The Curriculum Book

Bachelor of Technology

4-YEAR PROGRAMME
Food Technology
Choice Based Credit System with
Learning Outcomes based Curricular Framework
w. e. f. 2023-24

Faculty of Engineering and Technology

Chaudhary Devi Lal University

Sirsa-125055

Programme Specific Outcomes (PSOs)

PSO1	Familiarize students with major and minor food components, analytical techniques, instrumentation and changes resulting from processing of foods for addressing technical and engineering challenges in food industries.
PSO2	Understand the engineering and technology of handling, storage, processing, packaging, waste management, environmental impact and preservation of foods.
PSO3	Enhance capability of students to solve real problems related to food with regards to its overall quality, safety, society and environment.

Course code and definition:

Course code	Definitions
HSMC	Humanities, Social Science and Management Courses
BSC	Basic Science Courses
ESC	Engineering Science Courses
PC	Programme Core Courses
PE	Programme Elective Courses
OE	Open Elective Courses
MC	Mandatory Courses
EEC	Employment Enhancement Courses (Project/Summer Internship/Seminar, etc.)

Note 1: All B.Tech. Programmes running in the University and in Affiliated Colleges/Institutes are divided into following two groups:

Group	Engineering disciplines
A	Electronics and Communication Engineering
	Electrical Engineering
	Mechanical Engineering
	Food Technology
B	Computer Science and Engineering
	Artificial Intelligence and Machine learning
	Civil Engineering
	Information Technology

Note 2: New branch/disciplines of Engineering & Technology to be added to the Faculty of Engineering & Technology may be placed in the relevant Groups A/B keeping in mind the balancing of human resource load.

Table 3(a): Courses' codes, titles, and credits (Group–A)

Course Code	Course Title	Workload/Credit			
	Semester I	Theory	Tutorial	Practical	Total
BSC/1-T BSC/1-T(i) BSC/1-T(iv)	Physics: Introduction to Electromagnetic Theory (EE/ECE) Oscillations, Waves and Optics (ME)	3/3	1/1	-	4/4
BSC/3-T	Mathematics-I	3/3	1/1	-	4/4
ESC/1-T	Basic Electrical Engineering	3/3	1/1	-	4/4
ESC/4-T	Workshop/Manufacturing Practices	3/3	-	-	3/3
BSC/1-P BSC/1-P(i) BSC/1-P(iv)	Physics Lab: Introduction to Electromagnetic Theory (EE/ECE) Oscillations, Waves and Optics (ME)	-	-	4/2	4/2
ESC/1-P	Basic Electrical Engineering Lab	-	-	2/1	2/1
ESC/4-P	Workshop/Manufacturing Practices Lab	-	-	4/2	4/2
MC/1	Induction Training	-	-	-	-
		12/12	**3/3**	**10/5**	**25/20**
	Semester II	Theory	Tutorial	Practical	Total
BSC/2-T	Chemistry	3/3	1/1	-	4/4
BSC/4-T	Mathematics-II	3/3	1/1	-	4/4
ESC/3-T	Programming for Problem Solving	4/4	-	-	4/4
HSMC/1-T	English	2/2	-	-	2/2
MC/2-T	Environmental Science	3/-	-	-	3/-
BSC/2-P	Chemistry Lab	-	-	4/2	4/2
ESC/2-P	Engineering Graphics and Design Lab	-	-	4/2	4/2
ESC/3-P	Programming for Problem Solving Lab	-	-	4/2	4/2
HSMC/1-P	English Lab	-	-	2/1	2/1
Total		**15/12**	**2/2**	**14/7**	**31/21**

Table 3(b): Courses' codes, titles, and credits (Group–B)

Course Code	Course Title	Workload/Credit			
	Semester I	Theory	Tutorial	Practical	Total
BSC/2-T	Chemistry	3/3	1/1	-	4/4
BSC/3-T BSC/5-T	Mathematics-I Mathematics-I (for CSE/IT/AI&ML)	3/3	1/1	-	4/4
ESC/3-T	Programming for Problem Solving	4/4	-	-	4/4
HSMC/1-T	English	2/2	-	-	2/2
BSC/2-P	Chemistry Lab	-	-	4/2	4/2
ESC/2-P	Engineering Graphics and Design Lab	-	-	4/2	4/2
ESC/3-P	Programming for Problem Solving Lab	-	-	4/2	4/2
HSMC/1-P	English Lab	-	-	2/1	2/1
MC/1	Induction Training	-	-	-	-
Total		**12/12**	**2/2**	**14/7**	**28/21**
	Semester II	Theory	Tutorial	Practical	Total
BSC/1-T BSC/1-T(ii) BSC/1-T(v)	Physics: Introduction to Mechanics (for CE) Semiconductor Physics (CSE/IT/AI &ML)	3/3	1/1	-	4/4
BSC/4-T BSC/6-T	Mathematics-II Mathematics-II (for CSE/IT/AI&ML)	3/3	1/1	-	4/4
ESC/1-T	Basic Electrical Engineering	3/3	1/1	-	4/4
ESC/4-T	Workshop/Manufacturing Practices	3/3	-	-	3/3
MC/3-T	Indian Constitution	3/-	-	-	3/-
BSC/1-P BSC/1-P(ii) BSC/1-P(v)	Physics Lab: Introduction to Mechanics (for CE) Semiconductor Physics (CSE/IT/AI&ML)	-	-	4/2	4/2
ESC/1-P	Basic Electrical Engineering Lab	-	-	2/1	2/1
ESC/4-P	Workshop/Manufacturing Practices Lab	-	-	4/2	4/2
Total		**15/12**	**3/3**	**10/5**	**28/20**

Credit Scheme for B. Tech.(Food Technology) 2nd Year (Semester III & IV)

	Basic Science Courses (BSC)		Engineering Science Courses (ESC)		Programme Core Courses (PC)		Humanities, Social Sciences Courses (HSMC)		Mandatory Courses (MC)		Grand Total Credit
Semester	No. of Courses	Total Credits	No. of Courses	Total Credits	No. of Courses	Total Credits	No. of Courses	Total Credits	No. of Courses	Total Credits	
3rd	02	05	01	03	04	11	01	02	01	00	21
4th	00	00	00	00	08	23	00	00	01	00	23

B. Tech. 2nd Year Semester-III

Sr. No.	Course Code	Course Title	Work Load/Credit			
			Theory	Tutorial	Practical	Total
1	**MC/3-T	Indian Constitution	3/3	0/0	0/0	0/0
2	HSMC/3 -T	Fundamentals of Management for Engineers	2/2	0	0	2/2
3	BSC/8-T	Introduction to Food Biotechnology	3/3	0	0	3/3
4	BSC/8-P	Introduction to Food Biotechnology Lab	0	0	4/2	4/2
5	PC/FT/31-T	Food Composition and Analysis	3/3	0	0	3/3
6	PC/FT/31-P	Food Composition and Analysis Lab	0	0	4/2	4/2
7	PC/FT/32-T	Introduction to Food Nutrition	3/3	0	0	3/3
8	PC/FT/33-T	Introduction to Food Technology	3/3	0	0	3/3
9	ESC/6-T	Engineering Properties of Foods	3/3	0	0	3/3
Total						**26/21**

B. Tech. 2nd Year Semester-IV

Sr. No.	Course Code	Course Title	Work Load/Credit			
			Theory	**Tutorial**	**Practical**	**Total**
1	**MC/4-T	Essence of Indian Traditional Knowledge	3/3	0	0	3/0
2	PC/FT/41-T	Food Biochemistry	3/3	0	0	3/3
3	PC/FT/42-T	Principles and Methods of Food Processing	3/3	0	0	3/3
4	PC/FT/42-P	Principles and Methods of Food Processing Lab	0	0	4/2	4/2
5	PC/FT/43-T	Food Engineering	3/3	1/1	0	4/4
6	PC/FT/44-T	Food Microbiology	3/3	0	0	3/3
7	PC/FT/44-P	Food Microbiology Lab	0	0	4/2	4/2
8	PC/FT/45-T	Heat and Mass Transfer	3/3	1/1	0	4/4
9	PC/FT/45-P	Heat and Mass Transfer Lab	0	0	4/2	4/2
Total						**32/23**
B. Tech.(FT) student must undergo 6-8 weeks Summer Industrial/Training after IV semester						
1	***EEC/FT/51-P	Industrial Training/ Internship-I	0	0	4/2	4/2

**Non-credit qualifying mandatory courses. The assessment will be completely internal.

***The students will have to undergo Industrial Training/Internship for 6-8 weeks during summer vacations after the examinations of 4th semester which will be evaluated during 5th semester.

Note: Students will be allowed to use non-programmable scientific calculator only, however sharing of calculator will not be permitted.

Credit Scheme for B. Tech.(Food Technology) 3rd Year (Semester V & VI)

	Employability Enhancement Courses (EEC)		Programme Core Courses (PC)		Programme Elective Courses (PE)		Open Elective Courses (OE)		Mandatory Courses (MC)		Grand Total Credit
Semester	**No. of Courses**	**Total Credits**	**No. of Courses**	**Total Credits**	**No. of Courses**	**Total Credits**	**No. of Courses**	**Total Credits**	**No. of Courses**	**Total Credits**	
5th	01	02	06	16	00	00	01	03	00	00	21
6th	00	00	05	13	02	06	01	03	01	00	22

B. Tech. 3rd Year Semester-V

Sr. No.	Course Code	Course Title	Work Load/Credit			
			Theory	**Tutorial**	**Practical**	**Total**
1	PC/FT/51-T	Processing of Grains	3/3	0	0	3/3
2	PC/FT/51-P	Processing of Grains Lab	0	0	4/2	4/2
3	PC/FT/52-T	Fruits and Vegetables Processing	3/3	0	0	3/3
4	PC/FT/52-P	Fruits and Vegetables Processing Lab	0	0	4/2	4/2
5	PC/FT/53-T	Food Safety, Quality and Regulations	3/3	0	0	3/3
6	PC/FT/54-T	Food Refrigeration and Cold Storage Construction	3/3	0	0	3/3
7	OE-I	Open Elective course to be opted by the students from another branch	3/3	0	0	3/3
8	***EEC/FT/51-P	Industrial Training/ Internship-I	0	0	4/2	4/2
Total						**27/21**
***Students will have to prepare and submit a report of the Industrial Training/ Internship of 6-8 weeks done during summer vacations after the examinations of 4th semester under the supervision of faculty during 5th semester.						
Open Elective-I :- Students are required to study one elective subject from any other Department in 5th Semester						

B. Tech. 3rd Year Semester-VI

Sr. No.	Course Code	Course Title	Work Load/Credit			
			Theory	Tutorial	Practical	Total
1	PC/FT/61-T	Technology of Milk and Milk Products	3/3	0	0	3/3
2	PC/FT/61-P	Technology of Milk and Milk Products Lab	0	0	4/2	4/2
3	PC/FT/62-T	Fermentation Technology	3/3	0	0	3/3
4	PC/FT/62-P	Fermentation Technology Lab	0	0	4/2	4/2
5	PC/FT/63-T	Post Harvest Handling and Processing	3/3	0	0	3/3
6	PE/FT/61-T to PE/FT/63-T	Programme Elective course I to be opted by the students	3/3	0	0	3/3
7	PE/FT/64-T to PE/FT/66-T	Programme Elective course II to be opted by the students	3/3	0	0	3/3
8	OE-II	Open Elective course to be opted by the students from another branch	3/3	0	0	3/3
9	**MC/5-P	Technical Presentation	0	0	2/1	2/0
Total						**26/22**
B. Tech.(FT) student must undergo 6-8 weeks Summer Industrial/Training after VI semester.						
1	***EEC/FT/72-P	Industrial Training/ Internship-II	0	0	4/2	4/2
Open Elective-II :- Students are required to study one elective subject from any other Department in 6th Semester						

**Non-credit qualifying mandatory courses. The assessment will be completely internal.

***The students will have to undergo Industrial training/ internship for 6-8 weeks during summer vacations after the examinations of 6th semester which will be evaluated during 7th semester.

Note: Students will be allowed to use non-programmable scientific calculator only, however sharing of calculator will not be permitted.

Programme Elective-I

Course Code	Course Name	L	T	P	Credits
PE/FT/61-T	Bioprocess Engineering	3	-	-	3.0
PE/FT/62-T	Technology of Beverages	3	-	-	3.0
PE/FT/63-T	Specialty Foods	3	-	-	3.0

Programme Elective-II

Course Code	Course Name	L	T	P	Credits
PE/FT/64-T	Technology of Pulses and Oilseeds	3	-	-	3.0
PE/FT/65-T	Technology of Spices and Herbs	3	-	-	3.0
PE/FT/66-T	Dairy Process Engineering	3	-	-	3.0

Credit Scheme for B.Tech.(Food Technology) 4th Year (Semester VII & VIII)

	Employability Enhancement Courses (EEC)		Programme Core Courses (PC)		Programme Elective Courses (PE)		Open Elective Courses (OE)		Grand Total Credit
Semester	**No. of Courses**	**Total Credits**	**No. of Courses**	**Total Credits**	**No. of Courses**	**Total Credits**	**No. of Courses**	**Total Credits**	
7th	02	06	03	07	02	06	01	03	22
8th	01	06	03	07	02	06	00	00	19

B. Tech. 4th Year Semester-VII

Sr. No.	Course Code	Course Title	Work Load/Credit			
			Theory	**Tutorial**	**Practical**	**Total**
1	PC/FT/71-T	Instrumental Analysis of Foods	3/3	0	0	3/3
2	PC/FT/72-T	Waste Management and Effluent Treatment	3/3	0	0	3/3
3	PC/FT/72-P	Waste Management and Effluent Treatment Lab	0	0	2/1	2/1
4	EEC/FT/71-P	Minor Project	0	0	8	8/4
5	PE/FT/71-T to PE/FT/73-T	Programme Elective course III to be opted by the students	3/3	0	0	3/3
6	PE/FT/74-T to PE/FT/76-T	Programme Elective course IV to be opted by the students	3/3	0	0	3/3
7	OE-III	Open Elective course to be opted by the students from another branch	3/3	0	0	3/3
8	***EEC/FT/72-P	Industrial Training/Internship-II	0	0	4/2	4/2
	Total					**29/22**
***Students will have to prepare and submit a report of the Industrial Training/ Internship of 6-8 weeks done during summer vacations after the examinations of 6th semester under the supervision of faculty during 7th semester.						
Open Elective-III :- Students are required to study one elective subject from any other Department in 7th Semester						

Programme Elective-III

Course Code	Course Name	L	T	P	Credits
PE/FT/71-T	Food Plant Design and Layout	3	-	-	3.0
PE/FT/72-T	Introduction to Agri-Business Management	3	-	-	3.0
PE/FT/73-T	Food Flavours and Colours	3	-	-	3.0

Programme Elective-IV

Course Code	Course Name	L	T	P	Credits
PE/FT/71-T	Technology of Frozen Foods	3	-	-	3.0
PE/FT/71-T	Meat, Fish and Poultry Processing	3	-	-	3.0
PE/FT/71-T	Food Product Development and Sensory Evaluation	3	-	-	3.0

B. Tech. 4th Year Semester-VIII

Sr. No.	Course Code	Course Title	Work Load/Credit			
			Theory	Tutorial	Practical	Total
1	PC/FT/81-T	Food Packaging	3/3	0	0	3/3
2	PC/FT/81-P	Food Packaging Lab	0	0	2/1	2/1
3	PC/FT/82-T	Food Storage Engineering	3/3	0	0	3/3
4	PE/FT/81-T to PE/FT/83-T	Programme Elective course V to be opted by the students	3/3	0	0	3/3
5	PE/FT/84-T to PE/FT/86-T	Programme Elective course VI to be opted by the students	3/3	0	0	3/3
6	EEC/FT/81-P	Major Project	0	0	12/6	12/6
	Total					**26/19**

Note: Students will be allowed to use non-programmable scientific calculator only, however sharing of calculator will not be permitted.

Programme Elective-V

Course Code	Course Name	L	T	P	Credits
PE/FT/81-T	Baking and Confectionary Technology	3	-	-	3.0
PE/FT/82-T	Technology of Fats and Oils	3	-	-	3.0
PE/FT/83-T	Snack Food Technology	3	-	-	3.0

Programme Elective-VI

Course Code	Course Name	L	T	P	Credits
PE/FT/84-T	Introduction to Food Additives	3	-	-	3.0
PE/FT/85-T	Technology of Traditional Foods	3	-	-	3.0
PE/FT/86-T	Functional Foods and Nutraceuticals	3	-	-	3.0

Policy Document for providing exemptions in attendance to the B. Tech. students of the University for undertaking various internships/trainings during their final/penultimate semester

1. Background:

It has been realized that the students pursuing B. Tech. programmes offered by the University/affiliated Institutes/Colleges are facing challenges as under:

1. Students selected in industry during their programme are asked to join the industry for internship/training of duration upto one semester.
2. The provision is not there in these programmes to allow the students to join the internship by way of getting the required attendance of semester from internship/training.
3. So, students are not able to join such internship/training consequential to two-fold loss:
   (a) Job opportunity.
   (b) Skill development in industry environment.

But, presently, in the B. Tech. Programmes run by the University, there is no provision for the students to join the industry for such internship/training of/for more than 6–8-week duration. To facilitate the students for joining longer duration internships/trainings, a need for framing a policy document was felt.

Keeping in view the above challenges/statutory position and to avoid hardship to students and to improve the employability of the students, Ch. Devi Lal University, Sirsa has framed a policy to accord exemptions in attendance to students undertaking various internships/trainings during their final/penultimate semester of the B. Tech. Programmes.

2. Applicability of the policy with following Provisions:

The policy is applicable to the students studying in the final semester/ penultimate semester of B. Tech. programmes.

2.1 Provisions:

Student covered as per section title 'Applicability of the Policy' will be governed by the following provisions:

1. The student will be allowed to join the organization for internship/training in the final semester/ penultimate semester of the course for a period of up to one semester only if he/she must be passed/ cleared in all courses/subjects in all the semester examination whose results have been declared.
2. The student will earn his attendance from the organization during the period of internship.
3. Attendance will be certified by the organization, failing which student will be debarred from appearing in the University examinations of that semester.
4. The student will have to give an undertaking that he/she will appear in all the internal/external examination/practical as per requirements of the Programme and as per Schedule of the University examination for that programme. For this he/she will have to do the necessary preparation by himself/herself and Institute/department will not be responsible for the same.
5. If the student is selected in a company/industry/organization etc., and is asked to join the organization in the final semester/ penultimate semester for a period of upto one semester; then formally constituted Internship Facilitation Committee (IFC) will examine and give its recommendation as deemed fit.

2.2 Composition of Internship Facilitation Committee (IFC):

The composition of IFC will be as under:

1. Dean, Faculty of Engg. & Tech./Director/ Principal (or Nominee) (Chairperson)
2. Chairperson/Head/ In-charge of the concerned Department/Branch (Member)

3. In-Charge Academic Branch/Academic In-charge of Institute (Member)
4. Senior most faculty of the department other than Chairperson/ Director/Head of the Department/Branch (Member)
5. Training and Placement officer/ In-Charge TPO of the Institute /College/Department (Member Secretary)

Any offer by the organisations providing internship on demanding charges from a student will be discouraged by the Internship Facilitation Committee (IFC). Member Secretary of the IFC will schedule the meeting and maintain all the records.

3. Conclusion:

The students can only be allowed to join the internship/training in company/industry/ organization etc. with exemptions in attendance on the final recommendation of Internship Facilitation Committee (IFC) of the Institute/Department and permission given by the Department/Institute/College authority.

LIST OF OPEN ELECTIVE (OE) COURSES TO BE OFFERED BY FOOD TECHNOLOGY BRANCH/ DEPARTMENT TO THE STUDENTS OF OTHER BRANCH/DEPARTMENT

Open Elective Course –I for B. Tech. 5th Semester

S. No.	Course code	Course Name	Offered by	Credits
01	OE/FT/51-T	Principle of Food Processing	Food Technology	3.0
02	OE/FT/52-T	Introduction to Food Nutrition	Food Technology	3.0

Open Elective Course –II for B. Tech. 6th Semester

S. No.	Course code	Course Name	Offered by	Credits
01	OE/FT/61-T	Principle of Food Preservation	Food Technology	3.0
02	OE/FT/62-T	Food Laws and Regulations	Food Technology	3.0

Open Elective Course –I for B. Tech. 7th Semester

S. No.	Course code	Course Name	Offered by	Credits
01	OE/FT/71-T	Basics of Food Technology	Food Technology	3.0
02	OE/FT/72-T	Food Packaging	Food Technology	3.0

Detailed syllabus of
B. Tech. (Food Technology)
3rd Semester

B. Tech. 2nd Year Semester-III

Sr. No.	Course Code	Course Title	Work Load/Credit			
			Theory	**Tutorial**	**Practical**	**Total**
1	**MC/3-T	Indian Constitution	3/3	0/0	0/0	0/0
2	HSMC/3 -T	Fundamentals of Management for Engineers	2/2	0	0	2/2
3	BSC/8-T	Introduction to Food Biotechnology	3/3	0	0	3/3
4	BSC/8-P	Introduction to Food Biotechnology Lab	0	0	4/2	4/2
5	PC/FT/31-T	Food Composition and Analysis	3/3	0	0	3/3
6	PC/FT/31-P	Food Composition and Analysis Lab	0	0	4/2	4/2
7	PC/FT/32-T	Introduction to Food Nutrition	3/3	0	0	3/3
8	PC/FT/33-T	Introduction to Food Technology	3/3	0	0	3/3
9	ESC/6-T	Engineering Properties of Foods	3/3	0	0	3/3
Total						**26/21**

Indian Constitution

General Course Information

Course Code: MC/3-T **Course Credits: 0** **Type: Mandatory courses** **Contact Hours per week: 3** **Mode: Lectures (L)** **Examination Duration: 3 hours**	**Course Assessment Method: Max. Marks: 100** **Internal Evaluation (30 marks):** • Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks). • Assignments, quiz etc. will have weightage of 06 marks. **End semester examination (70 marks):** • Nine questions are to be set by the examiner. A candidate is required to attempt 05 questions in all, question number one is compulsory and remaining four questions by selecting one question from each of the four units. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions of 2 marks each. • Question numbers 2 to 9 are to be set by selecting 2 questions from each unit.

