	1
Average	**2.6**	**1.4**	**1.8**	**1.4**	**2.8**	**2**	**1.8**	**0.6**	**0.6**	**2.2**	**1.6**	**2**	**1.8**	**1.8**

Unit	Main Topics	Course Outlines	Lecture (s)
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 quality of the finished product; quality consideration and parameters; Staling and losses in baking	**12**
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, flavor and texture of confectionary; standard and regulations	**12**
	Equipment used in bakery and	Construction and working of various equipments like Mixers, proofing chambers, dough dividers, moulder and sheeter, baking ovens, cooling chamber, sealing and packaging	**10**

	confectionary industry	machines, Rolling and cutting machines project profile of bakery and confectionary unit	
		Total=	**44**

Books Recommended:

Author	**Title**
1. SB Arora	Handbook 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

Title of the course : **Health and Functional Food**

Subject Code : **PEFT-711A**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Objectives: Objective of this course is to impart knowledge about

- Classification of various food bioactive components showing health benefits.
- various type of health and functional foods for different aged group and alleviating chronic or lifestyle disease/disorder.
- extraction of bioactive compounds using non-thermal extraction techniques.
- effect of storage, packaging and safety of bioactive components and functional foods

Course Outcomes:

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

CO1	Discuss the scope, status and importance of functional foods and nutraceuticals in India, types of functional food and their properties	Understanding
CO2	Explain the various physiological and biochemical aspects of life threatening and chronic diseases and effect of various bioactive components on such diseases.	Applying
CO3	Select the raw material and processing of bioactive components	Understanding
CO4	Discuss safety and legal aspects and factor affecting marketing of nutraceutical and functional food.	Understanding
CO5	Discuss the packaging requirements and changes during storage of bioactive components	Applying

Mapping of Course Outcome and Program Outcome:

CO/PO Mapping (No correlation (0) / Weak (1) / Medium (2) / Strong (3) indicates strength of correlation)														
COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	3	1	1	3	1	2	1	1	2	1	1	2
CO2	2	1	1	3	2	3	1	1	1	2	3	1	3	2
CO3	3	1	1	3	1	3	3	2	1	2	2	1	3	3
CO4	3	1	1	2	2	3	1	1	2	1	1	1	3	1
CO5	1	3	3	2	2	3	1	1	1	2	2	2	2	2
Average	**2.2**	**1.6**	**1.8**	**2.2**	**1.6**	**3**	**1.4**	**1.4**	**1.2**	**1.6**	**2**	**1.2**	**2.4**	**2**

Unit	Main Topics	Course Outlines	Lecture (s)
I	**Introduction**	Status and scope of health and functional foods in India, Definition and classification of nutraceuticals	**3**
	Health and functional foods	Concept, types, development of functional foods, infant and baby foods, adolescent/ teen age foods, foods for pregnant ladies and nursing mothers, geriatric foods.	**7**
	Food constituents	Various food constituents responsible for functional effects -Anti-carcinogenic, hypocholesterolaemia and hypoglycaemic foods - Dietatic foods, anti-ageing foods - Fortified foods, diabetic foods - Biofedic, prebiotics and probiotic foods	**10**
II	**Processing and selection criteria**	Nonthermal extraction of bioactive compounds, Processing of health and functional foods.	**6**
	Storage, packaging and labeling	Storage, packaging and labeling of health and functional food.	**4**
	Marketing aspects	Marketing aspects of health and functional foods	**2**

	Safety aspects	Safety / Legal aspects of health and functional foods, transgenic plant foods with health claims	**4**
		Total=	**36**

Books Recommended:

Author	**Title**
1. Chadwick, Henson, Moseley	Functional Foods
2. Jeffrey Hurst	Methods of Analysis for Functional Foods and Nutraceuticals
3. Mazza	Functional Foods
4. Wildman	Handbook of Nutraceuticals and Functional Foods
5. Burton	Human nutrition: A textbook of nutrition in health and disease
6. Joshi	Nutrition and Dietetics.
7. Howe, Saunders	Basic Nutrition in Health and Disease.

Title of the course : **Technology of Food Plant By-product Utilization**

Subject Code : **PEFT - 711 B**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Objectives: Objective of this course is to impart knowledge about

- The importance of waste utilization from different food processing industries.
- Design, construct, operate and manage waste treatment for biogas plant.
- The concept of by-product Management, Minimization and Utilization.
- Legal, technical and management principles for effective by product utilization.
- The best available technologies for by product processing.

Course Outcomes:

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

CO1	Describe the current status of food processing waste and strategies to minimize the waste	Understanding
CO2	Execute the knowledge of utilization of fruits & vegetable and cereals based waste and manufacturing of various useful by-products.	Applying
CO3	Discuss the utilization of Meat, fish and poultry based waste and manufacturing of various useful by- products	Understanding
CO4	Execute the knowledge of utilization of dairy based waste and manufacturing of various useful by- products	Applying
CO5	Execute the knowledge of utilization oilseed processing and beverage industry based waste and manufacturing of various useful by- products	Understanding

Mapping of Course Outcome and Program Outcome:

CO/PO Mapping (No correlation (0) / Weak (1) / Medium (2) / Strong (3) indicates strength of correlation)														
COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	1	3	2	0	1	1	2	1	3	2
CO2	3	1	1	2	1	1	3	1	1	2	1	2	2	2
CO3	2	3	3	2	1	3	1	2	3	1	2	2	2	3
CO4	2	2	3	1	3	3	1	2	1	1	1	2	3	3
CO5	3	2	2	2	1	3	1	2	2	2	1	1	1	2
Average	**2.6**	**2**	**2.2**	**1.6**	**1.4**	**2.6**	**1.6**	**1.4**	**1.6**	**1.4**	**1.4**	**1.6**	**2.2**	**2.4**