UNIT-I

Basic features and fundamental principles. Meaning of the constitution law and constitutionalism. Historical perspective of the Constitution of India. Salient features and characteristics of the Constitution of India. Scheme of the fundamental rights. The scheme of the Fundamental Duties and its legal status.

UNIT-II

The Directive Principles of State Policy – Its importance and implementation. Federal structure and distribution of legislative and financial powers between the Union and the States. Parliamentary Form of Government in India – The constitution powers and status of the President of India

UNIT-III

Amendment of the Constitutional Powers and Procedure. The historical perspectives of the constitutional amendments in India Emergency. Provisions: National Emergency, President Rule, Financial Emergency Local Self. Government – Constitutional Scheme in India

UNIT-IV

Scheme of the Fundamental Right to Equality. Scheme of the Fundamental Right to certain Freedom under Article 19. Scope of the Right to Life and Personal Liberty under Article 21.

Fundamentals of Management for Engineers

General Course Information

Course Code: HSMC/3-T **Course Credits: 3** **Type: Humanities, Social Sciences and Management Courses** **Contact Hours per week: 3** **Mode: Lectures (L)** **Examination Duration: 3 hours**	**Course Assessment Method: Max. Marks: 100** **Internal Evaluation (30 marks):** • Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks). • Assignments, quiz etc. will have weightage of 06 marks. **End semester examination (70 marks):** • Nine questions are to be set by the examiner. A candidate is required to attempt 05 questions in all, question number one is compulsory and remaining four questions by selecting one question from each of the four units. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions of 2 marks each. • Question numbers 2 to 9 are to be set by selecting 2 questions from each unit.

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	RBT Level
CO1	To develop the basic understanding of the concept of management and functions of management.	**L3: Apply**
CO2	The students will come to know about Human Resource management and Marketing management functions of management.	**L2: Understand**
CO3	Students will come to know about the production activities of any manufacturing organisations.	**L2: Understand**
CO4	To know that how finances are arranged and disbursed for all the activities of business organisations.	**L4: Analyse**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

Concept of Management: Definitions, Characteristics, Significance, Practical Implications; Management Vs. Administration; Management- Art, Science and Profession; Development of Management Thoughts; Managerial Functions.

UNIT-II

Concept of Human Resource Management: Human resource planning; Recruitment, Selection, Training and Development, Compensation; Concept of Marketing Management: Objectives and functions of Marketing, Marketing Research, Advertising, Consumer Behavior.

UNIT-III

Concept of Production Management, Production Planning and Control, Material management, Inventory Control, Factory location and Production Layout.

UNIT-IV

Concept of Financial Management, Capital Structure and various Sources of Finance, Working Capital, Short term and long term finances, Capital Budgeting.

Recommended Readings:

1. Principles and Practices of Management: R. S. Gupta, B. D. Sharma, N. S. Bhalla; Kalyani Publishers.
2. Organization and Management: R. D. Aggarwal; Tata McGraw Hill.
3. Marketing Management: S. A. Sherlikar; Himalaya Publishing House.
4. Financial Management: I.M. Pandey; Vikas Publishing House.
5. Production Management: B. S. Goel; Himalaya Publishing House.

CO-PO Articulation Matrix Fundamentals of Management for Engineers Course (HSMC/3-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	-	-	-	-	-	-	-	3	-
CO2	3	2	1	-	-	-	-	-	-	-	3	-
CO3	1	2	3	-	-	-	-	-	-	-	3	-
CO4	1	2	3	-	-	-	-	-	-	-	3	-
3-High, 2-Medium, 1-Low												

Introduction to Food Biotechnology

General Course Information

Course Code: BSC/8-T **Course Credits: 3** **Type: Basic Science courses** **Contact Hours per week: 3** **Mode: Lectures (L)** **Examination Duration: 3 hours**	**Course Assessment Method: Max. Marks: 100** **Internal Evaluation (30 marks):** • Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks). • Assignments, quiz etc. will have weightage of 06 marks. **End semester examination (70 marks):** • Nine questions are to be set by the examiner. A candidate is required to attempt 05 questions in all, question number one is compulsory and remaining four questions by selecting one question from each of the four units. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions of 2 marks each. • Question numbers 2 to 9 are to be set by selecting 2 questions from each unit.

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	RBT Level
CO1	Describe the importance of biotechnology in food technology and microbial production of Single Cell Protein.	**L1: Remember**
CO2	Explain the microbial production of organic Acids, vitamins, and mushrooms.	**L2: Understand**
CO3	Illustrate enzymes, its purification and application in food industry.	**L3: Apply**
CO4	Describe about basics and terms related to Fermented Food Products and its preparation.	**L2: Understand**
CO5	Describe the biotechnological methods used in food industry waste management.	**L2: Understand**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

Introduction: History, scope and present status of biotechnology in India in relation to food technology and its general applications.

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.

UNIT-II

Microbial production of organic acids, vitamins and mushrooms: Biotechnological methods for the production of organic acids, vitamins and mushrooms, with special reference to the microorganisms involved, substrates used, optimum process parameters and their applications.
Enzyme technology: Sources of enzymes, advantages of microbial enzymes, production, extraction and purification of enzymes, applications of enzymes in food industry.

UNIT-III

Fermented Food Products: Dairy products (Dahi, yoghurt, cheese), cereal products (bread,), vegetables (sauerkraut, kimchi), meat (sausages, ham and bacon), fermented beverages (beer, vinegar, cider and wine).

UNIT-IV

Environmental Biotechnology: 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.

Recommended Readings:

1. Panesar P S, Marwaha S S (2013), Biotechnology in Agriculture & Food Processing: Opportunities and Challenges, CRC Press (1st Ed).
2. Gupta P K (2022), Elements of Biotechnology, Rastogi Publications.
3. Panesar P S, Marwaha S S, Chopra H K (2010), Enzymes in Food Processing, IK International Publishing House.
4. Marwaha S S (2000), Food Processing: Biotechnological Applications, Asiatech Publishers
5. Dubey R C (1993), A Textbook of Biotechnology, S. Chand Publishing.

CO-PO Articulation Matrix Introduction to Food Biotechnology Course (BSC/8-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	1	-	2	2	3	1	-	1	-	3	2	-	1
CO2	2	-	2	-	2	3	-	2	1	1	-	2	2	-	1
CO3	2	-	1	-	1	2	1	2	-	1	-	2	1	-	1
CO4	2	2	3	1	2	3	2	2	2	1	-	2	1	1	2
CO5	2	2	2	1	2	2	3	2	1	-	-	2	1	1	1
3-High, 2-Medium, 1-Low															

Introduction to Food Biotechnology Lab

General Information

Course Code: BSC/8-P **Course Credits: 2** **Type: Basic Science courses** **Contact Hours per week: 4** **Mode: Lab Practical and assignments**	**Course Assessment Method: Max. Marks: 100** **(Internal: 50; External: 50)** • The internal and external assessment is based on the level of participation in lab. Sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of lab, File and ethical practices followed. • The Internal Evaluation is conducted by the course coordinator. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department.

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	RBT Level
CO1	Describe the importance of biotechnological tools.	**L2: Understand**
CO2	Demonstration of media preparation, sterilization and plating.	**L3: Apply**
CO3	Analysis of fermented food products	**L4: Analyse**
CO4	Evaluation of waste water.	**L5: Evaluate**
CO5	Enlist various BIS standards for safer disposal of industrial waste water	**L1: Remember**

***Revised Bloom's Taxonomy Action verbs/Levels**

List of experiments

Note: Perform at least seven experiments from the list.

- Study of a compound microscope.
- Study of autoclave, preparation and sterilization of nutrient broth and agar.
- Gram staining and study of morphology of bacterial cells.
- Preparation of media, sterilization, serial dilution.
- Dilution and Plating by spread –plate and pour –plate techniques.
- Preparation of dahi and Analyse its morphology.
- Evaluate B.O.D. (Biological Oxygen Demand) of waste water.
- Evaluate C.O.D. (Chemical Oxygen Demand) of waste water.
- Enlist various BIS standards for safer disposal of industrial waste water.

Note:

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

CO-PO Articulation Matrix Introduction to Food Biotechnology Lab (BSC/8-P)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**2**	**-**	**-**	**-**	**3**	**-**	**-**	**1**	**-**	**-**	**-**	**2**	**2**	**-**	**1**
CO2	**2**	**1**	**-**	**2**	**2**	**-**	**1**	**1**	**-**	**-**	**-**	**1**	**1**	**-**	**1**
CO3	**2**	**-**	**1**	**2**	**1**	**1**	**-**	**1**	**-**	**-**	**-**	**2**	**2**	**-**	**1**
CO4	**2**	**2**	**1**	**-**	**1**	**3**	**3**	**2**	**1**	**1**	**-**	**2**	**1**	**-**	**2**
CO5	**2**	**-**	**-**	**-**	**-**	**2**	**1**	**2**	**-**	**1**	**-**	**2**	**1**	**-**	**1**
3-High 2-Medium 1-Low															

Food Composition and Analysis

General Course Information

Course Code: PC/FT/31-T **Course Credits: 3** **Type: Programme Core Courses** **Contact Hours per week: 3** **Mode: Lectures (L)** **Examination Duration: 3 hours**	**Course Assessment Method: Max. Marks: 100** **Internal Evaluation (30 marks):** • Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks). • Assignments, quiz etc. will have weightage of 06 marks. **End semester examination (70 marks):** • Nine questions are to be set by the examiner. A candidate is required to attempt 05 questions in all, question number one is compulsory and remaining four questions by selecting one question from each of the four units. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions of 2 marks each. • Question numbers 2 to 9 are to be set by selecting 2 questions from each unit.

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	**RBT Level**
CO1	Describe the chemical composition of macro and micro food components.	**L1: Remember**
CO2	Discuss the physical, chemical and functional properties of various food components.	**L2: Understand**
CO3	Classify different methods for qualitative and quantitative analysis of food components.	**L3: Apply**
CO4	Outline of enzyme applications with respect to their category.	**L4: Analyse**
CO5	Assess the appropriate method of food analysis by applying food composition knowledge.	**L5: Evaluate**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

Constituents of foods: General classification and importance. Nutritive values of common foods. Water: significance, structure of water, types of water, role of water activity in foods. Introduction to macro and micro nutrients and other food constituents like food flavours and pigments.

UNIT-II

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

UNIT-III

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

UNIT-IV

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

Recommended Readings:

1. Wang, D. (2012). Food Chemistry: Nova Science Publishers.

2. Chopra, H. K. &Panesar, P. S. (2010). Food chemistry: Alpha Science International Ltd, Oxford, U.K.

3. Coultate, T. P. (2009). Food: The Chemistry of Its Components (5 ed.): American Chemical Society.

4. Newton, D.E. (2009). Food Chemistry: Facts on File, Incorporated.

5. Damodaran, S., Parkin, K. L., & Fennema, O. R. (2007). Fennema's Food Chemistry: CRC Press, Taylor and Francis group.

CO-PO Articulation Matrix Food Composition and Analysis Course (PC/FT/31-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	1	1	-	-	2	-	1	-	2	1	2	3	1	2
CO 2	1	1	2	1	-	-	-	1	-	2	1	2	1	3	1
CO 3	1	2	1	2	-	1	-	1	-	2	2	1	3	1	1
CO 4		2	2	1	2	1	-	1	-	1	2	1	2	2	1
CO 5	1	2	1	1	1	1	-	1	-	1	2	2	2	2	1
3-High 2-Medium 1-Low															

Food Composition and Analysis Lab

General Information

Course Code: PC/FT/31-P **Course Credits: 2** **Type: Programme Core Courses** **Contact Hours per week: 4** **Mode: Lab Practical and assignments**	**Course Assessment Method: Max. Marks: 100** **(Internal: 50; External: 50)** • The internal and external assessment is based on the level of participation in lab. Sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of lab, File and ethical practices followed. • The Internal Evaluation is conducted by the course coordinator. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department.

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	RBT Level
CO1	Illustrate the different methods of food sampling.	**L2: Understand**
CO2	Examine the different methods used for food analysis.	**L3: Apply**
CO3	Identify the food components by using qualitative and quantitative methods of food analysis.	**L4: Analyse**
CO4	Evaluate the results of food analysis and use it for further data analysis.	**L5: Evaluate**
CO5	Formulate different food products by varying components.	**L6: Create**

***Revised Bloom's Taxonomy Action verbs/Levels**

List of experiments

Note: Perform at least seven experiments from the list.

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

Note:
The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of

assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

CO-PO Articulation Matrix Food Composition and Analysis Lab (PC/FT/31-P)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	2	3	2	3	1	1	1	1	1	1	2	3	2	3
CO 2	3	2	3	2	3	1	1	1	1	1	2	2	3	3	3
CO 3	3	3	3	2	3	1	1	1	1	1	2	1	2	2	2
CO 4	3	3	3	2	3	1	1	1	1	1	1	2	2	2	2
CO 5	3	3	3	2	3	1	1	1	1	1	1	2	2	2	2
3-High 2-Medium 1-Low															

Introduction to Food Nutrition

General Course Information

Course Code: PC/FT/32-T **Course Credits: 3** **Type: Programme Core Courses** **Contact Hours per week: 3** **Mode: Lectures (L)** **Examination Duration: 3 hours**	**Course Assessment Method: Max. Marks: 100** **Internal Evaluation (30 marks):** • Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks). • Assignments, quiz etc. will have weightage of 06 marks. **End semester examination (70 marks):** • Nine questions are to be set by the examiner. A candidate is required to attempt 05 questions in all, question number one is compulsory and remaining four questions by selecting one question from each of the four units. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions of 2 marks each. • Question numbers 2 to 9 are to be set by selecting 2 questions from each unit.

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	**RBT Level**
CO1	Define the terms and concepts related to food nutrition and health.	**L1: Remember**
CO2	Explain the requirements and source of various nutrients essential for human health.	**L2: Understand**
CO3	Judge the role of nutrition in health maintenance and management.	**L3: Apply**
CO4	Identify the role of various organizations in the field of nutrition and health.	**L4: Analyse**
CO5	Plan balanced diets according to specific health needs.	**L6: Create**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

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

UNIT-II

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

UNIT-III

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

UNIT-IV

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

Recommended Readings:

1. Joshi S. A., (1992) Nutrition and Dietetics Tata Mc Grow- Hill publishingCompany Ltd., New Delhi

2. M. Swaminathan, Vol I & II Foods and Nutrition NIN Publications

3. Manay S., and Shadksharawamis N., Food: Facts and Principles, New Age International Pvt. Ltd., New Delhi.

4. Mann J., and Truswell S., (2007) Essentials of Human Nutrition3rd Ed. Oxford University Press, 2007.

5. Khanna (1997) Textbook of Nutrition and Dietitics, Phoenix Publisher House Pvt. Ltd., New Delhi.

6. Eastwood M. S., (2003) Principles of Human Nutrition 2nd ed, Blackwell Publishers.

CO-PO Articulation Matrix Introduction to Food Nutrition Course (PC/FT/32-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	2	2	1	1	1	2	1	2	2	1	2	2	-	1
CO 2	3	3	2	1	3	1	1	1	1	2	2	1	1	-	1
CO 3	2	2	2	1	1	1	1	1	1	1	2	1	2	-	2
CO 4	2	1	2	2	1	2	1	2	2	3	2	2	1	-	1
CO 5	1	2	3	2	2	3	1	1	1	1	2	1	3	-	3
3-High 2-Medium 1-Low															

Introduction to Food Technology

General Course Information

Course Code: PC/FT/33-T **Course Credits: 3** **Type: Programme Core Courses** **Contact Hours per week: 3** **Mode: Lectures (L)** **Examination Duration: 3 hours**	**Course Assessment Method: Max. Marks: 100** **Internal Evaluation (30 marks):** • Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks). • Assignments, quiz etc. will have weightage of 06 marks. **End semester examination (70 marks):** • Nine questions are to be set by the examiner. A candidate is required to attempt 05 questions in all, question number one is compulsory and remaining four questions by selecting one question from each of the four units. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions of 2 marks each. • Question numbers 2 to 9 are to be set by selecting 2 questions from each unit.

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	**RBT Level**
CO1	Recite food, food technology, food processing.	**L1: Remember**
CO2	Explain functions of food and status of food Industry in Haryana and India.	**L2: Understand**
CO3	Describe nutritive value of food and various unit operations in food technology.	**L2: Understand**
CO4	Outline of food deterioration.	**L4: Analyse**
CO5	Illustrate food processing and preservation.	**L3: Apply**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

Introduction: Definition of Food, food technology, food processing, functions of foods - energy giving, body building, protecting and regulating. Status of food industry in Haryana and India.

Nutritive value of food: Food energy, carbohydrates, fats, vitamins, minerals, proteins, additional food constituents.

UNIT-II

Unit operations in food technology: Material handling, cleaning, separation, disintegration, mixing, heating, cooling, evaporation, types of evaporators, drying, types of dryers packaging, primary, secondary and tertiary packaging.

UNIT-III

Food deterioration and its control: Introduction, classification of food on the basis of its shelf life, major causes of deterioration of food, types of food spoilage (physical, chemical and

microbiological), control of food deterioration (temperature, light, RH, bacteria, fungus, enzymes and other factors).

UNIT-IV

Food Processing and Preservation: Principals of food processing & preservation, methods of food processing, refrigeration and cold storage, freezing and frozen storage, IMF (intermediate moisture foods), canning, pickling process.

Recommended Readings:

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

2. M. Swaminathan, Vol I & II Foods and Nutrition NIN Publications

3. Manay S., and Shadaksharaswamy M., Food: Facts and Principles, New Age International Pvt. Ltd., New Delhi.

CO-PO Articulation Matrix Introduction to Food Technology Course (PC/FT/33-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	2	1	1	1	2	1	1	-	-	-	1	1	2	2
CO 2	3	2	-	1	1	1	1	1	-	-	-	1	2	2	2
CO 3	2	2	1	-	1	1	1	-	-	-	-	1	2	2	1
CO 4	2	1	1	1	-	1	1	1	-	1	-	1	3	3	3
CO 5	2	1	1	1	1	2	1	1	-	-	-	1	2	1	3
3-High 2-Medium 1-Low															

Engineering Properties of Foods

General Course Information

Course Code: ESC/6-T **Course Credits: 3** **Type: Engineering Science Courses** **Contact Hours per week: 3** **Mode: Lectures (L)** **Examination Duration: 3 hours**	**Course Assessment Method: Max. Marks: 100** **Internal Evaluation (30 marks):** • Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks). • Assignments, quiz etc. will have weightage of 06 marks. **End semester examination (70 marks):** • Nine questions are to be set by the examiner. A candidate is required to attempt 05 questions in all, question number one is compulsory and remaining four questions by selecting one question from each of the four units. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions of 2 marks each. • Question numbers 2 to 9 are to be set by selecting 2 questions from each unit.

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	**RBT Level**
CO1	Describe various physical and rheological properties of food.	**L1: Remember**
CO2	Explain measurement techniques of engineering properties of foods.	**L2: Understand**
CO3	Examine different engineering properties of foods.	**L3: Apply**
CO4	Differentiate the food products based on engineering properties.	**L4: Analyse**
CO5	Devise processing conditions based on engineering properties of food.	**L6: Create**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

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

UNIT-II

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

UNIT-III

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

UNIT-IV

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

Recommended Readings:

1. Rao M. A., Rizvi S. S. H., Datta A. K. & Jasim A. (2014) Engineering properties of foods, 4th edition, CRC Press.

2. Lewis M. J. (1990) Physical Properties of Foods and Food Processing Systems. Woodhead Publishing.

3. Devahastin S. (2011) Physicochemical aspects of food engineering and processing, CRC Publication.

4. Singh R. P. & Heldman D. R. (2009) Introduction to Food Engineering 4th edition, Academic Press.

CO-PO Articulation Matrix Engineering Properties of Foods Course (ESC/6-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	1	1	-	1	1	1	1	1	1	-	1	2	2	1
CO 2	2	2	2	1	1	1	1	1	-	1	-	1	3		1
CO 3	2	2	1	2	1	-	1	2	-	1	-	1	2	2	1
CO 4	3	2	1	2	1	1	1	2	1	1	-	1	3	3	2
CO 5	2	2	1	2	1	2	1	1	-	1	-	1	3		2
3-High 2-Medium 1-Low															

Detailed syllabus of
B. Tech. (Food Technology)
4th Semester

B. Tech. 2nd Year Semester-IV

Sr. No.	Course Code	Course Title	Work Load/Credit			
			Theory	**Tutorial**	**Practical**	**Total**
1	**MC/4-T	Essence of Indian Traditional Knowledge	3/3	0	0	3/0
2	PC/FT/41-T	Food Biochemistry	3/3	0	0	3/3
3	PC/FT/42-T	Principles and Methods of Food Processing	3/3	0	0	3/3
4	PC/FT/42-P	Principles and Methods of Food Processing Lab	0	0	4/2	4/2
5	PC/FT/43-T	Food Engineering	3/3	1/1	0	4/4
6	PC/FT/44-T	Food Microbiology	3/3	0	0	3/3
7	PC/FT/44-P	Food Microbiology Lab	0	0	4/2	4/2
8	PC/FT/45-T	Heat and Mass Transfer	3/3	1/1	0	4/4
9	PC/FT/45-P	Heat and Mass Transfer Lab	0	0	4/2	4/2
Total						**32/23**
B. Tech.(FT) student must undergo 6-8 weeks Summer Industrial/Training after IV semester						
1	***EEC/FT/51-P	Industrial Training/ Internship-I	0	0	4/2	4/2

Essence of Indian Traditional Knowledge

General Course Information

Course Code: MC/4-T **Course Credits: 0** **Type: Mandatory Courses** **Contact Hours per week: 3** **Mode: Lectures (L)** **Examination Duration: 3 hours**	**Course Assessment Method: Max. Marks: 100** **Internal Evaluation (30 marks):** • Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks). • Assignments, quiz etc. will have weightage of 06 marks. **End semester examination (70 marks):** • Nine questions are to be set by the examiner. A candidate is required to attempt 05 questions in all, question number one is compulsory and remaining four questions by selecting one question from each of the four units. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions of 2 marks each. • Question numbers 2 to 9 are to be set by selecting 2 questions from each unit.