Unit	Main Topics	Course Outlines	Lecture (s)
I	**Introduction**	Identification of useful products from agricultural waste and food processing waste. By-products and effluent management specific to food processing units.	**10**
	By-products of F&V	Utilization of Fruit and Vegetable Wastes: Types of wastes in fruits and vegetable processing industries. Processes for waste utilization from fruit and vegetable industries	**7**
	Cereal industry by-products	Utilization of by-products from Wheat, rice, corn and dal milling. Extraction of oil from wheat germ. Rice bran utilization for edible grade oil extraction.	**7**
	Meat, fish and poultry industry by-product	Animal skins, bones, hides, trimmings, blood, fatty tissues, horns, feet, hoofs or internal organs utilization. Production of gelatin. Utilization of eggshell. fish oils, fish protein concentrate, fish meal, bioactive peptides, and fish protein hydrolysates	**7**
II	**Dairy industry by-product**	Utilization of by-products from dairy industry-whey utilization, ghee residue, butter milk, lactose utilizations. Preparation of beverages from whey. Preparation of toffee/pinni from ghee residue. Curd utilization etc.	**6**

	Oilseed processing	Utilization of by- products from oil milling industry- husk, oil cake for protein extraction and cattle feed, by products from oil refining-wax, pigment, gums, lecithin, free fatty acids. Extraction of protein from oil cake. Soap formation from free fatty acids.	**6**
	Beverage Industry	vine prunings, grape stalks, grape pomace and grape seeds, yeast lees, tartrate, carbon dioxide and wastewater, production of ethanol, tartrates and malates, citric acid, grape seed oil, hydrocolloids and dietary fibre from pomace, utilization of grape seed extracts (GSE).	**5**
		Total=	**47**

Books Recommended:

Author	**Title**
1. Metcalf & Eddy,	Waste water Engineering Treatment and Reuse
2. Eckenfelder, W. W. Jr.,	Industrial Water Pollution Control
3. Beagle	Rice Husk Conversion to Energy
4. A. Chakraverty	Post Harvest Technology of Cereals, Pulses and Oilseeds

Title of the Course : **Technology of Beverages**

Subject Code : **PEFT - 712A**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Objectives: Objective of this course is to impart knowledge about

- Importance of beverage and status of beverage industry in India
- Different types of beverages and their formulation.
- The alcoholic beverages and their processing.
- 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:

CO1	Describe status and different water treatment techniques before its utilization in beverages with quality standards.	Understanding
CO2	Discuss the technology of carbonated soft drinks.	Understanding
CO3	Execute the knowledge of processing of different types of tea and coffee and cocoa beans in food industry	Applying
CO4	Explain the involved technologies in production of alcoholic beverages	Understanding
CO5	Examine the physical, chemical and biological changes occurring in the processing and storage of both alcoholic and non-alcoholic beverages.	Analyzing

Mapping of Course Outcome and Program Outcome:

CO/PO Mapping (No correlation (0) / Weak (1) / Medium (2) / Strong (3) indicates strength of correlation)														
COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	3	1	1	3	1	2	1	1	2	1	1	2
CO2	2	1	1	3	2	3	1	1	1	2	3	1	3	2
CO3	3	1	1	3	1	3	3	2	1	2	2	1	3	3
CO4	3	1	1	2	2	3	1	1	2	1	1	1	3	1
CO5	1	3	3	2	2	3	1	1	1	2	2	2	2	2
Average	**2.2**	**1.6**	**1.8**	**2.2**	**1.6**	**3**	**1.4**	**1.4**	**1.2**	**1.6**	**2**	**1.2**	**2.4**	**2**

Unit	Main Topics	Course Outlines	Lecture (s)
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**
		Total=	**42**

Books Recommended:

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

Title of the course : **Industrial Microbiology**

Subject Code : **PEFT - 712B**

L	T	P	Credits	Weekly Load
3	**0**	**0**	**3**	**3**

Course Objectives: Objective of this course is to impart knowledge about

- The industrially important microorganisms.
- The basics of fermenter and different types of fermentation processes.
- The principles of secondary metabolite production.
- Role of industrially important micro-organisms in production of fermented food products

Course Outcomes: On the successful completion of the course, students will be able to:

CO1	Report the isolation, screening and genetic improvement of industrially important microorganisms.	Understanding
CO2	Discuss the design and working of various type of fermentation system	Understanding
CO3	Describe the principle associated to production of various biomaterial by fermentation process.	Understanding
CO4	Explain the secondary metabolite production and their properties.	Understanding
CO5	Execute the knowledge to utilize and dispose the Food industry waste through Microorganism and Genetically modified microorganism.	Applying

*As per Blooms Taxonomy

Mapping of Course Outcome and Program Outcome:

CO/PO Mapping (No correlation (0) / Weak (1) / Medium (2) / Strong (3) indicates strength of correlation)														
COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	2	1	1	1	1	2	2	2	1	3	1
CO2	2	2	3	3	1	2	1	1	0	3	2	1	1	2
CO3	2	2	2	3	1	3	0	3	1	1	2	2	3	3
CO4	2	1	1	3	2	1	1	0	2	2	1	1	1	3
CO5	3	2	1	1	2	1	3	1	2	1	2	2	2	2
Average	**2.4**	**1.6**	**1.6**	**2.4**	**1.4**	**1.6**	**1.2**	**1.2**	**1.4**	**1.8**	**1.8**	**1.4**	**2**	**2.2**

Unit	Main Topics	Course Outlines	Lecture(s)
I	**Introduction**	Historical development in industrial microbiology General overview about the industrially important organisms	**3**
	Fermentation Process	Types of fermentation and factors affecting fermentation. Submerged fermentation surface fermentation and solid substrate fermentation. Fundamentals of Batch, fed batch and continuous fermentation.	**7**
	Bioreactors	Designing and development of a bioreactor. Materials used in the construction of bioreactors. Aeration and agitation systems for bioreactors, baffles.	**8**
II	**Production of organic acids &polysaccharides**	Raw materials used & microorganisms involved, optimum process parameters for the production lactic acid. Raw materials used, microorganisms involved and optimum process parameters for the production of citric acid and acetic acid. Raw materials, microorganisms involved and process for the Fermentative production of microbial Xanthan. Raw materials, microorganisms involved and process for the Fermentative production of microbial pullulan.	**10**

	Production of alcoholic beverages	Raw materials, microorganisms involved and process for the production of non-distilled of wine. Raw materials, microorganisms involved and process for the production of non-distilled of beer. Raw materials, microorganisms involved and process for the production of distilled alcoholic beverages –whiskey. Raw materials, microorganisms involved and process for the production of distilled alcoholic beverages- brandy.	**8**
		Total =	**36**

Books Recommended:

Author	**Title**
1. M.M.J. Waites, N.L. Morgan, J.S. Rockey and G. Higton	Industrial Microbiology: An Introduction
2. K.S. Bilgrami	Essentials of Microbiology
3. Casida	Industrial Microbiology
4. W. Crueger, A. Crueger and T.D. Brock	Biotechnology: A Textbook of Industrial Microbiology
5. Stanbury P.F, Whitaker A., Hall S.J	Principles of Fermentation Technology

Title of the course : **Food Additives and Ingredients**

Subject Code : **PEFT - 721A**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Objectives: Objective of this course is to impart knowledge about

- Various different types of food additives
- Role of food additives in food quality control
- The techniques of best use of food additives
- 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

CO1	Describe the classification and functions of various food additive and their toxicological evaluation.	Understanding
CO2	Understand the suitable application of food ingredients in health foods and convenience food preparation	Understanding
CO3	Learn the techniques of food additives stability and use level, Familiarize various naturally occurring food additives	Understanding
CO4	Familiarize various aspects of food production and application of food additives	Understanding
CO5	Learn the students about the techniques used to in the preparation of natural food additives	Applying

Mapping of Course Outcome and Program Outcome:

CO/PO Mapping (No correlation (0) / Weak (1) / Medium (2) / Strong (3) indicates strength of correlation)														
COs	Programme Outcomes (POs)												Program Specific Outcomes (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**

Unit	Main Topics	Course Outlines	Lecture (s)
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, flavor emulsions; essential oils and oleoresins; authentication of flavours etc.	**12**
II	**Proteins, starches and lipids as functional ingredient**	Isolation, modification, specifications, functional properties and applications in foods and as nutraceuticals	**10**

	Applications	Manufacturing and applications of fibres from food sources, fructo-oligosaccharides.	**8**
		Total=	**42**

Books Recommended:

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

Title of the course : **Technology of Fats and Oils**

Subject Code : **PEFT - 721B**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Objectives: Objective of this course is to impart knowledge about

- Composition of fats/oils and their importance and functions in foods.
- Different methods of extraction of fat/oil and different types of extractors.
- Different refining methods used for oils/fats and techniques to minimize losses.
- Hydrogenation and effect of different processing parameters on the process of hydrogenation and manufacturing technology of different fat products.
- Different chemical reactions and quality parameters to control the quality of different fats.

Course Outcomes:

After successful completion of this subject, the students will be able to

CO1	Explain the basic extraction methods by using different extractors of Fats and Oils	Understanding
CO2	Explain the different methods of refining and techniques to minimizes refining losses and effect of hydrogenation process	Understanding
CO3	Discuss the Chemistry of fats and oils and manufacturing technology of different fats and fat rich products	Understanding
CO4	Explain the different quality parameters of fats and oils	Understanding
CO5	Discuss the soap processing and its application	Understanding

Mapping of Course Outcome and Program Outcome:

CO/PO Mapping (No correlation (0) / Weak (1) / Medium (2) / Strong (3) indicates strength of correlation)														
COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	3	0	1	2	3	1	1	3	2	1	2
CO2	3	2	1	1	1	3	1	0	2	2	1	1	1	2
CO3	3	3	3	1	3	3	1	0	0	1	2	2	3	3
CO4	2	3	3	3	1	1	0	1	2	2	1	1	2	3
CO5	2	1	1	3	2	1	1	0	0	2	1	1	1	3
Average	**2.4**	**2**	**1.8**	**2.2**	**1.4**	**1.8**	**1**	**0.8**	**1**	**1.6**	**1.6**	**1.4**	**1.6**	**2.6**

Unit	MAIN Topics	Course Outlines	Lecture (S)
I	**Introduction**	Nutritional aspects of fats and oils - metabolism – fat level in the diet and effect on health, fat reduction in foods. Importance and functions of fats and oils in foods, composition of fats/oils from different animal sources and oilseeds.	**3**
	Oil extraction	Different methods of oil extraction, Important characteristics of oils and oil expression from oilseeds like, mustard/rapeseed, coconut, sunflower, groundnut, sesame, cotton. Machines (Mechanical expellers and solvent extractors) used in the expression of oil, Calculations based on the extraction processes	**6**
	Oil/fat purification	Refining techniques: clarification, degumming, neutralization, bleaching, refining losses and deodorization, Batch and continuous refining and losses	**6**
	Hydrogenation	Chemistry of hydrogenation, Effect of process conditions, Hydrogenation in Practice, Catalysts and catalysis.	**3**
II	**Chemistry of fats and oils**	Lipolysis, auto-oxidation, thermal decomposition, chemistry of frying oils, inter-esterification, reversion	**3**

	Technology of individual fat products	Butter, Margarine, dressings for food (Mayonnaise and Salad dressings, pourable - type dressings, reduced calorie dressing), Shortening, Lard, Salad, cooking and frying oil. Blending and enrichment of edible oils, Speciality fats and designer lipids for nutrition and dietetics.	**8**
	Different quality parameters	Peroxide value, Saponification value, Iodine value, acid value, TBA, RM value, P-value, Kries value, Adulteration in oils and fats.	**3**
	Value added products and by-products	value added products from vegetable oil refining industry like lecithin, wax, Vitamin-E, oryzanol. By-products from bran oil and oil refining industry,	**4**
		Total=	**36**