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	RBT Level
CO1	Recognise the forms and sources of Indian traditional knowledge	**L1: Remember**
CO2	Identify the contribution of the great ancient Indian scientists and spiritual leaders to the world of knowledge.	**L2: Understand**
CO3	Apply the reasoning based on objectivity and contextual knowledge to address the social and cultural issues prevalent in Indian society.	**L3: Apply**
CO4	Differentiate the myths, superstitions from reality in context of traditional knowledge to protect the physical and social environment.	**L5: Evaluate**
CO5	Suggest means of creating a just and fair social environment that is free from any prejudices and intolerance for different opinions and cultures.	**L6: Create**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

Introduction to Indian Tradition Knowledge: Defining traditional knowledge, forms, sources and dissemination of traditional knowledge. Vedic Period: Vedas and Upanishads, Yogsutras of Patanjali Post Vedic Period: Budhism, Janism and Indian Materialism: Charvak School of Thought.

UNIT-II

Sufi and Bhakti Movement (14th to 17th century): सगुण निर्गुण भक्ति,, Sufism and Sufi saints, Kabir, Nanak and Guru Jambheshwar ji Maharaj etc., Composite Culture of Indian sub-continent.

UNIT- III

Jyotirao Phule and Savitri Bai Phule and other 19th Century Social Reform Movements; India's cultural heritage.

UNIT- IV

India's Contribution to the world of knowledge: प्राचीन भारत के महान वैज्ञानिक: बौधायन, चरक, कौमारभृत्य जीवन, सुश्रुत, आर्यभट, बराहमिहिर, ब्रह्मगुप्त, नागाजुयन, वाग्भट; Astrology and Astronomy, Myths and Reality.

Recommended Readings:

1. A. L. Bhansam, The Wonder That was India, A Survey of the Culture of the, Indian Sub-Continent before, the Coming of the Muslims, Vol 1, Groove Press, New York, 1959.

2. S. A. A. Rizvi, Wonder That was India, A Survey of the History and Culture of the Indian SubContinent from the Coming of the Muslims to the British Conquest 1200-1700, Vol 2, Rupa and Co. 2001.

3. प्रतियोगिता दर्पण अतिरिक्त सीरीज-5 भारतीय कला एवं संस्कृति

4. गुणाकर मूले, प्राचीन भारत के महान वैज्ञानिक, ज्ञान विज्ञान प्रकाशन, नई दिल्ली, 1990.

5. B. V. Subbarayappa, A Historical Perspective of Science in India, Rupa Publications, New Delhi, 2013.

6. Thich Nhat Hanh, Nguyen Thi Hop, Mobi Ho , Old Path White Clouds: Walking in the Footsteps of the Buddha, Parallax Press, 1991.

7. Hermann Hesse, Siddhartha, Simon & Brown, 2017.

8. सावित्री चंद्र शोभा, हिंदी भक्ति साहित्य में सामाजिक मूल्य एवं सहिष्णुतावाद, नेशनल बुक ट्रस्ट, इंडिया, 2007.

9. Rosalind O' Hanlon, Caste Conflict and Ideology, Mahatma Jyotirao Phule and low caste protest in nineteen century, Western India, Camridge University Press, 2009.

10. Melanie P. Kumar, Savitribai Phule: Forgotten liberator, Infochange, 2009.

11. Leah Verghese, Ranjna, and Medha Sundar, Savitribai, Journey of a Trailblazer, Azim Prem Ji University, 2014.

CO-PO Articulation Matrix Essence of Indian Traditional Knowledge Course (MC/4-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	-	1	-	-	-	-	-	-	-	-	-	1
CO 2	-	2	1	-	-	3	-	-	-	-	-	1
CO 3	-	3	3	2	-	3	-	-	-	-	-	3
CO 4	-	2	3	3	-	3	1	-	-	-	-	3
CO 5	-	3	3	3	-	3	-	-	-	-	-	3
3-High 2-Medium 1-Low												

Food Biochemistry

General Course Information

Course Code: PC/FT/41-T **Course Credits: 3** **Type: Programme Core Courses** **Contact Hours per week: 3** **Mode: Lectures (L)** **Examination Duration: 3 hours**	**Course Assessment Method: Max. Marks: 100** **Internal Evaluation (30 marks):** • Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks). • Assignments, quiz etc. will have weightage of 06 marks. **End semester examination (70 marks):** • Nine questions are to be set by the examiner. A candidate is required to attempt 05 questions in all, question number one is compulsory and remaining four questions by selecting one question from each of the four units. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions of 2 marks each. • Question numbers 2 to 9 are to be set by selecting 2 questions from each unit.

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	RBT Level
CO1	Describe the terminology and basics of biochemistry of food.	**L1: Remember**
CO2	Associate the concepts of water and energy balance with bio molecules.	**L2: Understand**
CO3	Classify various nutrients according to structures, sources and their functions.	**L3: Apply**
CO4	Identify physico-chemical properties of various nutrients.	**L4: Analyse**
CO5	Compare metabolic processes of macro nutrients.	**L6: Create**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

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

UNIT-II

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

UNIT- III

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

UNIT- IV

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

Recommended Readings:

1. David L. Nelson; Michael M. Cox (2021) Lehninger Principles of Biochemistry (8th Ed), New York Publication.

2. L. H. Meyer (2004). Food Chemistry, CBS Publisher.

3. Donald Voet and Judith G. Voet. 2011. Biochemisry, 4th Ed. John Wiley and Sons, Inc., NY, USA.

4. J. M. Berg, J. L. Tymoczko and Lubert Stryer (2007). Biochemistry (6th Ed), Freeman & Co, N.Y.

5. D. Voet, J. Voet, C. Pratt, (2016) Fundamentals of Biochemistry (5th Ed), Jonh Willey & Sons

6. M. Swaminathan (2014) Foods and Nutrition Vol I & II (2nd Ed), NIN Publications

CO-PO Articulation Matrix Food Biochemistry Course (PC/FT/41-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	1	2	-	3	1	-	1	-	1	1	1	-	2	2	2
CO 2	1	2	2	1	2	2	-	1	1	1	1	1	2	1	2
CO 3	2	1	1	2	3	1	2	2	1	1	1	1	2	1	2
CO 4	2	2	-	2	2	2	2	3	-	1	-	-	2	1	1
CO 5	1	-	2	2	1	-	1	1	1	1	1	2	3	2	2
3-High 2-Medium 1-Low															

Principles and Methods of Food Processing

General Course Information

Course Code: PC/FT/42-T **Course Credits: 3** **Type: Programme Core Courses** **Contact Hours per week: 3** **Mode: Lectures (L)** **Examination Duration: 3 hours**	**Course Assessment Method: Max. Marks: 100** **Internal Evaluation (30 marks):** • Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks). • Assignments, quiz etc. will have weightage of 06 marks. **End semester examination (70 marks):** • Nine questions are to be set by the examiner. A candidate is required to attempt 05 questions in all, question number one is compulsory and remaining four questions by selecting one question from each of the four units. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions of 2 marks each. • Question numbers 2 to 9 are to be set by selecting 2 questions from each unit.

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	RBT Level
CO1	Outline on food spoilage, principles and methods of food processing and preservation.	**L1: Remember**
CO2	Demonstrate the importance, scope and need of food processing and preservation.	**L2: Understand**
CO3	Classify various preservation methods and their advantages.	**L3: Apply**
CO4	Identify the novel methods for preservation of various types of foods.	**L4: Analyse**
CO5	Judge the food handling practices for reduction of food spoilage in industries.	**L6: Create**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

Introduction: Importance of food processing and preservation; classification of foods on the basis of shelf life, pH, origin.

Food spoilage: Types of food spoilage, viz. microbiological, enzymatic, chemical, physical and their effects on food quality.

Methods of food preservation: Introduction, classification and applications.

UNIT-II

High temperature processing: Pasteurization and sterilization, microbial destruction in batch and continuous sterilization, methods of heat transfer, heat resistance in microorganisms, factors affecting heat resistance in micro-organisms, ultra-heat treatment UHT processing; Industrial applications of canning and bottling: commercial canning operation, spoilage of canned food and its quality evaluation; food irradiation (commercial applications, quality/technological aspects);

application of ultra violet (UV) rays in food, microwave heating, its mechanism, effects and applications in food preservation.

UNIT-III

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

UNIT-IV

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

Recommended Readings:

1. Norman N. P., and Joseph H. H., (1997) Food Science 5th edition, CBS Publication, New Delhi.

2. Frazier W. C., and Westhoff D. C., (1996) Food Microbiology 4th Ed, Tata McGraw Hill Pvt Ltd., New Delhi.

3. Fellows P. J., (2002) Food Processing Technology: Principles and Practice 2nd Ed, Woohead Pub. Ltd.

4. Sivasankar B., (2002) Food Processing & Preservation, Prentice Hall of India.

5. Khetarpaul N., (2005) Food Processing and Preservation, Daya Publications.

6. Norman W. Desrosier; (2018) The Technology of food preservation, Medtech, New Jersey

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

CO-PO Articulation Matrix Principles and Methods of Food Processing Course (PC/FT/42-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	3	2	1	1	-	-	1	2	2	1	2	3	3
CO 2	3	2	3	2	1	2	1	1	1	2	2	1	3	3	3
CO 3	2	3	3	2	3	3	1	-	1	1	2	1	2	3	3
CO 4	3	3	3	3	2	1	1	1	1	2	2	1	2	3	3
CO 5	3	2	3	1	2	1	1	1	-	1	1	1	3	3	3
3-High 2-Medium 1-Low															

Principles and Methods of Food Processing Lab

General Information

Course Code: PC/FT/42-P **Course Credits: 2** **Type: Programme Core Courses** **Contact Hours per week: 4** **Mode: Lab Practical and assignments**	**Course Assessment Method: Max. Marks: 100** **(Internal: 50; External: 50)** • The internal and external assessment is based on the level of participation in lab. Sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of lab, File and ethical practices followed. • The Internal Evaluation is conducted by the course coordinator. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department.

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	RBT Level
CO1	Use of basic instruments for food processing and analysis.	**L3: Apply**
CO2	Identify various techniques for food preservation and food analysis.	**L4: Analyse**
CO3	Assess of different pre- processing parameters for shelf-life enhancement of foods.	**L5: Evaluate**
CO4	Formulate various methods and techniques of food processing.	**L6: Create**
CO5	Use of basic instruments for food processing and analysis.	**L3: Apply**

***Revised Bloom's Taxonomy Action verbs/Levels**

List of experiments

Note: Perform at least seven experiments from the list.

- Demonstration of various food processing equipment.
- Assessment of adequacy of blanching of food sample.
- Measurement of specific gravity of liquid sample.
- Preparation of the sugar syrup of different degree brix.
- Cut out analysis of can.
- Preservation of vegetable with the help of pickling.
- Study various types of drying on food quality.
- Preparation of jam.
- Adequacy tests for pasteurization and sterilization for different foods.

Note:

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

CO-PO Articulation Matrix Principles and Methods of Food Processing Lab (PC/FT/42-P)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	1	-	1	1	2	1	-	2	1	-	1	3	3	1
CO 2	3	2	1	2	2	1	1	1	1	1	-	1	2	1	2
CO 3	3	3	2	2	1	1	1	1	1	1	-	1	1	3	1
CO 4	3	2	2	-	1	2	1	1	2	1	-	1	2	1	1
CO 5	1	1	1	-	-	2	1	-	-	-	-	1	2	2	2
3-High 2-Medium 1-Low															

Food Engineering

General Course Information

Course Code: PC/FT/43-T **Course Credits: 4** **Type: Programme Core Courses** **Contact Hours per week: 4** **Mode: Lectures (L)** **Examination Duration: 3 hours**	**Course Assessment Method: Max. Marks: 100** **Internal Evaluation (30 marks):** • Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks). • Assignments, quiz etc. will have weightage of 06 marks. **End semester examination (70 marks):** • Nine questions are to be set by the examiner. A candidate is required to attempt 05 questions in all, question number one is compulsory and remaining four questions by selecting one question from each of the four units. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions of 2 marks each. • Question numbers 2 to 9 are to be set by selecting 2 questions from each unit.

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	RBT Level
CO1	Define the application basic science in food engineering.	**L1: Remember**
CO2	Apply the principles of mass and energy balance to food processing systems.	**L3: Apply**
CO3	Determine thermal processing time for pasteurization/sterilization.	**L3: Apply**
CO4	Identify suitable operating condition for a given process.	**L4: Analyse**
CO5	Determine the freezing time of food and discuss different types of freezer.	**L3: Apply**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT – I

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

UNIT - II

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

UNIT - III

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

UNIT - IV

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, different types of freezers.

Recommended Readings:

1. Batty J. C. & Folkman S. L. (1983) Food Engineering Fundamentals, John Wiley and Sons.

2. Singh R. P. & Heldman D. R. (2014) Introduction to Food Engineering, Academic Press.

3. Loncin M. &Merson R. L. (1979) Food Engineering Principles and Selected Applications, Academic Press.

4. Toledo R. T. (2007) Fundamentals of Food Process Engineering, 3rd edition, Springer.

5. Ibarz A. & Gustavo Barbosa-Cánovas V. (2003) Unit Operations in Food Engineering, CRC Press.

6. Berk Z. (2009) Food Process Engineering and Technology, Academic Press.

CO-PO Articulation Matrix Food Engineering Course (PC/FT/43-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	2	2	3	2	1	-	-	1	3	2	2	2	1
CO 2	3	3	3	1	1	1	1	-	-	1	1	2	3	3	1
CO 3	3	3	2	2	2	2	1	-	-	1	1	1	2	2	1
CO 4	3	3	1	2	3	1	1	-	-	1	1	2	3	3	2
CO 5	2	3	3	2	3	1	2	-	-	1	1	1	3	3	2
3-High 2-Medium 1-Low															

Food Microbiology

General Course Information

Course Code: PC/FT/44-T **Course Credits: 3** **Type: Programme Core Courses** **Contact Hours per week: 3** **Mode: Lectures (L)** **Examination Duration: 3 hours**	**Course Assessment Method: Max. Marks: 100** **Internal Evaluation (30 marks):** • Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks). • Assignments, quiz etc. will have weightage of 06 marks. **End semester examination (70 marks):** • Nine questions are to be set by the examiner. A candidate is required to attempt 05 questions in all, question number one is compulsory and remaining four questions by selecting one question from each of the four units. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions of 2 marks each. • Question numbers 2 to 9 are to be set by selecting 2 questions from each unit.

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	RBT Level
CO1	Describe the important pathogens and spoilage microorganisms in foods.	**L1: Remember**
CO2	Explain the microbiology of various food products.	**L2: Understand**
CO3	Classify the different types of food spoilage and food borne disease.	**L3: Apply**
CO4	Identify different factors affecting the growth of microorganisms.	**L4: Analyse**
CO5	Formulate suitable conditions both for growth and inactivation of microorganisms.	**L6: Create**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

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

UNIT-II

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

UNIT-III

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

UNIT-IV

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

Recommended Readings:

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

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

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

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

CO-PO Articulation Matrix Food Microbiology Course (PC/FT/44-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	1	-		1	-	-	-	-	-		2	1	3
CO 2	3	2	1	-	-	1	-	-	-	-	-	1	2	1	3
CO 3	2	3	-	2	1	--	-	-	-	-	-	1	2	1	2
CO 4	2	2	-	1	-	-	-	-	-	-	-	1	2	1	1
CO 5	3	2	1	-	1	-	-	-	-	-	-	1	1	1	2
3-High 2-Medium 1-Low															

Food Microbiology Lab

General Information

Course Code: PC/FT/44-P **Course Credits: 2** **Type: Programme Core Courses** **Contact Hours per week: 4** **Mode: Lab Practical and assignments**	**Course Assessment Method: Max. Marks: 100** **(Internal: 50; External: 50)** • The internal and external assessment is based on the level of participation in lab. Sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of lab, File and ethical practices followed. • The Internal Evaluation is conducted by the course coordinator. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department.

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	RBT Level
CO1	Describe the basic techniques of microbiological quality assessment.	**L1: Remember**
CO2	Demonstrate the working of different instruments used in microbiological examination of food.	**L2: Understand**
CO3	Use different methods of estimation, isolation and identification of microorganisms in food.	**L3: Apply**
CO4	Analyse microbial quality of milk.	**L4: Analyse**
CO5	Determine the numbers of bacteria present in culture.	**L5: Evaluate**

***Revised Bloom's Taxonomy Action verbs/Levels**

List of experiments

Note: Perform at least seven experiments from the list.

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

Note:

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

CO-PO Articulation Matrix Food Microbiology Lab (PC/FT/44-P)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	1	1	1	-	-	1	-	1	-	-	-	-	2	1	2
CO 2	1	1	1	-	-	1	-	1	-	-	-	1	2	1	2
CO 3	1	1	-	2	1	-	-	1	-	-	-	1	1	1	2
CO 4	1	1	-	1	-	-	-	1	-	-	-	1	2	1	1
CO 5	1	1	1	-	1	-	-	1	-	-	-	1	1	1	2
3-High 2-Medium 1-Low															

Heat and Mass Transfer

General Course Information

Course Code: PC/FT/45-T **Course Credits: 4** **Type: Programme Core Courses** **Contact Hours per week: 4** **Mode: Lectures (L)** **Examination Duration: 3 hours**	**Course Assessment Method: Max. Marks: 100** **Internal Evaluation (30 marks):** • Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks). • Assignments, quiz etc. will have weightage of 06 marks. **End semester examination (70 marks):** • Nine questions are to be set by the examiner. A candidate is required to attempt 05 questions in all, question number one is compulsory and remaining four questions by selecting one question from each of the four units. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions of 2 marks each. • Question numbers 2 to 9 are to be set by selecting 2 questions from each unit.

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	RBT Level
CO1	Apply the Principle of conduction and convection heat transfer during processing of food.	**L3: Apply**
CO2	Describe the principle of radiation heat transfer.	**L2: Understand**
CO3	Execute the knowledge of heat transfer to design heat exchanger	**L3: Apply**
CO4	Apply the processing technique to be adopted for various foods according to their heat and mass transfer properties.	**L5: Evaluate**
CO5	Design equipment for food processing using heat and mass transfer equations.	**L6: Create**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

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

UNIT-II

Convection 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.

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.

UNIT-III

Heat Exchangers: Parallel and counter flow heat exchangers, log mean temperature difference, single pass and multipass heat exchangers, plate heat exchangers, number of transfer unit.

UNIT-IV

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.

Recommended Readings:

1. Binay K. Dutta (2001) Heat Transfer Principles and Applications, Prentice Hall of India.

2. Nag P. K. (2015) Heat and mass transfer, 3 rd edition, McGraw Hill Publishers.

3. Rudramoorthy R. & Mayilsamy K. (2011) Heat and mass transfer, 2nd edition, Pearson Publication.

4. Barhr H. & Stephan K. (2011) Heat and mass transfer, 3 rd edition, Springer Publication.

5. Kamaraj G. & Raveendiran P. (2008) Heat and mass transfer, Scitech Publications.

6. D.S. Kumar. (2015). Heat and mass transfer. S.K. Kataria & Sons.

CO-PO Articulation Matrix Heat and Mass Transfer Course (PC/FT/45-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	3	2	1	1	1	-	1	1	1	1	3	2	3
CO 2	3	3	2	2	1	1	1	-	1	1	1	1	3	2	3
CO 3	3	3	1	2	1	-	1	-	1	1	1	1	3	2	2
CO 4	3	3	1	1	1	-	1	-	1	1	1	1	3	2	1
CO 5	3	3	3	2	1	-	1	-	1	1	1	1	3	2	2
3-High 2-Medium 1-Low															

Heat and Mass Transfer Lab

General Information

Course Code: PC/FT/45-P **Course Credits: 2** **Type: Programme Core Courses** **Contact Hours per week: 4** **Mode: Lab Practical and assignments**	**Course Assessment Method: Max. Marks: 100 (Internal: 50; External: 50)** • The internal and external assessment is based on the level of participation in lab. Sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of lab, File and ethical practices followed. • The Internal Evaluation is conducted by the course coordinator. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department.

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	RBT Level
CO1	Demonstrate the different modes of modes of heat transfer in various processing operations.	**L3: Apply**
CO2	Experiment to calculate various parameters in steady state heat transfer.	**L4: Analyse**
CO3	Demonstrate to examine the overall heat transfer coefficient and effectiveness of heat exchangers.	**L3: Apply**
CO4	Evaluate the performance of various heat transfer devices.	**L5: Evaluate**
CO5	Design and select a better heat exchanging/transfer device under given conditions.	**L6: Create**

***Revised Bloom's Taxonomy Action verbs/Levels**

List of experiments

Note: Perform at least seven experiments from the list.

- To determined the thermal conductivity of a rod.
- To determined the thermal conductivity of an insulating powder.
- To determined the thermal conductivity of a solid by the guarded hot plate method.
- To find the effectiveness of a pin fin in a rectangular duct under natural convection condition and plot temperature distribution along its length.
- To find the effectiveness of a pin fin in a rectangular duct under forced convection condition and plot temperature distribution along its length.
- To find out overall heat transfer coefficient and effectiveness of a heat exchanger under parallel flow condition. Also plot the temperature distribution along the length of the heat exchanger.
- To find out overall heat transfer coefficient and effectiveness of a heat exchanger under counter flow condition. Also plot the temperature distribution along the length of the heat exchanger.
- To verify the Stefen-Boltzmann constant for thermal radiation.

Note:

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and

schedule of submission will be prepared by the course coordinator at the beginning of the semester.

CO-PO Articulation Matrix Introduction to Heat and Mass Transfer Lab (PC/FT/45-P)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	2	1	-	1	1	1	1	1	-	2	2	3	2
CO 2	3	3	2	1	-	1	1	1	1	1	-	2	2	3	2
CO 3	3	3	3	2	1	2	1	1	1	1	-	2	1	2	2
CO 4	3	3	3	1	-	2	1	1	1	1	-	2	2	2	1
CO 5	3	3	1	1	1	1	1	1	2	1	-	2	1	3	2
3-High 2-Medium 1-Low															

Detailed syllabus of
B. Tech. (Food Technology)
5th Semester

B. Tech. 3rd Year Semester-V

Sr. No.	Course Code	Course Title	Work Load/Credit			
			Theory	**Tutorial**	**Practical**	**Total**
1	PC/FT/51-T	Processing of Grains	3/3	0	0	3/3
2	PC/FT/51-P	Processing of Grains Lab	0	0	4/2	4/2
3	PC/FT/52-T	Fruits and Vegetables Processing	3/3	0	0	3/3
4	PC/FT/52-P	Fruits and Vegetables Processing Lab	0	0	4/2	4/2
5	PC/FT/53-T	Food Safety, Quality and Regulations	3/3	0	0	3/3
6	PC/FT/54-T	Food Refrigeration and Cold Storage Construction	3/3	0	0	3/3
7	OE-I	Open Elective course to be opted by the students from another branch.	3/3	0	0	3/3
8	***EEC/FT/51-P	Industrial Training/ Internship-I	0	0	4/2	4/2
Total						**27/21**
***Students will have to prepare and submit a report of the Industrial Training/ Internship of 6-8 weeks done during summer vacations after the examinations of 4th semester under the supervision of faculty during 5th semester.						
Open Elective-I :- Students are required to study one elective subject from any other Department in 5th Semester						

Industrial Training/ Internship-I

General Course Information

Course Code: EEC/FT/51-P **Course Credits: 1** **Type: Employability Enhancement Courses** **Contact Hours per week: 2** **Mode: Industrial Training/ Internship Evaluation**	**Course Assessment Method: Max. Marks: 100** **(Internal: 100) :** An internal evaluation will be done by a faculty member appointed by the Chairperson/Head of the Department. The criteria for evaluation is given below: • Knowledge of problem domain (VIVA VOCE): 25 • Report writing: 25 • Judgment of the skill learned: 25 • Level of ethics followed: 25

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	RBT Level
CO1	Review the existing food processing set ups for their strengths and weaknesses.	**L4: Analyse**
CO2	Assess the food industry problems and their implications.	**L5: Evaluate**
CO3	Select and apply modern engineering and IT tools to design, and solve industrial problems.	**L3: Apply**
CO4	Evaluate the unit setup with respect to the manufacturing process, plant layout, and other infrastructure and suggest viable improvements.	**L5: Evaluate**
CO5	Organize the learned concepts and preparation of final report in an effective manner using technological tools.	**L6: Create**

***Revised Bloom's Taxonomy Action verbs/Levels**

About the Industrial Training/Internship:

Students do an Industrial Training/Internship of 6 to 8 weeks after fourth semester. They are expected to learn novel skills during the training period.

CO-PO Articulation Matrix Industrial Training/ Internship-I (EEC/FT/51-P)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**
CO 2	**1**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**2**
CO 3	**-**	**2**	**2**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**3**
CO 4	**1**	**2**	**2**	**3**	**2**	**1**	**1**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**3**
CO 5	**-**	**2**	**-**	**1**	**1**	**-**	**-**	**1**		**3**	**1**	**-**	**-**	**-**	**2**
3-High 2-Medium 1-Low															

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Processing of Grains

General Course Information

Course Code: PC/FT/51-T **Course Credits: 3** **Type: Programme Core Courses** **Contact Hours per week: 3** **Mode: Lectures (L)** **Examination Duration: 3 hours**	**Course Assessment Method: Max. Marks: 100** **Internal Evaluation (30 marks):** • Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks). • Assignments, quiz etc. will have weightage of 06 marks. **End semester examination (70 marks):** • Nine questions are to be set by the examiner. A candidate is required to attempt 05 questions in all, question number one is compulsory and remaining four questions by selecting one question from each of the four units. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions of 2 marks each. • Question numbers 2 to 9 are to be set by selecting 2 questions from each unit.

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	RBT Level
CO1	Describe structure of cereals and millets.	**L1: Remember**
CO2	Describe nutritional characteristics of cereals, millets and their processed products.	**L1: Remember**
CO3	Demonstrate working of machinery for valuable processed products.	**L2: Understand**
CO4	Examine functionalities of flour components in different food products.	**L3: Apply**
CO5	Design new approaches for providing solutions as per industry needs.	**L6: Create**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

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

UNIT-II

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

UNIT-III

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

UNIT-IV

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

Recommended Readings:

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

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

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

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

5.Tanley A. Watson and Paul E. Ramstad: Corn Chemistry and Technology, ADCC, USA. Julliano, B.O., Rice Chemistry and Technology, AACC, USA.

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

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

CO-PO Articulation Matrix Processing of Grains Course (PC/FT/51-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	2	2	-	1	1	1	1	1	1	-	2	3	1	3
CO 2	3	2	2	-	3	1	1	1	-	1	-	1	3	3	2
CO 3	3	1	3	-	2	1	1	1	-	1	-	1	2	2	1
CO 4	2	2	1	-	3	1	1	1	1	1	-	2	3	2	1
CO 5	3	2	3	3	3	-	-	1	-	1	-	1	3	3	3
3-High 2-Medium 1-Low															

Processing of Grains Lab

General Information

Course Code: PC/FT/51-P **Course Credits: 2** **Type: Programme Core Courses** **Contact Hours per week: 4** **Mode: Lab Practical and assignments**	**Course Assessment Method: Max. Marks: 100** **(Internal: 50; External: 50)** • The internal and external assessment is based on the level of participation in lab. Sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of lab, File and ethical practices followed. • The Internal Evaluation is conducted by the course coordinator. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department.

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	RBT Level
CO1	Estimate different physico-chemical properties of grains.	**L2: Understand**
CO2	Classify cereal grains on the basis of the different quality parameters.	**L3: Apply**
CO3	Compare output of milling operations of cereals and other grains.	**L4: Analyse**
CO4	Assess nutritional and functional characteristics of grains and flour.	**L5: Evaluate**
CO5	Formulate cereal based new products with improved quality and technology.	**L6: Create**

***Revised Bloom's Taxonomy Action verbs/Levels**

List of experiments

Note: Perform at least seven experiments from the list.

- Study the structure of wheat and paddy.
- Experimental milling of wheat.
- Experimental milling of paddy.
- Proximate analysis of grains and grain products.
- Estimation of dry and wet gluten of wheat flour.
- Parboiling and cooking properties of different varieties of rice.
- Determination of hectoliter weight and 1000 kernel weight of grains.
- Determination of water absorption capacity of wheat flour.
- Storage studies of various grains having different moisture levels.
- Determination of foaming and dough raising capacities of flour,
- Preparation of bread, cake and cookie and analyzing their quality parameters,
- Visit to a rice mill, flour mill and FCI godown.

Note:
The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

CO-PO Articulation Matrix Processing of Grains Lab (PC/FT/51-P)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	1	1	2	1	1	1	1	1	-	2	2	2	2
CO 2	3	2	1	-	1	1	1	-	1	1	-	1	3	1	2
CO 3	2	2	2	2	1	1	1	1	-	2	-	1	3	2	3
CO 4	3	3	2	1	2	2	1	1	-	1	-	2	2	3	1
CO 5	3	2	1	-	1	1	1	-	1	2	-	1	2	2	2
3-High 2-Medium 1-Low															

Fruits and Vegetables Processing

General Course Information

Course Code: PC/FT/52-T **Course Credits: 3** **Type: Programme Core Courses** **Contact Hours per week: 3** **Mode: Lectures (L)** **Examination Duration: 3 hours**	**Course Assessment Method: Max. Marks: 100** **Internal Evaluation (30 marks):** • Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks). • Assignments, quiz etc. will have weightage of 06 marks. **End semester examination (70 marks):** • Nine questions are to be set by the examiner. A candidate is required to attempt 05 questions in all, question number one is compulsory and remaining four questions by selecting one question from each of the four units. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions of 2 marks each. • Question numbers 2 to 9 are to be set by selecting 2 questions from each unit.

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	RBT Level
CO1	Describe fruits and vegetables structure, composition, nutritive value and factors affecting pre and post-harvest quality of fruits and vegetables.	**L1: Remember**
CO2	Explain maturity determination methods and various storage conditions for attaining quality products.	**L2: Understand**
CO3	Use of pre-processing unit operations and equipment for processing and preservation of fruits and vegetables products.	**L3: Apply**
CO4	Identify various physicochemical and microbial changes of processed products along with shelf-life evaluation.	**L4: Analyse**
CO5	Appraise problem solving strategies and methods of waste utilization for value addition of fruits and vegetables.	**L6: Evaluate**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

Scope of fruit and vegetable processing industry in India- present status, constraints and prospects. Fruits and vegetables- classification, types, structure and composition of fruits and vegetables- chemical composition and nutritive value and importance in our diet, Post-harvest technology and its significance, pre-harvest factors affecting post-harvest quality of fruits and vegetables.

UNIT-II

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

UNIT-III

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

UNIT-IV

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

Recommended Readings:

1. Giridharlal, Siddappa and Tandon, Preservation of fruits and vegetables. ICAR, New Delhi.
2. Srivastava. P., R., and Sanjeev Kumar. Fruit and vegetable preservation - 3rd Edition.
3. Thompson, A.K., (2003). Fruits and vegetables; Harvesting, handling and storage. Blackwell Publishing.
4. Norman. N. Potter Food Science.CBS publishers and distributors, New Delhi.
5. Hui, Y. H., (2006). Handbook of fruits and fruit processing. Blackwell Publishing.
6. Arthey, David, Arhurst, Philip, R., (2005). Fruit processing- Nutrition, products and quality management, 2nd edition. Springer.

CO-PO Articulation Matrix Fruits and Vegetables Processing Course (PC/FT/52-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	2	-	1	1	1	1	2	1	-	2	2	3	3
CO 2	3	2	1	1	2	-	1	1	1	1	-	1	3	2	1
CO 3	3	1	1	2	1	1	1	1	1	1	-	1	2	2	2
CO 4	3	2	3	2	1	1	1	1	1	1	-	2	2	3	1
CO 5	3	2	1	1	1	1	-	1	2	2	-	2	3	2	3
3-High 2-Medium 1-Low															

Fruits and Vegetables Processing Lab

General Information

Course Code: PC/FT/52-P **Course Credits: 2** **Type: Programme Core Courses** **Contact Hours per week: 4** **Mode: Lab Practical and assignments**	**Course Assessment Method: Max. Marks: 100 (Internal: 50; External: 50)** • The internal and external assessment is based on the level of participation in lab. Sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of lab, File and ethical practices followed. • The Internal Evaluation is conducted by the course coordinator. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department.

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	RBT Level
CO1	Understand various methods of analysis of fruits and vegetables.	**L2: Understand**
CO2	Use the principles of food processing for preparation of various fruits and vegetables products.	**L3: Apply**
CO3	Identify various processing techniques and equipments for product development.	**L4: Analyse**
CO4	Determine quality changes and evaluation of analytical parameters.	**L5: Evaluate**
CO5	Develop new products and techniques for value addition.	**L6: Create**

***Revised Bloom's Taxonomy Action verbs/Levels**

List of experiments

Note: Perform at least seven experiments from the list.

- Orientation to different fruit processing equipments, their functions and uses.
- Determination of moisture, titratable acidity, TSS of fruit and vegetable products.
- Preparation of fruit juices, squashes and cordial.
- Preservation and processing of certain vegetables by drying.
- Preparation of tomato ketchup, puree and paste.
- Preparation of pickles.
- Preparation of jam and their storage study.
- Preparation jelly and their storage study.
- Blanching of the given sample and assessment of its adequacy.
- Enzymatic browning of fruits and vegetables and its control.
- Preparation of preserve and dried fruit products (papad, bars, candy etc.).
- Determination of reducing and total sugars,
- Visit to local fruit and vegetables processing industries.

Note:

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

CO-PO Articulation Matrix Fruits and Vegetables Processing Lab (PC/FT/52-P)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	1	1	1	-	-	1	1	1	-	1	3	3	1
CO 2	3	3	2	-	1	1	1	-	1	1	-	2	2	2	2
CO 3	2	2	2	1	2	-	1	1	-	1	-	1	3	2	1
CO 4	3	2	3	1	2	1	1	2	-	1	-	2	2	2	2
CO5	3	3	1	-	3	-	-	1	1	-	-	2	3	3	1
3-High 2-Medium 1-Low															

Food Safety, Quality and Regulations

General Course Information

Course Code: PC/FT/53-T **Course Credits: 3** **Type: Programme Core Courses** **Contact Hours per week: 3** **Mode: Lectures (L)** **Examination Duration: 3 hours**	**Course Assessment Method: Max. Marks: 100** **Internal Evaluation (30 marks):** • Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks). • Assignments, quiz etc. will have weightage of 06 marks. **End semester examination (70 marks):** • Nine questions are to be set by the examiner. A candidate is required to attempt 05 questions in all, question number one is compulsory and remaining four questions by selecting one question from each of the four units. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions of 2 marks each. • Question numbers 2 to 9 are to be set by selecting 2 questions from each unit.

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	**RBT Level**
CO1	Describe concept of laws, standards and systems related to food quality and safety.	**L1: Remember**
CO2	Explain principles and mechanism related to food safety and quality management systems.	**L2: Understand**
CO3	Use various regulations as per the requirement of dynamic food sector.	**L3: Apply**
CO4	Assess various factors that affect food quality and safety for obtaining good quality and safe foods.	**L5: Evaluate**
CO5	Describe Food laws and regulatory agencies.	**L2: Understand**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

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

UNIT-II

Food safety aspects, Good Agricultural Practices (GAP), Good Manufacturing Practices (GMPs), Good Hygiene Practices (GHPs) and Hazard Analysis and Critical Control Point (HACCP) system for food safety: Principles and its applications.

UNIT-III

Fundamentals of quality management: Principles, quality management systems (QMS), total quality management (TQM) and food safety management systems (FSMS) systems and requirements, Guidelines of performance improvements; ISO: Fundamental, requirement and guidelines, Halal Certification.

UNIT-IV

Food laws and regulatory agencies: International Organizations – FAO (Food & Agriculture Organization), WHO (World Health Organization), Codex Alimentarius Commission (CAC), ISO-9000-01 certification, Food Safety and Standard act (FSSAI) 2006 and Regulations 2011: General Act, Important Definitions, Licensing and Registration, Packaging and Labelling, Food Recall Procedure, Food and drug administration (FDA), BIS (Bureau of Indian standards).

Recommended Readings:

1. Singh, S. P. (2009). Food Safety, Quality Assurance and Global Trade: Concerns and Strategies: International Book Distributing Co. Lucknow.

2. Alli, I. (2004). Food Quality Assurance: Principles and Practices: CRC Press.

3. Rekha, S. &Pushpa, R. (1997). Handbook of Indian Food Quality and authenticity: Woodhead Publishing Ltd., London

4. Julie, Miller & Jones (1998) Food safety, Association of official analytical chemist USA.

5. Michael M. & Cramera (2006) Food plant Sanitation (GMP), CRC Press, Taylor & Francis Group.

CO-PO Articulation Matrix Food Safety, Quality and Regulations Course (PC/FT/53-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	1	2	-	-	-	-	-	-	-	-	-	-	1	-	2
CO 2	-	-	2	-	-	-	-	-	-	-	-	-	-	2	1
CO 3	-	-	1	-	-	-	-	-	-	-	-	-	1	2	3
CO 4	-	3	-	-	-	-	-	-	-	-	-	-	3	-	1
CO 5	2	-	-	-	-	-	-	-	-	-	-	-	2	-	2
3-High 2-Medium 1-Low															

Food Refrigeration and Cold Storage Construction

General Course Information

Course Code: PC/FT/54-T **Course Credits: 3** **Type: Programme Core Courses** **Contact Hours per week: 3** **Mode: Lectures (L)** **Examination Duration: 3 hours**	**Course Assessment Method: Max. Marks: 100** **Internal Evaluation (30 marks):** • Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks). • Assignments, quiz etc. will have weightage of 06 marks. **End semester examination (70 marks):** • Nine questions are to be set by the examiner. A candidate is required to attempt 05 questions in all, question number one is compulsory and remaining four questions by selecting one question from each of the four units. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions of 2 marks each. • Question numbers 2 to 9 are to be set by selecting 2 questions from each unit.

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	RBT Level
CO1	Outline terminology associated with refrigeration system and cold storage design.	**L1: Remember**
CO2	Explain basic refrigeration systems and identify methods for performance improvement.	**L2: Understand**
CO3	Classify different refrigeration technique for different food.	**L3: Apply**
CO4	Compare the quality of frozen food preserved using refrigeration technique.	**L4: Analyse**
CO5	Assess the cold storage structure as per different commodity requirement.	**L5: Evaluate**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT- I

Principles of Refrigeration cycles used in food Industries, Vapour Compression and Vapour Absorption cycles, Refrigerants, characteristics of different refrigerants, Green house Potential Refrigerants, components of a Refrigeration system: compressor, condenser, evaporator, expansion valves.

UNIT-II

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

UNIT-III

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

UNIT-IV

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

Recommended Readings:

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

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

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

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

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

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

7. Aurel Gobaneu and Gabriala Laseha and others (1976) Cooling Technology in the Food Industry: Abacus Press, Tunbridge Wells, U.K.

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

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

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

CO-PO Articulation Matrix Food Refrigeration and Cold Storage Construction Course (PC/FT/54-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	1	1	-	-	-	1	-	-	-	-	-	-	2	2	2
CO 2	1	1	-	1	1	1	-	-	-	-	-	-	3	2	-
CO 3	2	-	-	2	-	-	-	-	-	-	-	-	2	2	-
CO 4	3	1	1	2	-	1	-	-	-	-	-	-	3	3	2
CO 5	2	3	-	2	-	-	-	--	-	-	-	-	3	-	2
3-High 2-Medium 1-Low															

Detailed syllabus of
B. Tech. (Food Technology)
6th Semester

B. Tech. 3rd Year Semester-VI

Sr. No.	Course Code	Course Title	Work Load/Credit			
			Theory	Tutorial	Practical	Total
1	PC/FT/61-T	Technology of Milk and Milk Products	3/3	0	0	3/3
2	PC/FT/61-P	Technology of Milk and Milk Products Lab	0	0	4/2	4/2
3	PC/FT/62-T	Fermentation Technology	3/3	0	0	3/3
4	PC/FT/62-P	Fermentation Technology Lab	0	0	4/2	4/2
5	PC/FT/63-T	Post Harvest Handling and Processing	3/3	0	0	3/3
6	PE/FT/61-T to PE/FT/63-T	Programme Elective course I to be opted by the students	3/3	0	0	3/3
7	PE/FT/64-T to PE/FT/66-T	Programme Elective course II to be opted by the students	3/3	0	0	3/3
8	OE-II	Open Elective course to be opted by the students from another branch	3/3	0	0	3/3
9	**MC/5-P	Technical Presentation	0	0	2/1	2/0
Total						**26/22**
B. Tech.(FT) student must undergo 6-8 weeks Summer Industrial/Training after VI semester.						
1	***EEC/FT/72-P	Industrial Training/ Internship-II	0	0	4/2	4/2
Open Elective-II :- Students are required to study one elective subject from any other Department in 6th Semester						

**Non-credit qualifying mandatory courses. The assessment will be completely internal.

***The students will have to undergo Industrial training/ internship for 6-8 weeks during summer vacations after the examinations of 6th semester which will be evaluated during 7th semester.

Note: Students will be allowed to use non-programmable scientific calculator only, however sharing of calculator will not be permitted.

Programme Elective-I

Course Code	Course Name	L	T	P	Credits
PE/FT/61-T	Bioprocess Engineering	3	-	-	3.0
PE/FT/62-T	Technology of Beverages	3	-	-	3.0
PE/FT/63-T	Specialty Foods	3	-	-	3.0

Programme Elective-II

Course Code	Course Name	L	T	P	Credits
PE/FT/64-T	Technology of Pulses and Oilseeds	3	-	-	3.0
PE/FT/65-T	Technology of Spices and Herbs	3	-	-	3.0
PE/FT/66-T	Dairy Process Engineering	3	-	-	3.0

Technology of Milk and Milk Products

General Course Information

Course Code: PC/FT/61-T **Course Credits: 3** **Type: Programme Core Courses** **Contact Hours per week: 3** **Mode: Lectures (L)** **Examination Duration: 3 hours**	**Course Assessment Method: Max. Marks: 100** **Internal Evaluation (30 marks):** • Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks). • Assignments, quiz etc. will have weightage of 06 marks. **End semester examination (70 marks):** • Nine questions are to be set by the examiner. A candidate is required to attempt 05 questions in all, question number one is compulsory and remaining four questions by selecting one question from each of the four units. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions of 2 marks each. • Question numbers 2 to 9 are to be set by selecting 2 questions from each unit.

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	RBT Level
CO1	Describe concepts related to the composition, properties, processing and utilization of milk.	**L1: Remember**
CO2	Explain milk processing techniques and subsequent manufacturing of milk products.	**L2: Understand**
CO3	Use technology for value addition and dairy plant sanitation.	**L3: Apply**
CO4	Assess the quality characteristics of various dairy products.	**L5: Evaluate**
CO5	Prescribe processing conditions and new technologies related to dairy sector.	**L6: Create**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

Current status of Indian dairy sector: Production, utilization and per capita consumption of milk, SWOT analysis.