Books Recommended:

Author	**Title**
1. Decker, Min, McDonald	Food Lipids and Health
2. Chrysam, Erickson and others	Bailey's Industrial Oil and Fat Products
3. Hamm and Hamilton	Edible Oil Processing
4. Meyer	Food Chemistry
5. Lawson	Food oils and fats
6. Maran	Fats in food products
7. Acharya	Oilseeds and Oil Milling in India

Title of the course : **Food Processing Plant Layout and Design**

Subject Code : **PEFT - 722A**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Objectives: Objective of this course is to impart knowledge about

- The various factors involved in the site selection and design of food plant.
- The processes involved in layout design.
- The concept of preparing cost estimate and economics
- The development and design consideration in different food industries.

Course Outcomes:

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

CO1	Execute the concepts, principles and theories for the location of food processing plant.	Applying
CO2	Demonstrate plant layout problems by using different tools and techniques	Applying
CO3	Execute techniques of project planning by using scheduling methods and interpret the cost analysis	Applying
CO4	Implement the knowledge of materials applied for construction of food equipment and hygienic construction for food plant	Applying
CO5	Design and setting up of new food processing plant as entrepreneur and/or consultant.	Creating

Mapping of Course Outcome and Program Outcome:

CO/PO Mapping (No correlation (0) / Weak (1) / Medium (2) / Strong (3) indicates strength of correlation)														
COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1	3	1	2	1	0	1	1	2	2	1	3
CO2	3	2	1	1	2	3	1	0	1	1	2	2	3	3
CO3	2	1	1	3	1	3	1	1	0	2	2	1	2	1
CO4	3	1	1	2	1	1	1	1	2	1	1	2	3	3
CO5	3	2	1	1	1	3	1	1	0	2	2	1	2	2
Average	**2.6**	**1.4**	**1**	**2**	**1.2**	**2.4**	**1**	**0.6**	**0.8**	**1.4**	**1.8**	**1.6**	**2.2**	**2.4**

Unit	Main Topics	Course Outlines	Lecture (s)
I	**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	**11**

		for machines, work stations and storage, symbols used for plant design and layout plant layout procedures	
II	**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, Aluminium, 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**
		Total=	**43**

Recommended Books:

Author	**Title**
1. O.P. Khanna	Production Engineering 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 Engineering
5. Rase and Barrow	Project Engineering of Process Plant
6. Farrall	

Title of the course : **Innovative Techniques in Food Processing**

Subject Code : **PEFT-722B**

L	T	P	Credits	Weekly Load
3	0	0	3	3

Course Objectives: Objective of this course is to impart knowledge about

- The concept of various novel food preservation techniques.
- Design of novel process equipments.
- Application of novel processing techniques in the preservation of foods.
- The principles behind working of various food processing techniques.

Course Outcomes:

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

CO1	Understand the membrane technology: MF, UF, NF & RO and Super critical fluid extraction process in food industry	Understanding
CO2	Understand the application of microwave and radio frequency wave technology in food processing	Understanding
CO3	Explain the working principle and advantage of high pressure processing (HPP) in food preservation	Understanding
CO4	Discuss the working principle and advantage of Ohmic and Radiation heating process in food processing	Understanding
CO5	Understand the Hurdle Technology and apply it to extend the shelf-life of food products	Applying

Mapping of Course Outcome and Program Outcome:

CO/PO Mapping (No correlation (0) / Weak (1) / Medium (2) / Strong (3) indicates strength of correlation)														
COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	3	1	3	1	1	1	2	2	1	3	3
CO2	3	1	1	2	2	3	1	0	1	0	2	1	2	3
CO3	3	3	3	2	3	3	2	0	1	1	2	2	3	1
CO4	3	1	1	3	2	3	3	1	0	1	2	1	2	1
CO5	1	1	3	3	3	3	2	0	1	3	2	2	3	3
Average	**2.6**	**1.6**	**2**	**2.6**	**2.2**	**3**	**1.8**	**0.4**	**0.8**	**1.4**	**2**	**1.4**	**2.6**	**2.2**

Unit	Main Topics	Course Outlines	Lecture (s)
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. Application of microwave and radio frequency technology process in food processing.	**6**
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	**4**

		HPP equipment. Application of HPP application in food processing.	
	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.	**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**
		Total=	**44**

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

Title of the course : **Enzyme in Food Processing**

Subject Code : **HDFT - 611**

L	T	P	Credits	Weekly Load
3	1	0	4	4

Course Objectives: Objective of this course is to impart knowledge about

- Enzyme, its classification, kinetics and function in foods.
- Different methods of enzyme production and purification.
- Application of enzymes in cereal and fruit and vegetable processing and milk and meat processing.
- Different method of enzyme immobilization techniques and their uses.

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

CO1	Know the different kind of enzymes and their activities	Understanding
CO2	Know different methods of enzyme production	Applying
CO3	Understand application of enzyme in cereal product and fruit and vegetable products and related benefits.	Applying
CO4	Know the effect of enzyme on quality of meat and milk products	Applying
CO5	Get knowledge of immobilization techniques and its benefits	Understanding

Mapping of Course Outcome and Program Outcome:

CO/PO Mapping (No correlation (0) / Weak (1) / Medium (2) / Strong (3) indicates strength of correlation)														
COs	Programme Outcomes (POs)												Program Specific Outcomes (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**