Milk: definition, types of milk, composition, nutritive value of milk and milk products; Physico-chemical properties of milk.

Milk processing: Reception, pasteurization (LTLT, HTST), homogenization, sterilization, UHT processing and aseptic packaging.

UNIT-II

Cream separation and related equipments: Butter: definition, butter-making process, overrun, defects in cream & butter.

Technology of ice-cream: Composition of ice-cream, methods of preparation.

Evaporated, concentrated and dried milks: Methods of manufacture and defects, dried whole milk/WMP, dried non-fat milk/SMP; milk drying system (film, roller, drum, spray, foam spray drying).

UNIT-III

Cultured milk and milk products: Types and manufacturing process.

Cheese: Technology of different varieties of cheese manufacturing (cheddar & mozzarella), changes during ripening; manufacture of processed cheese, defects in cheese.

Traditional dairy products: Rabri, kulfi, srikhand, khoa, channa, paneer, ghee.

UNIT-IV

By-products utilization: Caseinates, co-precipitates, whey protein concentrate.

Cleaning and disinfection in a dairy industry: Terms, definitions, cleaning and disinfection agents and processes; cleaning in place (CIP) and cleaning out of place (COP).

Recommended Readings:

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

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

3. Vaclavik V. A. & Christian E. W. (2003) Essentials of food science. 2nd edition, Springer International. 4. Spreer E. (1998) Milk and dairy product technology, Marcel Dekker Inc.

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

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

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

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

CO-PO Articulation Matrix Technology of Milk and Milk Products Course (PC/FT/61-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	1	1	-	1	1	1	-	1	-	1	2	2	3
CO 2	2	2	2	-	2	1	1	1	-	1	-	2	3	3	2
CO 3	3	3	2	-	1	2	1	1	1	1	-	2	3	3	1
CO 4	3	2	1	-	1	1	-	1	-	1	-	2	2	2	2
CO 5	3	2	2	1	2	2	1	2	1	1	-	3	3	2	3
3-High 2-Medium 1-Low															

Technology of Milk and Milk Products Lab

General Information

Course Code: PC/FT/61-P **Course Credits: 2** **Type: Programme Core Courses** **Contact Hours per week: 4** **Mode: Lab Practical and assignments**	**Course Assessment Method: Max. Marks: 100** **(Internal: 50; External: 50)** • The internal and external assessment is based on the level of participation in lab. Sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of lab, File and ethical practices followed. • The Internal Evaluation is conducted by the course coordinator. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department.

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	RBT Level
CO1	Demonstrate procedures and analytical techniques for milk and milk product testing.	**L2: Understand**
CO2	Judge quality of milk and milk products as prescribed by legal authorities.	**L3: Apply**
CO3	Detect the presence of inferior quality material in milk and milk products.	**L4: Analyse**
CO4	Assess method for quality assurance of milk and milk products.	**L5: Evaluate**
CO5	Formulate new milk products with enhanced quality characteristics and nutritional value.	**L6: Create**

***Revised Bloom's Taxonomy Action verbs/Levels**

List of experiments

Note: Perform at least seven experiments from the list.

- Sampling of milk and milk products.
- Platform tests of milk: Organoleptic test, Sediment test, COB test, Alcohol test.
- Determination of Titratable acidity and pH of milk.
- Determination of specific gravity of milk, total solids and solid-not-fat using lactometer.
- Detection of milk adulterants.
- Detection of neutralizers and preservatives in milk. (formalin and hydrogen peroxide) and synthetic milk (urea test, detergent test, common salt).
- Alkaline phosphatase test to determine adequacy of pasteurization.
- Fat estimation in milk using gerber/rose-gottlieb method.
- Testing of Reichert-Meissel number and Polenske value of ghee/butter.
- Detection of Saponification value of ghee.
- Separation of cream using cream separator.
- Development of some indigenous dairy products.
- Visit to a dairy plant.

Note:

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the

objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

CO-PO Articulation Matrix Technology of Milk and Milk Products Lab (PC/FT/61-P)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	1	1	1	-	1	1	-	1	-	2	3	2	2
CO 2	3	1	1	1	-	1	1	1	-	1	-	2	2	3	2
CO 3	3	2	1	1	2	1	1	1	-	1	-	2	2	1	1
1CO 4	3	3	2	1	-	1	1	1	-	1	-	1	1	1	1
CO 5	3	2	3	2	2	2	1	1	-	1	-	2	3	2	2
3-High 2-Medium 1-Low															

Fermentation Technology

General Course Information

Course Code: PC/FT/62-T **Course Credits: 3** **Type: Programme Core Courses** **Contact Hours per week: 3** **Mode: Lectures (L)** **Examination Duration: 3 hours**	**Course Assessment Method: Max. Marks: 100** **Internal Evaluation (30 marks):** • Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks). • Assignments, quiz etc. will have weightage of 06 marks. **End semester examination (70 marks):** • Nine questions are to be set by the examiner. A candidate is required to attempt 05 questions in all, question number one is compulsory and remaining four questions by selecting one question from each of the four units. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions of 2 marks each. • Question numbers 2 to 9 are to be set by selecting 2 questions from each unit.s by selecting one question from each unit

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	**RBT Level**
CO1	Outline the scope and importance of fermentation technology in food industry.	**L1: Remember**
CO2	Indicate fermenters parts, design features and measurements of fermentation parameters.	**L2: Understand**
CO3	Classify fermentation systems and products of fermentation.	**L3: Apply**
CO4	Assess the applications of fermentation technology for value-addition.	**L5: Evaluate**
CO5	Prescribe problem solving methods regarding manufacturing of fermented foods.	**L6: Create**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

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

UNIT-II

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

UNIT-III

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

UNIT-IV

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

Recommended Readings:

1. Godfrey T., and West S., (1996) Industrial enzymology, Stockholon Press, New York.

2. Pandey A., (1994) Solid state fermentation, New Age, Publishers. New Delhi.

3. Cruger W., and Kruger (2002), Biotechnology –A Textbook of Industrial Microbiology, 2ndEdition, Panima Publishing Corporation, New Delhi

4. Ward O. P., (1999), Fermentation Biotechnology – Principles, Process and Products. Prentice Hall Publishing, New Jersey.

CO-PO Articulation Matrix Fermentation Technology Course (PC/FT/62-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	1	-	-	1	1	1	-	1	-	1	1	1	2
CO 2	2	2	2	1	1	1	-	1	1	1	1	2	2	2	2
CO 3	1	1	2	2	1	1	1	1	1	1	1	2	2	2	3
CO 4	1	2	3	1	2	1	1	1	-	1	-	1	3	3	2
CO 5	3	2	2	3	1	1	-	1	-	1	-	1	3	2	3
3-High 2-Medium 1-Low															

Fermentation Technology Lab

General Information

Course Code: PC/FT/42-P **Course Credits: 2** **Type: Programme Core Courses** **Contact Hours per week: 4** **Mode: Lab Practical and assignments**	**Course Assessment Method: Max. Marks: 100** **(Internal: 50; External: 50)** • The internal and external assessment is based on the level of participation in lab. Sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of lab, File and ethical practices followed. • The Internal Evaluation is conducted by the course coordinator. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department.

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	RBT Level
CO1	Sketch different types of fermenters with demonstration.	**L3: Apply**
CO2	Distinguish working of various types of fermenters.	**L4: Analyse**
CO3	Appraise production methods and control tests for various types of fermented products.	**L5: Evaluate**
CO4	Formulate various methods of analysis for fermented foods.	**L6: Create**

***Revised Bloom's Taxonomy Action verbs/Levels**

List of experiments

Note: Perform at least seven experiments from the list.

- Study of autoclave and sterilization of glassware.
- Study of fermenter/bioreactor.
- Demonstration of different type of fermenters.
- Preparation of mother culture.
- Inoculation and Isolation of culture.
- Preparation of Yoghurt/dahi.
- Preparation of Wine.
- Production of traditional fermented foods such as idli, dhokla etc.

Note:

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

CO-PO Articulation Matrix Fermentation Technology Lab (PC/FT/62-P)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	1	2	2	-	-	1	-	-	1	-	-	1	3	1	-
CO 2	2	1	1	1	-	2	1	-	1	1	-	2	2	2	2
CO 3	2	1	1	1	-	1	1	1	-	-	-	1	1	2	2
CO 4	1	2	1	-	-	1	-	1	1	-	-	1	2	-	2
3-High 2-Medium 1-Low															

Post Harvest Handling and Processing

General Course Information

Course Code: PC/FT/63-T **Course Credits: 3** **Type: Programme Core Courses** **Contact Hours per week: 3** **Mode: Lectures (L)** **Examination Duration: 3 hours**	**Course Assessment Method: Max. Marks: 100** **Internal Evaluation (30 marks):** • Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks). • Assignments, quiz etc. will have weightage of 06 marks. **End semester examination (70 marks):** • Nine questions are to be set by the examiner. A candidate is required to attempt 05 questions in all, question number one is compulsory and remaining four questions by selecting one question from each of the four units. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions of 2 marks each. • Question numbers 2 to 9 are to be set by selecting 2 questions from each unit.

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	RBT Level
CO1	Describe various aspects of maturity indices and harvesting systems.	**L1: Remember**
CO2	Explain various post harvest handling operations.	**L2: Understand**
CO3	Illustrate integrated approach regarding post harvest management.	**L3: Apply**
CO4	Assess food safety issues related to post harvest technology.	**L5: Evaluate**
CO5	Describe processing of grains, fruits and vegetables.	**L6: Remember**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

Overview of post harvest technology: Concept, production and post harvest losses, prevention for losses. Maturity indices for different cereals, pulses, oil seeds, fruits and vegetables. difference between climacteric and non- climacteric fruits.

UNIT-II

Post Harvest Handling operations: Removal of field heat of produce, transport systems, loading patterns, environmental control, use of modified atmospheres. Scalping, Cleaning and grading of grains, washing of fruits and vegetables, types of cleaners, types of screens i.e. rotary screens, vibrating screens. Sorting, grading, methods of grading i.e. Size grading, colour grading, specific gravity grading.

UNIT-III

Post Harvest Pest Management: Storage losses (Seed and food) due to insects, mites, rodents and birds. Sources of infestation, Significance of temperature and moisture migration in the

development of moulds and insects population. Biochemical changes in stored commodities due to pests infestation.

UNIT-IV

Processing of fruits and vegetables: Canning, drying, freezing and value added products.

Processing of grains: Parboiling processes and milling operations.

Visit to central warehouse, FCI godowns.

Recommended Readings:

1. Earle, R. L. (2013). Unit operations in food processing. Elsevier.
2. Ranganna S. 1997. Hand Book of Analysis and Quality Control for Fruit and Vegetable Products. Tata McGraw-Hill.
3. Bhutani R.C. (2003). Fruit and Vegetable Preservation. Biotech Books.
4. Sahay & Singh (2004). Unit Operation in Agricultural Processing, Vikas Publishing House Private, Limited.
5. Srivastava, R. P., Srivastava, R. P., & Kumar, S. (2005). Fruit and vegetable preservation: principles and practices. International Book Distributing Company.
6. Norman. N. Potter Food Science.CBS publishers and distributors, New Delhi.
7. Haard, N.F. and Salunkhe, D.K. (1975). Postharvest Biology and Handling of Fruits and Vegetables. AVI, Westport.
8. Chakraverty, A. 1988. Post harvest Technology of Cereals, Pulses and oilseeds. Oxford and IBH, New Delhi.
9. McCabe & Smith. (2017). Unit Operations in Chemical Engineering, 7th Ed. McGraw Hills Publication.
10. Willis R., Mc Glassen W.B., Graham D. & Joyce D. 1998. Post Harvest. An Introduction to the Physiology and Handling of Fruits, Vegetables and Ornamentals. CABI.

CO-PO Articulation Matrix Post Harvest Handling and Processing Course (PC/FT/63-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	-	-	-	-	1	2	-	-	-	-	1	2	2	-
CO 2	3	-	-	-	1	-	1	1	1	-	-	1	3	2	-
CO 3	2	-	-	-	2	1	2	-	1	-	-	1	2	3	1
CO 4	-	2	-	2	-	-	-	-	-	-	-	-	-	2	1
CO 5	2	-	3	-	2	2	2	2	3	1	-	2	3	3	1
3-High 2-Medium 1-Low															

Bioprocess Engineering

General Course Information

Course Code: PE/FT/61-T **Course Credits: 3** **Type: Programme Elective Courses** **Contact Hours per week: 3** **Mode: Lectures (L)** **Examination Duration: 3 hours**	**Course Assessment Method: Max. Marks: 100** **Internal Evaluation (30 marks):** • Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks). • Assignments, quiz etc. will have weightage of 06 marks. **End semester examination (70 marks):** • Nine questions are to be set by the examiner. A candidate is required to attempt 05 questions in all, question number one is compulsory and remaining four questions by selecting one question from each of the four units. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions of 2 marks each. • Question numbers 2 to 9 are to be set by selecting 2 questions from each unit.

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	RBT Level
CO1	Describe the kinetics of microbial growth and enzymes, bioreactors and downstream processing.	**L1: Remember**
CO2	Illustrate the growth conditions and instrumentation used in bioprocesses.	**L2: Understand**
CO3	Classify various types of bioreactors and its components.	**L3: Apply**
CO4	Identify the various unit operations involved in bioprocessing.	**L5: Evaluate**
CO5	Plan the production of industrially important metabolites.	**L6: Design**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

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

UNIT-II

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

UNIT-III

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

UNIT-IV

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

Recommended Readings:

1. Kumar, H. D. (1998). A Textbook on Biotechnology 2nd Ed., East West Publisher.

2. Prescott and Dunn. (2004). Industrial Microbiology. CBS Publication.

3. Shuichi Aiba, Arthur E., Humphrey and Nancy F., Millis. (1973). Biochemical Engineering. Academic Press Publisher.

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

5. Shuler M. L., and Kargi F., (2002) Bioprocess Engineering – Basic Concepts Second Edition, Prentice Hall 6.Lee J. M., Fundamentals of biochemical engineering

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

CO-PO Articulation Matrix Bioprocess Engineering Course (PE/FT/61-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	1	1	-	2	-	1	1	1	1	-	1	2	2	1
CO 2	3	2	1	1	2	-	2	1	-	1	-	1	2	2	2
CO 3	1	1	3	1	1	-	1	1	-	-	-	2	1	2	3
CO 4	3	2	2	2	1	-	1	1	1	-	-	1	2	3	2
CO 5	2	2	3	1	-	1	1	1	-	2	-	2	1	2	3
3-High 2-Medium 1-Low															

Technology of Beverages

General Course Information

Course Code: PE/FT/62-T **Course Credits: 3** **Type: Programme Elective Courses** **Contact Hours per week: 3** **Mode: Lectures (L)** **Examination Duration: 3 hours**	**Course Assessment Method: Max. Marks: 100** **Internal Evaluation (30 marks):** • Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks). • Assignments, quiz etc. will have weightage of 06 marks. **End semester examination (70 marks):** • Nine questions are to be set by the examiner. A candidate is required to attempt 05 questions in all, question number one is compulsory and remaining four questions by selecting one question from each of the four units. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions of 2 marks each. • Question numbers 2 to 9 are to be set by selecting 2 questions from each unit.

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	RBT Level
CO1	Outline the scope, types and importance of food beverages.	**L1: Remember**
CO2	Explain various unit operations adopted for processing and packaging of beverages.	**L2: Understand**
CO3	Classify various beverages along with their specifications.	**L3: Apply**
CO4	Assess various processing changes during production of beverages.	**L5: Evaluate**
CO5	Formulate and quality analysis of food beverages.	**L6: Create**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

Beverages: Classification and scope of beverage industries in India and world; Water for beverage industry, Technology of alcoholic and non-alcoholic beverages and their manufacturing; Important aspects of unit operations for beverage processing.

UNIT-II

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

UNIT-III

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

UNIT-IV

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

Recommended Readings:

1. Choudhury, M.R. (1978) "Tea Industry and India".
2. Ashurst P. R. (2005) Chemistry and technology of Soft drink and fruit juices, 2nd edition, Blackwell Publishing Ltd.
3. Steen D. P. &Ashurst P. R. (2000) Carbonated soft drinks – Formulation and manufacture, Blackwell Publishing Ltd.
4. Manay S. N. & Shadakdharaswamy M (2000) Foods – Facts and Principles, 3 rd edition New, Age International Pvt. Ltd.
5. Bamforth C. W. (2005) Food, fermentation and microorganisms, Blackwell Science Publishing Ltd.
6. Bamforth C.W. (2006) Brewing New Technology, CRC Press, Woodhead Publishers.
7. Hui Y. H. (2012) Handbook of Plant Based fermented technology & Beverages, Taylor & Francis Group.

CO-PO Articulation Matrix Technology of Beverages Course (PE/FT/62-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	1	-	2	1	-	-	1	2	-	1	1	1	1	2	2
CO 2	2	2	1	2	2	1		-	1	1	1	1	2	2	1
CO 3	1	-	1	1	-	1	2	2	-	1	2	1	3	1	2
CO 4	2	1	1	1	1	1	3	1	-	2	2	1	2	1	1
CO 5	3	2	3	2	2	1	1	2	2	1	2	2	2	1	2
3-High 2-Medium 1-Low															

Specialty Foods

General Course Information

Course Code: PE/FT/63-T **Course Credits: 3** **Type: Programme Elective Courses** **Contact Hours per week: 3** **Mode: Lectures (L)** **Examination Duration: 3 hours**	**Course Assessment Method: Max. Marks: 100** **Internal Evaluation (30 marks):** • Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks). • Assignments, quiz etc. will have weightage of 06 marks. **End semester examination (70 marks):** • Nine questions are to be set by the examiner. A candidate is required to attempt 05 questions in all, question number one is compulsory and remaining four questions by selecting one question from each of the four units. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions of 2 marks each. • Question numbers 2 to 9 are to be set by selecting 2 questions from each unit.

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	RBT Level
CO1	Outline the classification of specialty foods based on processes and sources.	**L1: Remember**
CO2	Discuss the scope of specialty foods along with nutritional and therapeutic benefits.	**L2: Understand**
CO3	Generalize the effectiveness of different specialty foods for consumer-specific needs.	**L3: Apply**
CO4	Justify the formulation of specialty foods tailored according to consumer requirements.	**L5: Evaluate**
CO5	Prescribe the food business operators regarding marketing and regulations pertaining to specialty foods.	**L6: Create**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

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

UNIT-II

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

UNIT-III

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

UNIT-IV

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

Recommended Readings:

1. Gibson GR & William CM. 2000. Functional Foods - Concept to Product.

2. Robert EC. 2006. Handbook of Nutraceuticals and Functional Foods. 2nd Ed. Wildman.

3. Manson P.2001. Dietary Supplements. 2nd Ed. Pharmaceutical Press.

4. Bamji MS, Rao NP & Reddy V. 2003. Textbook of Human Nutrition. Oxford & IBH.

CO-PO Articulation Matrix Specialty Foods Course (PE/FT/63-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	1	2	1	2	-	1	1	1	2	1	-	1	2	1	2
CO 2	1	1	3	1	-	-	1	1	1	1	1	1	2	3	1
CO 3	2	1	2	-	1	1	1	1	1	1	1	1	2	2	3
CO 4	2	2	2	1	1	2	2	1	1	1	1	2	2	3	2
CO 5	1	2	2	2	2	3	2	1	2	1	2	1	1	1	2
3-High 2-Medium 1-Low															

Technology of Pulses and Oilseeds

General Course Information

Course Code: PE/FT/64-T **Course Credits: 3** **Type: Programme Elective Courses** **Contact Hours per week: 3** **Mode: Lectures (L)** **Examination Duration: 3 hours**	**Course Assessment Method: Max. Marks: 100** **Internal Evaluation (30 marks):** • Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks). • Assignments, quiz etc. will have weightage of 06 marks. **End semester examination (70 marks):** • Nine questions are to be set by the examiner. A candidate is required to attempt 05 questions in all, question number one is compulsory and remaining four questions by selecting one question from each of the four units. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions of 2 marks each. • Question numbers 2 to 9 are to be set by selecting 2 questions from each unit.

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	RBT Level
CO1	Define nutritional characteristics of major pulses and oilseeds.	**L1: Remember**
CO2	Demonstrate working of machinery for valuable processed products from pulses and oilseeds.	**L2: Understand**
CO3	Judge different techniques for oil extraction and food applications of deoiled cake.	**L3: Apply**
CO4	Assess suitable processes and storage practices for obtaining best quality products with minimum losses.	**L5: Evaluate**
CO5	Plan new applications and processes of pulses and oilseeds for their proper utilization in national and international market.	**L6: Create**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

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

UNIT-II

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

UNIT-III

Processing of oilseeds: Introduction to chemical composition and characters of oil seed and oils, post-harvest technology of oil seeds- handling, drying, storage, grading, pre-treatment, cleaning, dehulling, size reduction and flaking.

Oil extraction: Ghani, power ghanis, solvent extraction process: principle, pretreatments i.e. breaking, cracking and flaking, desolventization.

UNIT-IV

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

Recommended Readings:

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

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

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

CO-PO Articulation Matrix Technology of Pulses and Oilseeds Course (PE/FT/64-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	1	-	-	-	-	1	-	1	-	2	1	1	3	1	3
CO 2	3	2	1	1	1	2	1	1	1	3	2	2	3	3	1
CO 3	3	1	-	1	2	1	1	1	1	1	2	2	2	2	2
CO 4	1	2	1	-	1	2	1	1	2	2	1	1	3	2	1
CO 5	3	1	3	3	2	3	1	1	2	1	1	2	3	3	3
3-High 2-Medium 1-Low															

Technology of Spices and Herbs

General Course Information

Course Code: PE/FT/65-T **Course Credits: 3** **Type: Programme Elective Courses** **Contact Hours per week: 3** **Mode: Lectures (L)** **Examination Duration: 3 hours**	**Course Assessment Method: Max. Marks: 100** **Internal Evaluation (30 marks):** • Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks). • Assignments, quiz etc. will have weightage of 06 marks. **End semester examination (70 marks):** • Nine questions are to be set by the examiner. A candidate is required to attempt 05 questions in all, question number one is compulsory and remaining four questions by selecting one question from each of the four units. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions of 2 marks each. • Question numbers 2 to 9 are to be set by selecting 2 questions from each unit.