Unit	Main Topics	Course Outlines	Lecture (S)
I	**Introduction**	Enzymes, definition, co-enzymes, cofactors, classification of enzymes and their functions. Mechanism of enzyme action, enzyme kinetics, Line-Weaver Burk Plot, Numericals related with enzyme kinetics, factors affecting enzyme action.	**8**
	Enzyme production	Selection of enzymes, sources of enzymes, advantages of microbial enzymes, production by solid substrate fermentation and submerged fermentation, enzyme extraction and purification.	**8**
	Enzymes in cereal processing	Enzymes in the processes of malting, brewing, baking and high fructose corn syrups (HFCS), glucose syrups.	**6**
	Enzyme in fruit processing	Use of enzymes in fruit juice clarification, removal of haziness and bitterness, wine clarification.	**4**
II	**Enzyme in meat and milk**	Meat tenderization, ageing, cheese processing	**4**
	Enzyme in fats and oils	Enzymes causing quality changes in foods, enzymatic fat modification	**4**
	Protein recovery	Enzymatic process for protein recovery	**2**
	Immobilized Enzymes	Definition, Enzyme immobilization techniques and its benefits, use of immobilized biocatalysts in food processing technology.	**4**
		Total=	**40**

Books Recommended:

Author	**Title**
1. Tombs	Biotechnology in the Food Industry
2. Nagodwithana and Reeds	Enzymes in Food Processing
3. Godfrey	Industrial Enzymology
4. Kuddus	Enzymes in Food Processing

Title of the course : **Basic Agricultural Process Engineering**

Subject Code : **HDFT - 612**

L	T	P	Credits	Weekly Load
3	1	0	4	4

Course objectives: Objective of this course is to impart knowledge about

- Production and consumption trends, structure, composition, quality evaluation of agricultural product
- Processing technologies for product development and value addition of various cereals, pulses and oilseeds

Course outcomes:

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

CO1	Explain the harvesting methods, post harvest losses and threshing of different grains	Understanding
CO2	Discuss the principles and implement the various cleaning, grading operation	Applying
CO3	Interpret the role of moisture content and psychrometry in grain storage	Applying
CO4	Explain the principles of drying and different dryers and execute the drying of grains	Applying
CO5	Explain the principles of various material handling equipments	Understanding

Mapping of Course Outcome and Program Outcome:

CO/PO Mapping

(No correlation (0) / Weak (1) / Medium (2) / Strong (3) indicates strength of correlation)

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	3	3	2	2	0	0	1	2	2	3	2
CO2	2	3	2	3	1	1	1	0	2	2	1	1	2	2
CO3	1	3	2	1	0	0	2	1	0	1	2	2	2	2
CO4	2	2	1	1	0	2	1	0	0	1	2	2	2	2
CO5	2	2	1	2	0	1	1	1	2	2	1	1	2	2
Average	**1.8**	**2.2**	**1.6**	**2**	**0.8**	**1.2**	**1.4**	**0.4**	**0.8**	**1.4**	**1.6**	**1.6**	**2.2**	**2**

Unit	Main Topics	Detailed Contents	Lectures
I	**Introduction**	Structure and composition of food grains, harvesting- optimum stage of harvest, methods of harvesting, post harvest losses in durable and perishable crops.	**5**
	Threshing	Types of threshers, types of threshing cylinders, working principles and their operation. Shelling and decortication principle of operation. maize shellers, groundnut decorticator - hand operated and motorised.	**8**
	Cleaning and grading	Principles, particle motion during screening, screen openings, ideal and actual screens, effectiveness of screen, types of cleaners and graders; Air-screen cleaner-design consideration of an air screen cleaner, disk separator, Indented cylinder separator, Spiral separator, magnetic separator, colour sorter, specific gravity separator, cyclone separator -efficiency of separation - performance index	**8**
II	**Moisture content & Psychrometry**	Methods of determination, direct and indirect methods, equilibrium moisture content, sorption isotherm, Properties of air, water vapour mixture, humidification, dehumidification-psychrometry applied for food grains.	**10**
	Drying	Principles, thin layer drying, constant - rate and falling-rate period of drying, rate period of drying, effect of different factors on drying process, deep bed drying. Methods of mechanical drying depending on modes of heat transfer. Grain dryers - Types of mechanical dryers, Batch type and continuous types.	**8**
	Material handling and storage	Types of handling and conveying systems for agricultural products and their design - belt conveyor, screw conveyor, bucket elevators and pneumatic conveyors. Storage - conditions for safe storage of durable commodities. Bag and bulk storage- Design of silos and storage structures.	**8**

Total=	**47**

Books Recommended:

Author	**Title**
1. Sahay & Singh	Unit Operation in Agricultural Processing
2. Chakraverty, A.	Postharvest Technology of Cereals and Pulses.

Title of the course : **Instrumental Techniques in Food**

Subject Code : **HDFT - 621**

L	T	P	Credits	Weekly Load
3	1	0	4	4

Course Objectives: Objective of this course is to impart knowledge about:

- The fundamentals of chromatography and spectroscopy principles, instrumentation and advantages and disadvantages of the techniques
- Data acquisition, interpret measurements and perform qualitative and quantitative analysis on selected foods.
- Matrix effects.
- The performance of these techniques for rapid and routine analysis as compared to reference methods.

Course Outcomes: On successful completion of the subject, the student will be able to

CO1	Define key terms related to qualitative and quantitative physical and chemical food analysis.	Analyzing	
CO2	Describe approaches necessary in sampling of food prior to its analysis.	Applying	
CO3	Describe the basic principles underlying analytical techniques associated with food analysis.	Analyzing	
CO4	Describe physical and chemical techniques necessary for chromatographic analysis and analytical instrumentation of food constituents.	Analyzing	
CO5	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.	Analyzing	

Mapping of Course Outcome and Program Outcome:

CO/PO Mapping (No correlation (0) / Weak (1) / Medium (2) / Strong (3) indicates strength of correlation)														
COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	3	3	1	0	1	1	0	2	1	2	3	1
CO2	2	3	3	1	1	3	1	1	0	2	1	2	2	2
CO3	3	2	2	3	3	1	3	1	0	2	2	1	3	3
CO4	2	2	2	1	1	2	2	1	0	2	1	1	1	3
CO5	1	3	1	2	2	3	1	1	0	1	2	2	3	3
Average	**2**	**2.2**	**2.2**	**2**	**1.6**	**1.8**	**1.6**	**1**	**0**	**1.8**	**1.4**	**1.6**	**2.4**	**2.4**

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	**6**
	Sampling	Acceptance sampling: operational characteristics, risks, attribute sampling plans, administration of attribute, sampling error	**6**
	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.	**4**
II	**Spectroscopy**	Beers and Lambert's Law. Extinction coefficient. General principles of colorimeters and spectrophotometers, AAS, Emmission spectroscopy, IR spectroscopy: NMR, FTIR. Flourimetry, Spectroflourometers.	**6**
	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

Title of the course : **Food Rheology**

Subject Code : **HDFT - 711**

L	T	P	Credits	Weekly Load
3	1	0	4	4

Course Objectives: Objective of this course is to impart knowledge about

- Texture and rheological measurement of various food products.
- Detailed rheology of foods.
- Various types of spectroscopy methods.

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

CO1	Explain the basic principle of food rheology.	Understanding
CO2	Interpret the rheological properties of various type of food	Applying
CO3	Interpret the rheological test result	Applying
CO4	Explain the textural properties of food	Understanding
CO5	Describe rheological, textural properties and sensory properties of food	Understanding

Mapping of Course Outcome and Program Outcome:

CO/PO Mapping

(No correlation (0) / Weak (1) / Medium (2) / Strong (3) indicates strength of correlation)

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	3	3	1	0	1	1	0	2	1	2	3	1
CO2	2	3	3	3	3	1	1	0	0	2	2	2	2	2
CO3	3	3	2	3	3	2	1	1	0	2	2	2	3	3
CO4	2	2	2	1	2	1	2	1	0	2	1	2	2	2
CO5	1	3	2	2	2	1	1	1	0	2	2	1	3	3
Average	**2**	**2.4**	**2.4**	**2.4**	**2.2**	**1**	**1.2**	**0.8**	**0**	**2**	**1.6**	**1.8**	**2.6**	**2.2**

Unit	Main Topic	Detailed Contents	Lecture (s)
I	**Introduction**	Food rheological behaviour. Rheology: definitions and importance. Rheological tests. Fundamental rheological tests, Working principle of rheometer and various viscometer	**4**
	Fundamentals of rheology	Rheology of macromolecules suspensions: relative viscosity, specific and reduced viscosity and intrinsic viscosity. Applied rheology: consistency and texture. fundamental food characteristic, sensory evaluation versus instrumental evaluation. The importance of glassy state in food quality and texture preservation. Application of rheology concepts (non Newtonian fluid behavior	**8**
II	**Textural measurements**	Requirement of test systems for measuring food texture. Types of texture Instrument and their operating mechanisms, Calibration, Performance of test and measurements of test parameters. Interpretation of test results.	**8**
	Application-I	Textural properties of fruits & vegetables; Dough, Pasta and Baked products; dairy products; Meat; Fat and fat products; and their instrumental Measurements.	**8**
	Application-II	Rheology of chocolate, Textural characteristics of food emulsions, Functions of emulsifiers in relation to food texture, Sensory measurement of food texture and texture profile.	**8**
		Total=	**36**

Title of the course : **Food Processing and Preservation**

Subject Code : **MDFT - 511**

L	T	P	Credits	Weekly Load
3	1	0	4	4

Course Objectives: Objective of this course is to impart knowledge about

- Importance of food processing and preservation, classification of foods on the basis of shelf life, pH and origin.
- Basic understanding of the concept of food spoilage.
- Basic understanding of Low and High Temperature Preservation.
- Low Moisture and Chemical preservation
- Radiation preservation.

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

CO1	Discuss fundamental principles of food preservation	Understanding
CO2	Describe the principles of low temperature preservation	Understanding
CO3	Explain thermal processing and execute high temperature processing in food industry	Applying
CO4	Discuss the concept of water activity and preservation by Drying & Dehydration	Understanding
CO5	Describe the principles of non-thermal preservation methods	Understanding

Mapping of Course Outcome and Program Outcome:

CO/PO Mapping (No correlation (0) / Weak (1) / Medium (2) / Strong (3) indicates strength of correlation)														
COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	3	2	3	2	1	1	0	0	1	2	2	1	3	3
CO2	3	2	3	2	1	1	1	1	1	2	2	1	3	3
CO3	3	3	3	2	3	3	1	1	1	1	2	1	3	3
CO4	3	3	3	3	2	3	1	1	1	3	2	1	3	3
CO5	3	2	3	1	2	1	1	0	0	1	1	1	3	3
Averag e	**3**	**2.4**	**3**	**2**	**1.8**	**1.8**	**0.8**	**0.6**	**0.8**	**1.8**	**1.8**	**1**	**3**	**3**

Unit	Main Topics	Course Outlines	Lecture (s)
I	**Introduction**	Importance of food processing and preservation; classification of foods on the basis of shelf life, pH, origin	**6**
	Food spoilage	Different types of food spoilage viz. microbiological, enzymatic, chemical and physical and their effects on food quality	**6**
	Low Temperature Preservation	Low temperature requirement for different foods — Refrigeration, slow and fast freezing, freezing process; Types of freezer, their advantages and limitations; Storage and thawing of frozen food	**8**
II	**High Temperature Preservation**	Canning: Definition, advantages and disadvantages; Can formation; Unit operations in canning: Selection of raw material, peeling/coring, blanching, filling, brining/syruping, exhausting, sealing, processing, cooling, labeling and storage	**8**
	Low Moisture preservation	Drying and dehydration methods- Solar, cabinet, tray and drum	**6**

	Chemical preservation	Introduction, classification and applications.	**4**
	Radiation preservation	Introduction, sources, and applications.	**4**