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	RBT Level
CO1	Outline the classification, types, role and uses of spices and herbs.	**L1: Remember**
CO2	Explain the nutritional and medicinal properties of major Indian spices and herbs.	**L2: Understand**
CO3	Use of various processing and packaging techniques/machineries for value addition of spices and herbs.	**L3: Apply**
CO4	Identify effects of using spices, herbs, spice extractives and blends on human health.	**L4: Analyse**
CO5	Develop improved methods for manufacturing various value-added spice products.	**L6: Create**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

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

UNIT-II

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

UNIT-III

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

UNIT-IV

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

Recommended Readings:

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

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

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

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

CO-PO Articulation Matrix Technology of Spices and Herbs Course (PE/FT/65-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	1	1	1	-	-	2	1	1	-	1	-	1	2	2	1
CO 2	2	1	3	1	-	1	1	2	1	1	1	2	3	2	2
CO 3	3	2	2	1	2	1	2	1	1	1	-	2	2	3	2
CO 4	2	2	1	2	1	2	2	1	1	1	1	1	1	2	2
CO 5	2	1	2	2	1	3	1	2	1	1	1	2	1	2	2
3-High 2-Medium 1-Low															

Dairy Process Engineering

General Course Information

Course Code: PE/FT/66-T **Course Credits: 3** **Type: Programme Elective Courses** **Contact Hours per week: 3** **Mode: Lectures (L)** **Examination Duration: 3 hours**	**Course Assessment Method: Max. Marks: 100** **Internal Evaluation (30 marks):** • Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks). • Assignments, quiz etc. will have weightage of 06 marks. **End semester examination (70 marks):** • Nine questions are to be set by the examiner. A candidate is required to attempt 05 questions in all, question number one is compulsory and remaining four questions by selecting one question from each of the four units. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions of 2 marks each. • Question numbers 2 to 9 are to be set by selecting 2 questions from each unit.

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	RBT Level
CO1	Describe principle, working and application of equipments used in dairy processing.	**L1: Remember**
CO2	Illustrate mechanisms and calculations associated with dairy operations for achieving efficient production.	**L2: Understand**
CO3	Use manufacturing equipments of milk processing considering their efficient utilization.	**L3: Apply**
CO4	Determine the effects of various unit operations on the properties of milk and milk products.	**L5: Evaluate**
CO5	Formulate various processing condition for equipments on the basis of different product requirements.	**L6: Create**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

Evaporation: basic principles of evaporators, construction and operation, different types of evaporators used in dairy industry, calculation of heat transfer area and water requirement of condensers, basic concepts of multiple effect evaporators, operations and various feeding systems, thermo processor and MVR system, care and maintenance of evaporators.

UNIT-II

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

UNIT-II

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

UNIT-IV

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

Recommended Readings:

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

CO-PO Articulation Matrix Dairy Process Engineering Course (PE/FT/66-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	1	1	-	-	-	-	1	1	1	-	1	2	3	1
CO 2	1	2	1	-	2	1	-	1	2	1	1	2	3	2	2
CO 3	2	1	1	1	3	1	-	2	1	2	-	3	2	3	2
CO 4	3	1	2	1	2	1	-	2	2	1	1	1	3	1	3
CO 5	1	2	1	-	2	2	-	1	2	1	-	1	2	2	2
3-High 2-Medium 1-Low															

Technical Presentation

General Course Information

Course Code: MC/5-P **Course Credits: 0** **Type: Mandatory Courses** **Contact Hours per week: 2** **Mode: Practical (P)**	**Course Assessment Method Internal Examination(100marks):** • This is a **non-credit course of qualifying nature**. • Internal continuous assessment of 100 marks on the basis of report writing, presentation and VIVA VOCE in practical classes by the faculty member. • The Course Coordinator/Internal Examiners will maintain and submit the bifurcation of marks obtained by the students in the proformas (attached herewith as Annexure I and II) to the respective departments in addition to submitting and uploading of overall marks on the university portal as per the requirement of the result branch.

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	RBT Level
CO1	Recite and understand recent trends and technologies in the field of Food Technology.	**L1: Remember**
CO2	Discuss concise, comprehend and conclude selective topic in the field of Food Technology.	**L2: Understand**
CO3	Show skills in presentation and discussion of research topics in a public forum.	**L3: Apply**
CO4	Formulate innovative ideas in the field of engineering.	**L6: Create**

***Revised Bloom's Taxonomy Action verbs/Levels**

Course content

The students are required to give power point presentation on the topic related to current research area in the field of Food Technology. The presentation should be held in the class room/seminar hall in presence of the course coordinator.

CO-PO Articulation Matrix Technical Presentation (MC/5-P)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	1	2	-	-	-	-	-	-	2	2	3	-	2
CO 2	3	1	2	2	-	-	-	-	-	2	-	2	2	-	-
CO 3	-	-	-	-	-	-	-	-	-	3	-	2	-	-	-
CO 4	3	2	2	2	-	-	-	-	-	2	-	2	2	2	2
3-High 2-Medium 1-Low															

Detailed syllabus of
B. Tech. (Food Technology)
7th Semester

B. Tech. 4th Year Semester-VII

Sr. No.	Course Code	Course Title	Work Load/Credit			
			Theory	**Tutorial**	**Practical**	**Total**
1	PC/FT/71-T	Instrumental Analysis of Foods	3/3	0	0	3/3
2	PC/FT/72-T	Waste Management and Effluent Treatment	3/3	0	0	3/3
3	PC/FT/72-P	Waste Management and Effluent Treatment Lab	0	0	2/1	2/1
4	EEC/FT/71-P	Minor Project	0	0	8	8/4
5	PE/FT/71-T to PE/FT/73-T	Programme Elective course III to be opted by the students	3/3	0	0	3/3
6	PE/FT/74-T to PE/FT/76-T	Programme Elective course IV to be opted by the students	3/3	0	0	3/3
7	OE-III	Open Elective course to be opted by the students from another branch.	3/3	0	0	3/3
8	*EEC/FT/72-P	Industrial Training/Internship-II	0	0	4/2	4/2
	Total					**29/22**
*Students will have to prepare and submit a report of the Industrial Training/ Internship of 6-8 weeks done during summer vacations after the examinations of 6th semester under the supervision of faculty during 7th semester.						
Open Elective-III :- Students are required to study one elective subject from any other Department in 7th Semester						

Programme Elective-III

Course Code	Course Name	L	T	P	Credits
PE/FT/71-T	Food Plant Design and Layout	3	-	-	3.0
PE/FT/72-T	Introduction to Agri-Business Management	3	-	-	3.0
PE/FT/73-T	Food Flavours and Colours	3	-	-	3.0

Programme Elective-IV

Course Code	Course Name	L	T	P	Credits
PE/FT/71-T	Technology of Frozen Foods	3	-	-	3.0
PE/FT/71-T	Meat, Fish and Poultry Processing	3	-	-	3.0
PE/FT/71-T	Food Product Development and Sensory Evaluation	3	-	-	3.0

Instrumental Analysis of Foods

General Course Information

Course Code: PC/FT/71-T **Course Credits: 3** **Type: Programme Core Courses** **Contact Hours per week: 3** **Mode: Lectures (L)** **Examination Duration: 3 hours**	**Course Assessment Method: Max. Marks: 100** **Internal Evaluation (30 marks):** • Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks). • Assignments, quiz etc. will have weightage of 06 marks. **End semester examination (70 marks):** • Nine questions are to be set by the examiner. A candidate is required to attempt 05 questions in all, question number one is compulsory and remaining four questions by selecting one question from each of the four units. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions of 2 marks each. • Question numbers 2 to 9 are to be set by selecting 2 questions from each unit.

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	RBT Level
CO1	List instrumental techniques used for qualitative and quantitative parameters of food.	**L1: Remember**
CO2	Illustrate principle and working of instrument related to physical, chemical and microbiological analysis.	**L2: Understand**
CO3	Judge operational conditions and preciseness of different techniques.	**L3: Apply**
CO4	Compare different methods used in instrumental quality evaluation.	**L4: Analyse**
CO5	Propose an appropriate instrumental process and interpretation of obtained parameters.	**L6: Create**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

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

UNIT-II

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

UNIT-III

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

UNIT-IV

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

Recommended Readings:

1. Nielson S. S. (2003) Food analysis, Kluwer Academic Press.

2. Pomeranz Y. J. (2000) Food Analysis, Springer Publications.

3. Srivastava (2000) Instrumental Approach to chemical analysis, S. Chand Publishers.

4. Winton A. L. (1999) Techniques of food analysis, Allied Science, Official methods of analysis, Association of official analytical chemist USA.

5. Das H. (2005) Food processing operations analysis, Asian Books private ltd.

6. James CS (1998). Analytical chemistry of foods, BlackicAcad, UK.

7. Winton, AL (1999). Techniques of food analysis, Allied Science Publication, New Delhi.

8. Song, DWS (1996) Mechanism and theory in food chemistry Champasian and Hall Inc. New York.

CO-PO Articulation Matrix Instrumental Analysis of Foods Course (PC/FT/71-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	1	1	-	-	1	-	1	-	-	1	1	1	2	2	1
CO 2	3	2	1	-	2	1	1	-	1	2	1	1	3	1	1
CO 3	3	3	1	1	2	1	-	-	1	3	1	1	3	2	1
CO 4	3	3	2	3	3	1	1	-	-	1	1	2	2	3	1
CO 5	3	3	3	2	1	1	1	-	-	1	2	2	3	3	3
3-High 2-Medium 1-Low															

Waste Management and Effluent Treatment

General Course Information

Course Code: PC/FT/72-T **Course Credits: 3** **Type: Programme Core Courses** **Contact Hours per week: 3** **Mode: Lectures (L)** **Examination Duration: 3 hours**	**Course Assessment Method: Max. Marks: 100** **Internal Evaluation (30 marks):** • Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks). • Assignments, quiz etc. will have weightage of 06 marks. **End semester examination (70 marks):** • Nine questions are to be set by the examiner. A candidate is required to attempt 05 questions in all, question number one is compulsory and remaining four questions by selecting one question from each of the four units. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions of 2 marks each. • Question numbers 2 to 9 are to be set by selecting 2 questions from each unit.

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	RBT Level
CO1	Define food waste management and effluent treatment.	**L1: Remember**
CO2	Interpret physicochemical and microbial quality of food industry waste.	**L3: Apply**
CO3	Use different approaches for waste management and effluent treatment.	**L5: Evaluate**
CO4	Assess effect of food waste on environment.	**L5: Evaluate**
CO5	Propose appropriate approach for waste treatment and management as per safety guidelines.	**L6: Create**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

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

UNIT-II

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

UNIT-III

Biological treatment/Secondary treatment: Aerobic and anaerobic biological treatment processes, combined aerobic and anaerobic treatment processes; Suspended growth and attached

growth biological treatment; Oxidation ditches; Activated sludge process; Biological oxidation-trickling filters; Bio- towers; Rotating biological contractors, aerated lagoons; Anaerobic sludge blanket processes.

UNIT-IV

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

Recommended Readings:

1. Metcalf & Eddy (2013) Wastewater Engineering treatment and Resource recovery, 5th edition, McGraw Hill.

2. Marriott N. G. (2006) Principles of Food Sanitation, 5th edition, CBS Publication.

3. Lawrence K. W., Howard H. Y. &Yapijakis C. (2005) Waste Treatment in the Food Processing Industry, CRC Press.

4. Wang & Lo H. (2006) Waste treatment in the food processing industry, CRC Press, Taylor & Francis Group.

5. Loannis & Arvanitoyannis S. (2008) Waste management for the food industries, Elsevier publishers.

CO-PO Articulation Matrix Waste Management and Effluent Treatment Course (PC/FT/72-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	1	2	3	-	1	2	1	-	1	-	1	1	3	1
CO 2	3	2	2	1	-	1	1	-	1	1	-	2	2	2	2
CO 3	3	3	3	1	-		2	1	1	1	-	1	1	3	2
CO 4	3	2	3	2	-	2	1	-	1	1	-	1	2	3	2
CO 5	3	3	2	1	-	2	1	-	1	1	-	2	3	2	1
3-High 2-Medium 1-Low															

Waste Management and Effluent Treatment Lab

General Information

Course Code: PC/FT/72-P **Course Credits: 1** **Type: Programme Core Courses** **Contact Hours per week: 2** **Mode: Lab Practical and assignments**	**Course Assessment Method: Max. Marks: 100 (Internal: 50; External: 50)** • The internal and external assessment is based on the level of participation in lab. Sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of lab, File and ethical practices followed. • The Internal Evaluation is conducted by the course coordinator. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department.

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	RBT Level
CO1	Estimate different physical and chemical characteristics in food waste.	**L2: Understand**
CO2	Examine food waste and its utilisation.	**L3: Apply**
CO3	Identify various methods employed for the treatment of industrial wastes.	**L4: Analyse**
CO4	Compare different waste produced in the industries.	**L5: Evaluate**
CO5	Propose methods of waste and disposal on environment.	**L6: Create**

***Revised Bloom's Taxonomy Action verbs/Levels**

List of experiments

Note: Perform at least seven experiments from the list.

- Demonstration of different sewage, water and effluent treatment plant in various industries.
- Determination of pH of different samples by pH meter.
- Determination of total solids in waste sample.
- Determination of total dissolved solids in waste water sample by Gravimetric Method.
- Determination of total suspended solids in waste water sample,
- Determination of fixed and volatile solids in waste water sample.
- Determination of total organic matter in a given waste water.
- Determination of BOD of waste water sample.
- Determination of COD of waste water sample.
- Determination of Total Organic Carbon of waste water sample.

Note:

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

CO-PO Articulation Matrix Waste Management and Effluent Treatment Lab (PC/FT/72-P)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	-	-	1	-	-	1	1	-	-	-	-	1	1	3	1
CO 2	-	-	1	-	-	1	1	-	-	-	-	-	1	2	2
CO 3	1	-	1	1	-	-	-	-	-	-	-	2	-	3	2
CO 4	1	2	-	1	-	2	1	-	-	-	-	-	-	3	2
CO 5	2	2	2	-	-	2	2	-	-	-	-	2	-	2	1
3-High 2-Medium 1-Low															

Minor Project

General Course Information

Course Code: EEC/FT/71-P **Course Credits: 4** **Type: Employability Enhancement Courses** **Contact Hours per week: 8** **Mode: Self learning under the guidance of faculty members**	**Course Assessment Method: Max. Marks: 100 (Internal evaluation: 50 marks; External Evaluation marks: 50)** The internal and external assessment is based on the level of participation in laboratory Sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the laboratory course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. The Course Coordinator/Internal Examiners/External Examiners will maintain and submit the marks obtained by the students in internal as well as external evaluations in the Performa to the respective departments in addition to submitting and uploading of overall marks on the university portal as per the requirement of the result branch.

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	**RBT Level**
CO1	Assessment of current research problems on the basis of literature review.	**L5: Evaluate**
CO2	Planning of research problems pertaining to food science and engineering.	**L6: Create**
CO3	Identify the relevant methodology and conduct the research effectively.	**L4: Analyse**
CO4	Organize the research findings and publish the report ethically.	**L6: Create**

CO5	Invent procedures, methodologies and possible solutions to cater to the needs of all the stakeholders.	**L6: Create**

***Revised Bloom's Taxonomy Action verbs/Levels**

About the Minor Project:

Students start working on their project work in seventh semester. Student do the background research for identifying appropriate problems, methodology and tools/ equipment to be used for their respective project works to be culminated in eighth semester. They prepare a synopsis of the project work to be carried out. At the end of seventh semester, each student is required to prepare a synopsis in the format provided and present it in front of Departmental Research Committee (DRC) committee constituted by the Chairperson of the Department. Students can carry out projects in groups. In case of group project, the size of the problem should be significant, and members of the group must specify their individual contribution.

CO-PO Articulation Matrix Minor Project EEC/FT/71-P)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	**1**	-	-	-	-	-	-	-	-	-	-	-	**1**	-	-
CO 2	**1**	**1**	**1**	**1**	-	-	-	-	-	-	-	-	-	**2**	**2**
CO 3	**1**	**3**	**2**	**2**	**1**	-	-	**1**	-	-	-	-	-	**3**	**2**
CO 4	-	**2**	-	**3**	**3**	-	-	**2**	**1**	-	-	-	-	-	**2**
CO 5	**1**	**2**	**2**	-	**1**	**1**	-	-	-	-	-	**1**	-	**1**	**1**
3-High 2-Medium 1-Low															

Industrial Training/ Internship-II

General Course Information

Course Code: EEC/FT/72-P **Course Credits: 1** **Type: Employability Enhancement Courses** **Contact Hours per week: 2** **Mode: Industrial Training/ Internship Evaluation**	**Course Assessment Method: Max. Marks: 100** **(Internal: 100):** An internal evaluation will be done by a faculty member appointed by the Chairperson/Head of the Department. The criteria for evaluation is given below: • Knowledge of problem domain (VIVA VOCE): 25 • Report writing: 25 • Judgment of the skill learned: 25 • Level of ethics followed: 25

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	RBT Level
CO1	Review the existing food processing set ups for their strengths and weaknesses.	**L4: Analyse**
CO2	Assess the food industry problems and their implications.	**L5: Evaluate**
CO3	Select and apply modern engineering and IT tools to design, and solve industrial problems.	**L3: Apply**
CO4	Evaluate the unit setup with respect to the manufacturing process, plant layout, and other infrastructure and suggest viable improvements.	**L5: Evaluate**
CO5	Organize the learned concepts and publish final report in an effective manner using technological tools.	**L6: Create**

***Revised Bloom's Taxonomy Action verbs/Levels**

About the Industrial Training/Internship:

Students do an Industrial Training/Internship of 6 to 8 weeks after sixth semester. They are expected to learn novel skills during the training period.

CO-PO Articulation Matrix Industrial Training/ Internship-II (EEC/FT/72-P)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	**1**	-	-	-	-	-	-	-	-	-	-	-	-	**3**	**2**
CO 2	**1**	**2**	**2**	**1**	-	-	-	-	-	-	-	-	**1**	-	**2**
CO 3	-	**2**	**2**	**2**	**3**	-	-	-	-	-	-	-	-	**1**	**3**
CO 4	**1**	**2**	**2**	**3**	**2**	**1**	**1**	-	-	-	-	**1**	-	-	**3**
CO 5	-	**2**	-	**1**	**1**	-	-	**1**	-	**3**	**1**	-	-	-	**2**
3-High 2-Medium 1-Low															

Food Plant Design and Layout

General Course Information

Course Code: PE/FT/71-T **Course Credits: 3** **Type: Programme Elective Courses** **Contact Hours per week: 3** **Mode: Lectures (L)** **Examination Duration: 3 hours**	**Course Assessment Method: Max. Marks: 100** **Internal Evaluation (30 marks):** • Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks). • Assignments, quiz etc. will have weightage of 06 marks. **End semester examination (70 marks):** • Nine questions are to be set by the examiner. A candidate is required to attempt 05 questions in all, question number one is compulsory and remaining four questions by selecting one question from each of the four units. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions of 2 marks each. • Question numbers 2 to 9 are to be set by selecting 2 questions from each unit.

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	RBT Level
CO1	Describe all requirements related to food plant design, its documentation maintenance and improvement.	**L1: Remember**
CO2	Sketch the most suited location for plant setup.	**L2: Understand**
CO3	Prepare an efficient and economic system for plant design.	**L3: Apply**
CO4	Assess the plant thoroughly with respect to product quality, documentation, hygiene and cost.	**L4: Analyse**
CO5	Propose an effective plant layout design for food processing as per requirement of the stakeholders and industry.	**L6: Create**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

Food Plant design: Importance and economics of plant design, Legal and commercial aspects of plant design, General consideration, specification, Food plant design process, Feasibility study and analysis, Preliminary studies of food products and raw materials, Location and site selection for food plants, Factors involved in plant location decision.

UNIT-II

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

UNIT-III

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

UNIT-IV

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

Recommended Readings:

1. Food Plant Design, by Antonio Lopez-Geomez and Gustavo V. Barbosa-Canovas, CRC press, Taylor & Francis, New York

2. Food Plant Economics, by Zacharias B. Maroulis and George D. Saravacos, CRC press, Taylor & Francis, New York

3. Plant Design and Economics for Chemical Engineers by Peter, M.S. and Timmerhaus, K.D. McGraw Hill

CO-PO Articulation Matrix Food Plant Design and Layout Course (PE/FT/71-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	1	-	-	-	-	-	-	-	-	-	-	-	3	1	-
CO 2	2	2	3	-	-	-	-	-	-	-	-	-	3	3	-
CO 3	3	3	3	-	-	-	-	-	-	-	-	-	3	2	-
CO 4	3	3	3	3	-	-	-	-	-	-	-	-	3	3	-
CO 5	3	3	3	3	-	2	-	1	-	-	-	-	3	3	3
3-High 2-Medium 1-Low															

Introduction to Agri-Business Management

General Course Information

Course Code: PE/FT/72-T **Course Credits: 3** **Type: Programme Elective Courses** **Contact Hours per week: 3** **Mode: Lectures (L)** **Examination Duration: 3 hours**	**Course Assessment Method: Max. Marks: 100** **Internal Evaluation (30 marks):** • Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks). • Assignments, quiz etc. will have weightage of 06 marks. **End semester examination (70 marks):** • Nine questions are to be set by the examiner. A candidate is required to attempt 05 questions in all, question number one is compulsory and remaining four questions by selecting one question from each of the four units. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions of 2 marks each. • Question numbers 2 to 9 are to be set by selecting 2 questions from each unit.