Recommended Books:

Author	**Title**
1. Desrosier	Technology of food preservation
2. Fennema.	Karrel Principles of Food Science Vol-I

Title of the course : **Food Biochemistry and Nutrition**

Subject Code : **PCFT- 521 / MDFT - 521**

L	T	P	Credits	Weekly Load
3	1	0	4	4

Course objectives: Objective of this course is to impart knowledge about

- Concept of human food requirements and digestion.
- Best use of available nutrients in order to full fill the requirements of balanced diet for the consumers.
- The role of safe food in health promotion and disease prevention
- 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:

CO1	Demonstrate the role of enzymes and their importance in food biochemical processing and food digestion.	Understandings
CO2	Describe about the chemical/biochemical properties and metabolic pathways of carbohydrates, lipids, and proteins.	Understandings
CO3	Familiarize/interprets various aspects of food nutritional requirements for health sustainability and concept of balance diet	Applying
CO4	Elaborate/apply about the techniques used to calculate protein quality, dietary allowances of different people and techniques of nutritional assessment	Applying
CO5	Describe and demonstrate the society to develop preventive measures for balanced diet and eradication of malnutrition.	Applying

Mapping of Course Outcome and Program Outcome:

CO/PO Mapping (No correlation (0) / Weak (1) / Medium (2) / Strong (3) indicates strength of correlation)														
COs	Programme Outcomes (POs)												Program Specific Outcomes (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	3	2
CO2	1	2	1	2	2	2	0	0	2	2	2	1	3	2
CO3	3	0	2	2	3	3	1	3	1	2	1	3	3	2
CO4	2	***2***	1	***1***	2	2	0	3	1	0	2	3	3	3
CO5	1	0	1	2	0	3	1	1	1	1	2	2	3	3
Average	**1.6**	**1.2**	**1**	**2**	**1.6**	**2**	**0.6**	**1.4**	**1**	**1.2**	**2**	**2**	**3**	**2.4**

Unit	Main Topics	Course Outlines	Lecture (s)
I	**Enzymes**	Enzymes nomenclature and classification, factors effecting enzyme activity, active site of enzyme, co-enzymes, co-factors, iso-enzymes, specificity of enzymes, enzyme inhibition and activation, mechanism of enzyme action, enzyme thermodynamics, enzyme kinetics, enzyme applications	**10**
	Metabolism of carbohydrates	Digestion and absorption, major pathways of carbohydrates metabolism (glycolysis, gluconeogenesis, Kreb's cycle, glycogenesis, glycogenolysis), galactose and fructose metabolism, Disorders of carbohydrate metabolism	**12**
	Metabolism of lipids	Digestion and absorption, β-oxidation of fatty acids, Biosynthesis of fatty acids and triacylglycerol. Functions of lipids in the diet.	**9**
II	**Metabolism of Proteins**	Digestion and absorption, amino acid pool, nitrogen balance, metabolism of amino acids (general aspects, deamination, transamination),	**10**

		metabolism of ammonia, Biosynthesis of protein, urea cycle, disorders of amino acid metabolism.	
	Biological Oxidation	Bioenergetics, high energy compounds, biological oxidation, electron transport chain, oxidative phosphorylation and inhibitors. Shuttle pathways	**6**
	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, balance diet Causes and preventions of malnutrition.	**14**
		Total	**61**

Books Recommended:

Author	**Title**
1. A.V.V.S Ramaroa	Biochemistry
2. Lahhanger	Principles of Biochemistry
3. Mohinder Singh	Biochemistry
4. M.S.Swaminathan	Food and Nutrition Vol. I&II
5. U. Satyanarayana & U. Charkrapany	Biochemistry (Third Ed.)

Title of the course : **Plant Food Product Technology**

Subject Code : **MDFT - 611**

L	T	P	Credits	Weekly Load
3	1	0	4	4

Course objectives: Objective of this course is to impart knowledge about

- Milling of cereals & pulses and bakery products
- Extrusion & extruded products and oilseed processing
- Processing of fruits, vegetables and spices

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

CO1	Explain the factor affecting the shelf life of product	Understanding
CO2	Discuss milling of cereals & pulses and bakery products	Understanding
CO3	Describe the extrusion and extruded products	Understanding
CO4	Explain the processing of oilseeds	Understanding
CO5	Describe Processing of fruits, vegetables and spices	Understanding

Mapping of Course Outcome and Program Outcome:

CO/PO Mapping

(No correlation (0) / Weak (1) / Medium (2) / Strong (3) indicates strength of correlation)

COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	3	3	2	2	0	0	1	2	2	3	2
CO2	2	3	2	3	1	1	1	0	2	2	1	1	2	2
CO3	1	3	2	1	0	0	2	1	0	1	2	2	2	2
CO4	2	2	1	1	0	2	1	0	0	1	2	2	2	2
CO5	2	2	1	2	0	1	1	1	2	2	1	1	2	2
Average	**1.8**	**2.2**	**1.6**	**2**	**0.8**	**1.2**	**1.4**	**0.4**	**0.8**	**1.4**	**1.6**	**1.6**	**2.2**	**2**

Unit	Main Topics	Detailed Contents	Lectures
I	**Introduction**	Scope and importance of food processing- Properties of food- Physical, thermal, mechanical, sensory. Characteristics of tissues and non-tissues foods, Degree of perishability of unmodified foods, Causes of quality deterioration and spoilage of perishable foods, intermediate moisture foods, wastage of foods	**8**
	Milling of cereals & pulses and bakery products	Milling operations for cereals and pulses, various types of improved machinery employed in rice and other grain milling, advances in baking technology, recent development in bakery ingredient and their functionality.	**8**
	Extrusion and extruded products	Principle of extrusion, advances in extrusion and co-extrusion processes, advances in extruded and other ready to eat food products e.g. Roasted toasted and fried products, instant ready to use formulations,	**8**
II	**Processing of oilseeds**	Processing of oilseeds for oil and protein products, advances in oil processing, recent modification in oil,.	**4**
	Processing of fruits, vegetables and spices	Fruits and vegetable processing, Recent trends in fruits and vegetables preservation and processing techniques, Fruits and vegetable-based products, processing of common dry spices and possible adulterants identification.	**12**
		Total=	**40**