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	RBT Level
CO1	Describe basic concept about WTA and Agri-business management.	**L1: Remember**
CO2	Explain all policies and responsibilities related to agribusiness with food business management.	**L2: Understand**
CO3	Generalize different approaches for entrepreneurship and market research.	**L3: Apply**
CO4	Evaluate risks associated with market, product and consumer behavior.	**L4: Analyse**
CO5	Plan to set up start up and food business.	**L6: Create**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

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

UNIT-II

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

UNIT-III

Marketing management: Role of management in agri-business, attributes and responsibility of manager. Marketing of agricultural produce. Market research for agri-business. Different types of

management in agri-business: production, retail and supply chain and inventory management (introduction, need, attributes and function).

UNIT-IV

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

Recommended readings:

1. Kottler (1994). Marketing Management: Prentice Hall of India, New Delhi.

2. Baker, G. A., Grunewald, O. & Gorman, W. D. (2002). Introduction to food and agribusiness management: Prentice Hall of India, New Delhi.

3. Khanks, S. S. (1999). Entrepreneurial Development: Chand and company, New Delhi.

4. Jakobsen, G. &Torp, J. E. (2001). Understanding business systems in developing countries.

5. Ahmad, S. M. (2000). Management Info Guide.

CO-PO Articulation Matrix Introduction to Agri-Business Management Course (PE/FT/72-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	1	-	-	-	-	-	-	1	1	-	-	-	2	-	-
CO 2	2	1	-	-	-	-	-	-	-	-	1	-	2	-	1
CO 3	3	2	-	1	-	-	-	-	-	-	2	-	3	-	2
CO 4	-	-	-	-	-	-	-	2	2	-	3	-	3	-	3
CO 5	-	-	3	-	-	2	-	-	3	3	-	-	3	-	3
3-High 2-Medium 1-Low															

Food Flavours and Colours

General Course Information

Course Code: PE/FT/73-T **Course Credits: 3** **Type: Programme Elective Courses** **Contact Hours per week: 3** **Mode: Lectures (L)** **Examination Duration: 3 hours**	**Course Assessment Method: Max. Marks: 100** **Internal Evaluation (30 marks):** • Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks). • Assignments, quiz etc. will have weightage of 06 marks. **End semester examination (70 marks):** • Nine questions are to be set by the examiner. A candidate is required to attempt 05 questions in all, question number one is compulsory and remaining four questions by selecting one question from each of the four units. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions of 2 marks each. • Question numbers 2 to 9 are to be set by selecting 2 questions from each unit.

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	RBT Level
CO1	Recognize various terms related to food flavours, colours and their classification.	**L1: Remember**
CO2	Explain different methods of extraction and production of food flavours and colours.	**L2: Understand**
CO3	Use of flavoring components and pigments in processed foods.	**L3: Apply**
CO4	Identify various physicochemical properties of food colours and flavours along with their limitations.	**L4: Analyse**
CO5	Assess the quality parameters of certified flavors, dyes, lakes and their uses in food industries.	**L6: Create**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

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

UNIT-II

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

UNIT-III

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

UNIT-IV

Certified colours: Colorants subject to certification, certified F, D and C colorants, Primary certified food colours, blending of colours, lakes and dyes, properties and uses of certified dyes and their regulatory aspects.

Microbial colours: Methods of production, advantages and disadvantages, maximum permissible limits of food colours, standards for use in processed foods.

Recommended Readings:

1. Fennema O. R. (1996) Food Chemistry 3rd edition, Marcel Dekker Inc.

2. Fisher C. & Scott T. R. (1997) Food flavours- Biology and Chemistry, The Royal Society of Chemistry.

3. Branen A. L., Davidson P. M. &Salminen S. (1980) Food Additives 2nd edition, Marcel Dekker Inc.

4. A.O.A.C. (1997) Official methods of analysis. 16th edition, Vol. II. AOAC International Publication.

CO-PO Articulation Matrix Food Flavours and Colours Course (PE/FT/73-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	1	-	-	-	-	1	1	-	-	-	-	-	2	2	1
CO 2	-	-	1	1	-	-	1	-	-	1	-	-	2	2	2
CO 3	1	1	1	-	2	-	1	-	-	-	-	-	2	3	2
CO 4	-	-	-	1	1	-	-	-	-	-	-	-	-	2	2
CO 5	-	-	2	1	1	2	-	-	-	-	-	-	-	2	2
3-High 2-Medium 1-Low															

Technology of Frozen Foods

General Course Information

Course Code: PE/FT/74-T **Course Credits: 3** **Type: Programme Elective Courses** **Contact Hours per week: 3** **Mode: Lectures (L)** **Examination Duration: 3 hours**	**Course Assessment Method: Max. Marks: 100** **Internal Evaluation (30 marks):** • Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks). • Assignments, quiz etc. will have weightage of 06 marks. **End semester examination (70 marks):** • Nine questions are to be set by the examiner. A candidate is required to attempt 05 questions in all, question number one is compulsory and remaining four questions by selecting one question from each of the four units. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions of 2 marks each. • Question numbers 2 to 9 are to be set by selecting 2 questions from each unit.

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	RBT Level
CO1	Recognize the freezing mechanism of foods and types of freezing methods.	**L1: Remember**
CO2	Interpret properties of frozen food and calculation of freezing time.	**L2: Understand**
CO3	Examine sensory and shelf-life characteristics of frozen foods.	**L3: Apply**
CO4	Identify various packaging materials and machine for manufacturing of frozen products	**L4: Analyse**
CO5	Generate ideas regarding improved technologies for development of valueadded frozen foods and management of suitable cold chain facilities in India.	**L6: Create**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

Introduction: Current status of frozen food industry in India.

Freezing process: Mechanism of freezing, freezing curve, factors affecting freezing rate, glass transition temperature, thermo-physical properties of frozen foods, freezing load, freezing time calculations.

UNIT-II

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

UNIT-III

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

UNIT-IV

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

Recommended Readings:

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

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

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

CO-PO Articulation Matrix Technology of Frozen Foods Course (PE/FT/74-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	1	1	-	-	-	1	-	-	-	-	-	-	2	2	1
CO 2	1	1	1	-	-	-	-	-	-	-	1	-	2	1	1
CO 3	1	1	-	-	-	-	1	1	-	-	-	-	2	1	2
CO 4	1	1	1	-	1	1	-	-	1	-	-	-	2	2	3
CO 5	1	1	2	-	1	1	1	-	1	-	-	-	1	2	2
3-High 2-Medium 1-Low															

Meat, Fish and Poultry Processing

General Course Information

Course Code: PE/FT/75-T **Course Credits: 3** **Type: Programme Elective Courses** **Contact Hours per week: 3** **Mode: Lectures (L)** **Examination Duration: 3 hours**	**Course Assessment Method: Max. Marks: 100** **Internal Evaluation (30 marks):** • Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks). • Assignments, quiz etc. will have weightage of 06 marks. **End semester examination (70 marks):** • Nine questions are to be set by the examiner. A candidate is required to attempt 05 questions in all, question number one is compulsory and remaining four questions by selecting one question from each of the four units. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions of 2 marks each. • Question numbers 2 to 9 are to be set by selecting 2 questions from each unit.

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	RBT Level
CO1	Describe the composition, structure and properties of meat.	**L1: Remember**
CO2	Explain various preservation techniques of meat, poultry and fish.	**L2: Understand**
CO3	Examine the safety and quality aspects of meat, fish and poultry products.	**L3: Apply**
CO4	Infer the need for utilization of by-products of the meat, fish and poultry industry.	**L4: Analyse**
CO5	Prescribe suitable processing conditions and quality assessment for foods of animal origin.	**L6: Create**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

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

UNIT-II

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

UNIT-III

Poultry products: Types, chemical composition and nutritive value of poultry meat.

Egg: Structure, composition and nutritive value, storage, grading of eggs and preservation, Quality evaluation of eggs, Egg products: egg powder, liquid egg products, value added egg products. Packaging of egg and egg products.

UNIT-IV

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

Recommended Readings:

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

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

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

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

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

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

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

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

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

CO-PO Articulation Matrix Meat, Fish and Poultry Processing Course (PE/FT/75-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	-	-	1	-	-	-	-	-	-	-	-	-	2	-	2
CO 2	1	2	3	1	-	-	-	-	-	-	-	-	2	3	1
CO 3	1	-	2	-	-	3	-	-	-	-	-	-	2	2	3
CO 4	1	2	2	-	-	1	1	-	-	-	-	-	-	3	2
CO 5	1	2	2	2	1	1	-	-	-	-	-	-	1	1	2
3-High 2-Medium 1-Low															

Food Product Development and Sensory Evaluation

General Course Information

Course Code: PE/FT/76-T **Course Credits: 3** **Type: Programme Elective Courses** **Contact Hours per week: 3** **Mode: Lectures (L)** **Examination Duration: 3 hours**	**Course Assessment Method: Max. Marks: 100** **Internal Evaluation (30 marks):** • Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks). • Assignments, quiz etc. will have weightage of 06 marks. **End semester examination (70 marks):** • Nine questions are to be set by the examiner. A candidate is required to attempt 05 questions in all, question number one is compulsory and remaining four questions by selecting one question from each of the four units. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions of 2 marks each. • Question numbers 2 to 9 are to be set by selecting 2 questions from each unit.

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	RBT Level
CO1	Outline different aspect related to NPD.	**L1: Remember**
CO2	Discuss market need for new food product.	**L2: Understand**
CO3	Use different sensory methods and their applications in NPD.	**L3: Apply**
CO4	Assess the viability and market acceptability of developed product.	**L4: Analyse**
CO5	Develop the new food product as per market, consumer and legal aspects.	**L6: Create**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

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

UNIT-II

Market and market place influence on new product development, Market Survey, Consumer survey to identify new products in terms of Line Extension Repositioning Existing Products New form/Reformulation. New packaging of existing products, Innovative products, Creative Products. Tapping traditional foods and unconventional sources of foods.

UNIT-III

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

UNIT-IV

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

Recommended Readings:

1. Earle R, Earle R & Anderson A. 2001. Food Product Development. Woodhead Publ.

2. Lyon, D.H.; Francombe, M.A.; Hasdell, T.A.; Lawson, K. (eds), Guidelines for Sensory Analysis in Food Product Development and Quality Control, Chapman and Hall, London.

3. Amerine, M.A.; Pangborn, R.M.; Roessler, E.B., Principles of Sensory Evaluation, Academic Press, NY

4. Kapsalis, J.G, Objective Methods in Food Quality Assessment, CRC Press, Florida.

5. Martens, M.; Dalen, G.A.; Russwurm, H. (eds), Flavour Science and Technology, John Wiley and Sons, Chichester.

6. Moskowitz, H.R. (eds), Food Texture: Instrumental and Sensory Measurement, Marcel Dekker Inc., New York.

7. Earle R, Earle R & Anderson A. 2001. Food Product Development. Woodhead Publ.

8. Fuller 2004. New Food Product Development - from Concept to Market Place. CRC.

9. Moskowitz, Howard R. 2009. An Integrated Approach to New Food Product Development. CRC Press.

CO-PO Articulation Matrix Food Product Development and Sensory Evaluation Course (PE/FT/76-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	1	-	-	--	---	-	--	-	-	-	-	-	1	-	1
CO 2	-	2	2	-	-	-	-	-	-	-	-	-	2	1	3
CO 3	3	2	2	2	-	-	-	-	-	-	-	-	3	3	1
CO 4	3	3	3	2	-	-	-	-	-	-	-	-	2	-	3
CO 5	3	3	3	3	-	-	-	-	-	-	-	-	3	-	3
3-High 2-Medium 1-Low															

Detailed syllabus of
B. Tech. (Food Technology)
8th Semester

B. Tech. 4th Year Semester-VIII

Sr. No.	Course Code	Course Title	Work Load/Credit			
			Theory	Tutorial	Practical	Total
1	PC/FT/81-T	Food Packaging	3/3	0	0	3/3
2	PC/FT/81-P	Food Packaging Lab	0	0	2/1	2/1
3	PC/FT/82-T	Food Storage Engineering	3/3	0	0	3/3
4	PE/FT/81-T to PE/FT/83-T	Programme Elective course V to be opted by the students	3/3	0	0	3/3
5	PE/FT/84-T to PE/FT/86-T	Programme Elective course VI to be opted by the students	3/3	0	0	3/3
6	EEC/FT/81-P	Major Project	0	0	12/6	12/6
					Total	**26/19**

Note: Students will be allowed to use non-programmable scientific calculator only, however sharing of calculator will not be permitted.

Programme Elective-V

Course Code	Course Name	L	T	P	Credits
PE/FT/81-T	Baking and Confectionary Technology	3	-	-	3.0
PE/FT/82-T	Technology of Fats and Oils	3	-	-	3.0
PE/FT/83-T	Snack Food Technology	3	-	-	3.0

Programme Elective-VI

Course Code	Course Name	L	T	P	Credits
PE/FT/84-T	Introduction to Food Additives	3	-	-	3.0
PE/FT/85-T	Technology of Traditional Foods	3	-	-	3.0
PE/FT/86-T	Functional Foods and Nutraceuticals	3	-	-	3.0

Food Packaging

General Course Information

Course Code: PC/FT/81-T **Course Credits: 3** **Type: Programme Core Courses** **Contact Hours per week: 3** **Mode: Lectures (L)** **Examination Duration: 3 hours**	**Course Assessment Method: Max. Marks: 100** **Internal Evaluation (30 marks):** • Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks). • Assignments, quiz etc. will have weightage of 06 marks. **End semester examination (70 marks):** • Nine questions are to be set by the examiner. A candidate is required to attempt 05 questions in all, question number one is compulsory and remaining four questions by selecting one question from each of the four units. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions of 2 marks each. • Question numbers 2 to 9 are to be set by selecting 2 questions from each unit.

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	RBT Level
CO1	Describe packaging terminologies, its type and functions.	**L1: Remember**
CO2	Explain the manufacturing of packaging materials based on paper, glass, metal and plastic.	**L2: Understand**
CO3	Classify the traditional and modern types of food packaging.	**L3: Apply**
CO4	Identify suitable packaging materials for given food items	**L4: Analyse**
CO5	Assessment of different packaging materials for different foods	**L6: Create**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

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

UNIT-II

Different type of packaging materials: Advantages and disadvantages. Paper and paper-based packaging materials: types and properties. Metal packaging materials: manufacture of tin plate, electrolytic chromium coated steel (ECCS), aluminium and container making process. Corrosion and corrosiveness of foods and lacquers; Glass packaging materials: composition, properties, manufacture and closures; Plastic polymer as packaging materials: processing, classification and properties of polymers. Additives in plastics.

UNIT –III

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

UNIT –IV

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

Recommended Readings:

1. Robertson G. L., (2006) Food Packaging: Principles and Practice.
2. 2nd edition, Taylor and Francis Group. 2. Mattsson B., and Sonesson U., (2000) Environmentally-friendly food processing Woodhead Publishing Ltd.
3. Ahvenainen R., (2003) Novel food packaging techniques. Woodhead Publishing Ltd.

CO-PO Articulation Matrix Food Packaging Course (PC/FT/81-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	-	-	-	-	2	-	-	-	-	-	-	-	2	3
CO 2	2	1	2	-	-	-	-	-	-	-	-	-	2	2	-
CO 3	-	1	-	-	-	-	-	-	-	-	-	-	-	3	-
CO 4	-	1	2	-	-	-	2	1	-	-	-	-	1	3	2
CO 5	-	-	2	-	-	-	2	2	-	-	-	-	-	2	2
3-High 2-Medium 1-Low															

Food Packaging Lab

General Information

Course Code: PC/FT/81-P **Course Credits: 1** **Type: Programme Core Courses** **Contact Hours per week: 2** **Mode: Lab Practical and assignments**	**Course Assessment Method: Max. Marks: 100 (Internal: 50; External: 50)** • The internal and external assessment is based on the level of participation in lab. Sessions and the timely submission of lab experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of lab, File and ethical practices followed. • The Internal Evaluation is conducted by the course coordinator. The external examination is conducted by external examiner appointed by the Controller of Examination in association with the internal examiner appointed by the Chairperson of the Department.

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	RBT Level
CO1	Describe various analytical procedure related to the food packaging.	**L1: Remember**
CO2	Classify different types of packaging materials.	**L2: Understand**
CO3	Choose the best packaging material as per the product requirement in consideration with environmental concerns.	**L3: Apply**
CO4	Evaluate shelf life of packaged foods.	**L4: Analyse**
CO5	Examine the role and effectiveness of various packaging systems with respect to specific foods.	**L6: Create**

***Revised Bloom's Taxonomy Action verbs/Levels**

List of experiments

Note: Perform at least seven experiments from the list.

- Testing of properties of different packaging materials (paper, plastic, glass and metal).
- Study of symbols and labels used on food packages.
- Identification of various types of plastic packaging material, vacuum packaging, form-fill-seal packaging.
- Determination of changes in packed foods, food packaging under different packaging conditions, preparation and applications of edible packaging,
- Comparative evaluation of different packages for some specific foods like spongy, crispy texture foods etc.
- Shelf life studies of foods under different packaging and environmental conditions.
- To determine the bursting strength of a carton board.

Note:

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

CO-PO Articulation Matrix Food Packaging Lab (PC/FT/81-P)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	-	3	-	-	1	-	-	-	-	-	-	2	3	-	3
CO 2	-	2	-	1	-	-	-	-	-	-	-	2	2	1	2
CO 3	-	1	-	2	1	-	-	-	-	-	1	2	2	-	2
CO 4	-	-	-	-	2	-	-	-	2	-	-	-	-	-	2
CO 5	-	-	-	-	-	-	-	-	2	2	-	-	3	-	2
3-High 2-Medium 1-Low															

Food Storage Engineering

General Course Information

Course Code: PE/FT/82-T **Course Credits: 3** **Type: Programme Core Courses** **Contact Hours per week: 3** **Mode: Lectures (L)** **Examination Duration: 3 hours**	**Course Assessment Method: Max. Marks: 100** **Internal Evaluation (30 marks):** • Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks). • Assignments, quiz etc. will have weightage of 06 marks. **End semester examination (70 marks):** • Nine questions are to be set by the examiner. A candidate is required to attempt 05 questions in all, question number one is compulsory and remaining four questions by selecting one question from each of the four units. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions of 2 marks each. • Question numbers 2 to 9 are to be set by selecting 2 questions from each unit.

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	RBT Level
CO1	Describe the engineering properties of biological materials and their importance in design of handling and storage equipments.	**L1: Understand**
CO2	Discuss the storage environment and its interaction with stored products.	**L2: Understand**
CO3	Describe the design of various handling equipments and storage structures like silos and bins.	**L3: Understand**
CO4	Execute the theories associated with storage structures of perishable & non-perishable food	**L5: Apply**
CO5	Interpret the management practices followed for storage structures and godowns.	**L6: Apply**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

Introduction: Purpose and justification of storage of perishable and nonperishable foods, factors influencing shelf life of food materials, Brief account of engineering properties of biological materials important in design of handling and storage equipments.

UNIT-II

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.

UNIT –III

Mechanical Handling equipments: Design of handling equipments like bucket elevators, belt, screw and pneumatic conveyors, and fans**.**

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.

UNIT –IV

Storage structures for perishables: Design aspects of ventilated, cold, modified and controlled atmosphere storage systems.

Management practices: Labeling, record keeping and management of godowns, silos and cold storages; maintenance of buildings and equipments; sanitary conditions in storages.

Recommended Readings:

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. Sahay & Singh (2004). Unit Operation in Agricultural Processing, Vikas Publishing House Private, Limited.

CO-PO Articulation Matrix Food Storage Engineering Course (PC/FT/82-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	1	1	3	3	1	1	-	1	2	1	3	1	2
CO 2	3	1	3	2	1	1	3	1	3	2	1	2	1	2	1
CO 3	3	3	1	3	3	1	2	-	1	2	1	1	1	3	3
CO 4	3	3	2	1	1	3	1	1	-	-	2	2	3	3	2
CO 5	3	3	3	3	3	3	1	1	1	2	2	1	3	2	2
3-High 2-Medium 1-Low															

Baking and Confectionary Technology

General Course Information

Course Code: PE/FT/81-T **Course Credits: 3** **Type: Programme Elective Courses** **Contact Hours per week: 3** **Mode: Lectures (L)** **Examination Duration: 3 hours**	**Course Assessment Method: Max. Marks: 100** **Internal Evaluation (30 marks):** • Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks). • Assignments, quiz etc. will have weightage of 06 marks. **End semester examination (70 marks):** • Nine questions are to be set by the examiner. A candidate is required to attempt 05 questions in all, question number one is compulsory and remaining four questions by selecting one question from each of the four units. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions of 2 marks each. • Question numbers 2 to 9 are to be set by selecting 2 questions from each unit.

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	RBT Level
CO1	Describe various raw materials used for preparation of bakery and confectionary products.	**L1: Remember**
CO2	Demonstrate unit operations and working of equipment's involved in bakery and confectionary.	**L2: Understand**
CO3	Examine functionalities of different ingredients used in bakery and confectionary industry.	**L3: Apply**
CO4	Assess different processes used in product preparation and product quality.	**L5: Evaluate**
CO5	Develop new bakery and confectionary products.	**L6: Create**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

Introduction: Status of bakery and confectionery industries in India.

Raw materials for bakery and confectionery products: Essential and optional ingredients; Functionality of bakery ingredients; Rheological characteristics of flour, FSSAI specification of raw materials;

Bakery equipment: Mixer, divider, sheeter, rounder, proofer, moulder, oven, slicer.