Books Recommended:

Author (s)	**Title**
1. Sivasankar	Food Processing and Preservation
2. P.J Fellows	Food Processing and Preservation
3. M.Shafeiur Rahman	Food Processing Technology: Principles and Practice
4. Khetarpaul N	Food Processing and Preservation

Title of the course : **Unit Operations in Food Engineering**

Subject Code : **MDFT - 621**

L	T	P	Credits	Weekly Load
3	1	0	4	4

Course Objectives: Objective of this course is to impart knowledge about

- The theory and application of basic unit operations performed in various food processing industries.
- The size reduction and mixing operations of different types of foods necessary in the processing of foods.
- The engineering principles to analyze and design the various unit operations and equipments
- 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:

CO1	Describe and discuss the processing of foods in terms of commonunit operations like size reduction, mixing, and separation.	Analyzing
CO2	Apply computational skills in calculating the energy required in size reduction, mixing operations.	Applying
CO3	Understand the construction, working and applicability of various size reduction, mixing and separation equipments.	Analyzing
CO4	Analyse the optimum value of reflux ratio to achieve best quality product at minimum total cost in case of the continuous distillation system.	Analyzing
CO5	Able to understand the principle and application of leaching and extraction process.	Analyzing

Mapping of Course Outcome and Program Outcome:

CO/PO Mapping (No correlation (0) / Weak (1) / Medium (2) / Strong (3) indicates strength of correlation)														
COs	Programme Outcomes (POs)												Program Specific Outcomes (PSO)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	3	1	3	1	0	0	2	2	1	3	2
CO2	2	1	2	2	2	3	0	1	2	1	1	2	3	1
CO3	1	1	2	3	1	3	2	0	1	2	3	0	3	1
CO4	2	2	1	1	1	1	0	0	1	1	1	1	2	2
CO5	3	3	2	1	3	3	1	1	1	1	2	0	2	2
Average	**2.2**	**1.8**	**2**	**2**	**1.6**	**2.6**	**0.8**	**0.4**	**1**	**1.4**	**1.8**	**0.8**	**2.6**	**1.6**

Unit	Main Topic	Detailed Contents	Lectures
I	**Introduction**	Definition and application in food processing.	**2**
	Size reduction	Theory of communition, 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 process, Fineness modules and particle size distribution	**6**
	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**

Books Recommended:

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

Title of the course : **Engineering Properties of Foods**

Subject Code : **MDFT - 711**

L	T	P	Credits	Weekly Load
3	**1**	**0**	**4**	**4**

Course Objectives: Objective of this course is to impart knowledge about

- The various engineering properties of biomaterials.
- The measuring /determination of the various engineering properties of biomaterials.
- The application of engineering properties in designing process equipment.

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

CO1	Acquire knowledge on various engineering properties of biomaterial/food materials.	Analyzing
CO2	Acquire knowledge on techniques of measurement/determination of engineering properties.	Analyzing
CO3	Acquire knowledge on engineering properties of biomaterials and its application in designing of process equipments and storage structures.	Analyzing
CO4	Acquire knowledge on engineering properties of biomaterials and its application in the development of novel food processing techniques.	Analyzing
CO5	Acquire knowledge on engineering properties of biomaterials and its application in the quality control of processed food products.	Analyzing

Unit	Main Topic	Detailed Contents	Lectures
I	**Introduction**	Biomaterials and their properties in relation to processing, their role in the development of new products and processes.	**4**
	Physico-Chemical Characteristics	Physico-chemical characteristics: Definition, concept and understanding of shape, sphericity, size, volume, density, porosity, surface area, coefficients of friction, and angle of repose of food materials. Various techniques used in the measurement/determination of engineering properties. Influence of proximate composition/ chemical constituents on physical properties of food materials and its influence in processing and design of process equipments.	**8**
	Mechanical and Rheological Properties	Flow behaviour properties of food materials: definition and concept in general and detailed understanding on granular and powdered food materials. Textural profile analysis and interpretation of data of food products using various types of food texture analyzer and interpretation of data. Mechanical damage on food its significance in causing biological and chemical reactions. Mechanical damage: detection and interpretation of data. Static and dynamic resistance to mechanical damage: comparison and evaluation. Impact damage: damage under dead load, vibration damage-stress cracking.	**8**
	Aero and hydrodynamic	Drag coefficients, terminal velocity in agricultural materials: definition, concepts understanding. Determination/measurement of aero and hydrodynamic properties. Application of aero and hydrodynamic properties: processing, handling of agricultural produce and designing of process equipments.	**7**
II	**Thermal, Electrical and**	Specific heat, thermal conductivity, thermal diffusivity, electrical resistance and conductance, dielectric constant, reflectivity, transmitivity and absorbtivity of incident rays:	**7**

	Optical Properties	definition, concepts understanding. Determination/measurement of thermal, electrical and optical properties of agricultural materials/biomaterials. Application of thermal, electrical and optical properties: processing, handling of agricultural produce and designing of process equipments.	
	Applications	Application of engineering properties in process development as well as design and operation of equipment and structures associated with handling, processing and storage of raw as well as processed food products and applications in the development of novel processing techniques.	**6**
		Total=	**40**

Recommended Books

Author	**Title**
1. M.A. Rao and S.S. H. Rizvi	Engineering Properties of Foods
2. J. M. Aguilera & D. W. Stanley	Microstructural principles of food processing and Engineering
3. N. N. Mohsenin	Physical properties of plant and animal materials