UNIT-II

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

UNIT-III

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

UNIT-IV

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

Recommended Readings:

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

CO-PO Articulation Matrix Baking and Confectionary Technology Course (PE/FT/81-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	1	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO 2	1	-	-	-	-	-	-	-	-	-	-	-	2	3	-
CO 3	1	2	-	1	-	-	-	-	-	-	-	-	3	-	-
CO 4	3	2	2	-	-	-	-	-	-	-	-	-	3	2	-
CO 5	3	3	3	3	-	-	-	-	-	-	-	-	2	2	3
3-High 2-Medium 1-Low															

Technology of Fats and Oils

General Course Information

Course Code: PE/FT/82-T **Course Credits: 3** **Type: Programme Elective Courses** **Contact Hours per week: 3** **Mode: Lectures (L)** **Examination Duration: 3 hours**	**Course Assessment Method: Max. Marks: 100** **Internal Evaluation (30 marks):** • Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks). • Assignments, quiz etc. will have weightage of 06 marks. **End semester examination (70 marks):** • Nine questions are to be set by the examiner. A candidate is required to attempt 05 questions in all, question number one is compulsory and remaining four questions by selecting one question from each of the four units. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions of 2 marks each. • Question numbers 2 to 9 are to be set by selecting 2 questions from each unit.

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	RBT Level
CO1	Describe sources, types and physicochemical properties of fats and oils.	**L1: Remember**
CO2	Explain method for production and of various fat and oil products.	**L2: Understand**
CO3	Judge the effect of processing and other environmental conditions on the quality of fats and oils.	**L3: Apply**
CO4	Distinguish between various fats and oils on the basis of their origin and use.	**L4: Analyse**
CO5	Assess various quality parameters in controlling the quality of fats and oils.	**L5: Evaluate**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

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

UNIT-II

Storage of oilseeds, extraction of oils: Cold pressing and hot pressing, solvent extraction, rendering, removal and recovery of solvent form miscella, removal and recovery of solvent from extracted residue.

Refining of oil: neutralization, degumming, bleaching, alkali refining, deodorization, winterization of oil, hardening of oil, filtration of hardened oil; Production of palm oil –rice bran

oil, soybean oil, modifications of the properties of oils and fats including chemical and biotechnological processes, toxicity of frying oil, detection of adulteration.

UNIT-III

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

UNIT-IV

Preparation of various products: Salad dressing and mayonnaise, imitation dairy products, low calorie spreads.

By-products of fat/oil processing industries: Oil seed protein isolates; quality standards of edible oils and fats; vegetable oils as biodiesel.

Recommended Readings:

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

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

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

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

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

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

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

CO-PO Articulation Matrix Technology of Fats and Oils Course (PE/FT/82-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	-	-	2	1	-	-	-	-	-	-	-	--	1	-	1
CO 2	-	-	-	1	-	-	-	-	-	-	-	-	1	1	3
CO 3	-	-	1	-	-	-	-	-	-	-	-	-	1	1	2
CO 4	-	-	-	1	-	-	-	-	-	-	-	-	1	1	1
CO 5	-	1	1	-	1	-	-	-	-	-	-	-	1	1	2
3-High 2-Medium 1-Low															

Snack Food Technology

General Course Information

Course Code: PE/FT/83-T **Course Credits: 3** **Type: Programme Elective Courses** **Contact Hours per week: 3** **Mode: Lectures (L)** **Examination Duration: 3 hours**	**Course Assessment Method: Max. Marks: 100** **Internal Evaluation (30 marks):** • Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks). • Assignments, quiz etc. will have weightage of 06 marks. **End semester examination (70 marks):** • Nine questions are to be set by the examiner. A candidate is required to attempt 05 questions in all, question number one is compulsory and remaining four questions by selecting one question from each of the four units. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions of 2 marks each. • Question numbers 2 to 9 are to be set by selecting 2 questions from each unit.

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	**RBT Level**
CO1	Recognize the concept and importance of snack foods.	**L1: Remember**
CO2	Distinguish technological aspects of traditional and modern snack foods.	**L2: Understand**
CO3	Examine various equipments used for value addition in snack food areas.	**L3: Apply**
CO4	Assess the changes due to various factors in snack food processing.	**L5: Evaluate**
CO5	Design economical, nutritionally adequate and organoleptically acceptable snack foods.	**L6: Create**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

Snack foods: Definition, classification, importance and need. Concept of junk and fried foods and their impact on human health.

Technology for grain-based snacks: Breakfast cereals; Introduction and classification (flaked cereals, oven puffed cereals, gun puffed cereals, shredded products). Breakfast cereal-manufacturing processes (traditional and modern methods), High shear cooking process and steam cookers. Whole grains snack technology roasted, toasted, puffed, popped, flaked.

UNIT-II

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

UNIT-III

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

UNIT-IV

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

Recommended Readings:

1. Booth, R. G. (1997). Snack Food: CBS, New Delhi.

2. Raymond, W. L. & Rooney, L. W. (2001). Snack Foods Processing: CRC. London.

3. Lusas, E. W. & Rooney, L. W. (2015). Snack Foods Processing: CRC. London.

4. Guy, R. (2001). Extrusion Cooking: Technologies and Applications: Woodhead, USA.

5. Riaz, M. N. (2000). Extruders in Food Applications: Technomic, Lanchester.

CO-PO Articulation Matrix Snack Food Technology Course (PE/FT/83-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	1	-	1	1	-	1	-	-	-	-	-	-	2	1	1
CO 2	2	-	2	1	-	1	-	-	-	-	-	1	1	2	3
CO 3	2	-	2	1	2	1	-	-	-	-	-	-	3	3	1
CO 4	-	2	2	1	-	1	-	-	-	-	-	-	3	1	2
CO 5	1	1	3	3	2	3	-	-	-	-	-	-	2	1	3
3-High 2-Medium 1-Low															

Introduction to Food Additives

General Course Information

Course Code: PE/FT/84-T **Course Credits: 3** **Type: Programme Elective Courses** **Contact Hours per week: 3** **Mode: Lectures (L)** **Examination Duration: 3 hours**	**Course Assessment Method: Max. Marks: 100** **Internal Evaluation (30 marks):** • Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks). • Assignments, quiz etc. will have weightage of 06 marks. **End semester examination (70 marks):** • Nine questions are to be set by the examiner. A candidate is required to attempt 05 questions in all, question number one is compulsory and remaining four questions by selecting one question from each of the four units. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions of 2 marks each. • Question numbers 2 to 9 are to be set by selecting 2 questions from each unit.

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	RBT Level
CO1	Describe chemistry and functionality of different food additives	**L1: Remember**
CO2	Illustrate significance of food additives in food processing industries.	**L2: Understand**
CO3	Examine uses of additives as per product specifications.	**L3: Apply**
CO4	Assess impact of various food additives on shelf life of food products and human health.	**L5: Evaluate**
CO5	Prescribe food additives doses as per National and International standards.	**L6: Create**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT – I

Food Additives: Definitions, classification and applications, food preservatives- classification, antimicrobial agents, types and their action, regulatory issues in India, international legal issues; Antioxidants (synthetic and natural, mechanism of oxidation inhibition), anti-browning agent (types and mode of action, application).

Chelating agents: Types, uses and mode of action.

Coloring agents: Applications and natural colorants, sources of natural color, color extraction techniques, color stabilization.

UNIT – II

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

UNIT – III

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

UNIT – IV

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

Recommended Readings:

1. Branen A. L., Davidson P. M., and Salminen S. (2001) Food Additives. 2nd Ed. Marcel Dekker.

2. Gerorge A. B., (1996) Encyclopedia of Food and Color Additives. Vol. III. CRC Press.

3. Gerorge A. B., (2004) Fenaroli's Handbook of Flavor Ingredients5th Ed. CRC Press.

4. Morton I. D., and Macleod A. J., (1990) Food Flavours. Part A, B & C. Elsevier.

5. Stephen A. M., (2006) Food Polysaccharides and Their Applications. Marcel Dekker.

CO-PO Articulation Matrix Introduction to Food Additives Course (PE/FT/84-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	1	-	-	-	-	-	-	--	-	-	--	-	3	3	2
CO 2	1	-	-	-	-	-	-	-	-	-	-	-	1	3	3
CO 3	-	1	2	2	-	-	-	2	-	-	-	-	2	2	2
CO 4	-	-	3	1	-	2	-	2	-	-	-	-	1	2	3
CO 5	-	2	2	2	-	2	2	2	-	-	-	-	2	3	3
3-High 2-Medium 1-Low															

Technology of Traditional Foods

General Course Information

Course Code: PE/FT/85-T **Course Credits: 3** **Type: Programme Elective Courses** **Contact Hours per week: 3** **Mode: Lectures (L)** **Examination Duration: 3 hours**	**Course Assessment Method: Max. Marks: 100** **Internal Evaluation (30 marks):** • Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks). • Assignments, quiz etc. will have weightage of 06 marks. **End semester examination (70 marks):** • Nine questions are to be set by the examiner. A candidate is required to attempt 05 questions in all, question number one is compulsory and remaining four questions by selecting one question from each of the four units. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions of 2 marks each. • Question numbers 2 to 9 are to be set by selecting 2 questions from each unit.

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	RBT Level
CO1	Outline the basic concepts of different traditional foods.	**L1: Remember**
CO2	Explain the processing technologies used to manufacture different categories of traditional foods.	**L2: Understand**
CO3	Apply various methods of food processing while retaining the traditional essence.	**L3: Apply**
CO4	Distinguish the needs of modern society to make safe and healthy ready-to-use traditional Indian formulations.	**L4: Analyse**
CO5	Judge the knowledge of bioactive components of traditional foods for specific health needs.	**L6: Create**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

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

UNIT-II

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

UNIT-III

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

UNIT-IV

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

Recommended Readings:

1. Sen, Colleen Taylor “Food Culture in India” Greenwood Press, 2005.

2. Davidar, Ruth N. “Indian Food Science: A Health and Nutrition Guide to Traditional Recipes: East-West Books, 2001.

CO-PO Articulation Matrix Technology of Traditional Foods Course (PE/FT/85-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	1	-	1	-	1	1	-	--	-	-	-	-	2	2	-
CO 2	1	-	1	-	-	-	--	-	-	-	-	-	-	2	1
CO 3	2	2	2	-	-	1	-	-	-	-	-	-	1	2	3
CO 4	-	1	3	-	-	3	-	-	-	-	-	-	1	2	3
CO 5	-	-	2	--	2	3	-	-	-	--	-	1	-	1	3
3-High 2-Medium 1-Low															

Functional Foods and Nutraceuticals

General Course Information

Course Code: PE/FT/86-T **Course Credits: 3** **Type: Programme Elective Courses** **Contact Hours per week: 3** **Mode: Lectures (L)** **Examination Duration: 3 hours**	**Course Assessment Method: Max. Marks: 100** **Internal Evaluation (30 marks):** • Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks). • Assignments, quiz etc. will have weightage of 06 marks. **End semester examination (70 marks):** • Nine questions are to be set by the examiner. A candidate is required to attempt 05 questions in all, question number one is compulsory and remaining four questions by selecting one question from each of the four units. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions of 2 marks each. • Question numbers 2 to 9 are to be set by selecting 2 questions from each unit.

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	RBT Level
CO1	Outline the concepts of nutraceuticals and functional foods.	**L1: Remember**
CO2	Illustrate the health applications of functional foods from different sources.	**L2: Understand**
CO3	Examine the stability of various functional components under different processing conditions.	**L3: Apply**
CO4	Identify the potential and efficacy of different nutraceuticals in health management.	**L4: Analyse**
CO5	Formulate a functional food specific to particular health condition.	**L6: Create**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

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

UNIT-II

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

UNIT-III

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

UNIT-IV

Nutritional significance: Role of nutraceutical/ functional foods in cardiovascular health, diabetes, obesity, immunity, neuromuscular, joints and bone related disorders, stress.

Recommended readings:

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

CO-PO Articulation Matrix Functional Foods and Nutraceuticals Course (PE/FT/86-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	-	-	-	-	-	--	-	-	-	-	-	-	2	-	1
CO 2	1	2	1	2	-	-	--	-	-	-	-	-	2	-	1
CO 3	1	1	1	-	1	-	--	-	-	-	-	-	2	2	2
CO 4	1	2	2	1	2	-	-	-	-	-	-	-	-	2	2
CO 5	2	2	-	3	2	-	-	1	-	-	-	-	2	-	3
3-High 2-Medium 1-Low															

Major Project

General Information

Course Code: EEC/FT/81-P **Course Credits: 6** **Type: Employability Enhancement Courses** **Contact Hours per week: 12** **Mode: Self learning under the guidance of faculty members**	**Course Assessment Method: Max. Marks: 100** **(Internal evaluation: 50 marks; External Evaluation marks: 50)** The internal and external assessment is based on the level of participation in laboratory Sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the laboratory course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. The Course Coordinator/Internal Examiners/External Examiners will maintain and submit the marks obtained by the students in internal as well as external evaluations in the Performa to the respective departments in addition to submitting and uploading of overall marks on the university portal as per the requirement of the result branch.

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	**RBT Level**
CO1	Assessment of current research problems on the basis of literature review	**L5: Evaluate**
CO2	Planning of research problems pertaining to food science and engineering.	**L6: Create**
CO3	Identify the relevant methodology and conduct the research effectively	**L4: Analyse**
CO4	Organize the research findings and publish the report ethically	**L6: Create**
CO5	Invent procedures, methodologies and possible solutions to cater to the needs of all the stakeholders	**L6: Create**

***Revised Bloom's Taxonomy Action verbs/Levels**

About the Major Project:

Students start working on their project work in seventh semester. Student do the background research for identifying appropriate problems, methodology and tools/ equipment to be used for their respective project works to be culminated in eighth semester. They prepare a synopsis of the project work to be carried out. At the end of seventh semester, each student is required to prepare a synopsis in the format provided and present it in front of Departmental Research Committee (DRC) constituted by the Chairperson of the Department. Students can carry out projects in groups. In case of group project, the size of the problem should be significant, and members of the group must specify their individual contribution.

CO-PO Articulation Matrix Major Project (EEC/FT/81-P)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	1	-	-	-	--	--	-	-	--	-	-	-	1	-	-
CO 2	1	1	1	1	-	-	-	-	-	-	-	-	-	2	2
CO 3	1	3	2	3	1	-	-	1	-	-	-	-	-	3	2
CO 4	-	2	-	2	3	-	-	2	1	-	-	-	-	-	2
CO 5	1	2	2	-	1	1	-	-	-	-	-	1	-	1	1
3-High 2-Medium 1-Low															

Detailed syllabus of Open Elective offered by the Department of Food Technology

Principles of Food Processing

General Course Information

Course Code: OE/FT/51-T **Course Credits: 3** **Type: Open Elective Courses** **Contact Hours per week: 3** **Mode: Lectures (L)** **Examination Duration: 3 hours**	**Course Assessment Method: Max. Marks: 100** **Internal Evaluation (30 marks):** • Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks). • Assignments, quiz etc. will have weightage of 06 marks. **End semester examination (70 marks):** • Nine questions are to be set by the examiner. A candidate is required to attempt 05 questions in all, question number one is compulsory and remaining four questions by selecting one question from each of the four units. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions of 2 marks each. • Question numbers 2 to 9 are to be set by selecting 2 questions from each unit.

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	RBT Level
CO1	Develop the basic concept of food processing, causes of spoilage and preservation of food.	**L2: Understand**
CO2	Have a concept of role of nutrients in food and human health.	**L3: Apply**
CO3	Get an overview on principles, mechanism and application of processing methods on different food groups.	**L3: Apply**
CO4	Apply their knowledge on effect of processing on the characteristics of different food groups.	**L3: Apply**
CO5	Understand the concepts related to emerging food processing technologies.	**L2: Understand**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-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.

Nutrients: Basic concept of food, nutrients, nutrition, Definition, classification, properties and requirements of carbohydrates, lipids, proteins, water, minerals and vitamins for humans.

UNIT-II

Fruits and vegetables: Peeling, size reduction, processing and processed products of fruits and vegetables. Minimal processing of fruits and vegetables.

UNIT-III

Cereals and millets: Concept of milling, Processed products of wheat and rice. Types of millets and food uses.

Legume: Types, milling, germination and processed products.

Oilseeds: Use of oilseeds, processing and oil extraction and food uses.

UNIT-IV

Emerging food processing technologies: Concept of high pressure, pulsed electric fields, radio frequency and ultrasound processing.

Recommended Readings:

1. Norman N. P., and Joseph H. H., (1997) Food Science 5th edition, CBS Publication, New Delhi.

2. Fellows P. J., (2002) Food Processing Technology: Principles and Practice 2nd Ed, Woohead Pub. Ltd.

3. Kent NL, (1975) Technology of Cereals, Oxford ; New York : Pergamon Press

4. Sivasankar B., (2002) Food Processing & Preservation, Prentice Hall of India.

5. Khetarpaul N., (2005) Food Processing and Preservation, Daya Publications.

6. Norman W. Desrosier; (2018) The Technology of food preservation, Medtech, New Jersey

CO-PO Articulation Matrix Principles of Food Processing Course (OE/FT/51-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	2	2	2	2	2	1	-	1	3	3	3	3	2
CO 2	3	2	2	2	2	2	2	2	-	1	3	3	3	3	1
CO 3	3	2	2	2	2	2	2	2	-	1	3	3	3	3	2
CO 4	3	2	2	2	2	2	2	2	-	1	3	3	3	3	3
CO 5	3	3	2	3	1	3	1	1	1	-	2	1	3	3	2
3-High 2-Medium 1-Low															

Introduction to Food Nutrition

General Course Information

Course Code: OE/FT/52-T **Course Credits: 3** **Type: Open Elective Courses** **Contact Hours per week: 3** **Mode: Lectures (L)** **Examination Duration: 3 hours**	**Course Assessment Method: Max. Marks: 100** **Internal Evaluation (30 marks):** • Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks). • Assignments, quiz etc. will have weightage of 06 marks. **End semester examination (70 marks):** • Nine questions are to be set by the examiner. A candidate is required to attempt 05 questions in all, question number one is compulsory and remaining four questions by selecting one question from each of the four units. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions of 2 marks each. • Question numbers 2 to 9 are to be set by selecting 2 questions from each unit.

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	RBT Level
CO1	Describe the basic concept of food, nutrients, nutrition, health and fitness	**L2: Understand**
CO2	Explain the fate of food on ingestion to the body.	**L2: Understand**
CO3	Interpret the role of macro & micro nutrients in human health.	**L3: Apply**
CO4	Develop a dietary chart for different age groups of Indian considering RDA and interpret the effect processing on food component.	**L3: Apply**
CO5	Discuss the nutrition and alternative systems for physical fitness.	**L2: Understand**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

Introduction: Basic concept of food, nutrients, nutrition, health and fitness. Interrelationship between nutrition and health.

Metabolism: Digestion, absorption and metabolism of foods, Basal and resting metabolism and influencing factors.

UNIT-II

Classification: Functions of food and classification of food and nutrients.

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 acidssources 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.

Micronutrients: Occurrence and physiological functions of vitamins and minerals.

UNIT-III

Water: Definition, Dietary sources (visible, invisible), Functions of water, Role of water in maintaining health (water balance).

Basic principles of planning diet: Nutritional assessment and RDA for Indians.

UNIT-IV

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.

Recommended Readings:

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

CO-PO Articulation Matrix Introduction to Food Nutrition Course (OE/FT/52-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	1	2	1	1	3	1	2	2	1	2	3	1	2
CO 2	3	3	2	2	3	3	-	1	1	2	2	1	2	2	1
CO 3	2	2	1	1	-	1	-	1	1	1	2	1	3	3	1
CO 4	2	2	3	3	2	-	1	2	2	3	2	2	3	3	2
CO 5	-	1	3	3	-	-	1	2	1	1	2	1	3	3	2
3-High 2-Medium 1-Low															

Principles of Food Preservation

General Course Information

Course Code: OE/FT/61-T **Course Credits: 3** **Type: Open Elective Courses** **Contact Hours per week: 3** **Mode: Lectures (L)** **Examination Duration: 3 hours**	**Course Assessment Method: Max. Marks: 100** **Internal Evaluation (30 marks):** • Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks). • Assignments, quiz etc. will have weightage of 06 marks. **End semester examination (70 marks):** • Nine questions are to be set by the examiner. A candidate is required to attempt 05 questions in all, question number one is compulsory and remaining four questions by selecting one question from each of the four units. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions of 2 marks each. • Question numbers 2 to 9 are to be set by selecting 2 questions from each unit.

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	RBT Level
CO1	Discuss fundamental principles of food preservation.	**L2: Understand**
CO2	Describe the principles of low temperature preservation by refrigeration, freezing and freeze drying.	**L2: Understand**
CO3	Explain thermal processing and execute high temperature processing in food industry.	**L3: Apply**
CO4	Explain the concept of water activity and preservation by drying and dehydration.	**L2: Understand**
CO5	Implement the knowledge of preservatives, fermentation and non thermal technology in food preservation.	**L3: Apply**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-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.

UNIT-II

Thermal preservation techniques: High temperature based-Pasteurization, sterilization, drying, canning. Low temperature based- freezing and cold storage.

UNIT-III

Bio-preservation techniques: Fermentation- principles and microorganisms, curing and pickling.
Use of preservative: Chemical preservative, bio-preservatives, antibiotics, antioxidant, antimicrobials.

UNIT-IV

Packaging as Preservation Technique: Concept of food packaging, major packaging materials, Active and Intelligent packaging. Control/Modified Atmosphere packaging.

Emerging preservation techniques: Concept of high pressure processing, pulsed electric fields, ultrasound, irradiation and hurdle technology.

Recommended Readings:

1. Norman N. P., and Joseph H. H., (1997) Food Science, 5th edition, CBS Publication, New Delhi.

2. Sivasankar B., (2002) Food Processing & Preservation, Prentice Hall of India.

3. Norman W. Desrosier; (2018) Technology of food preservation, Medtech, New Jersey.

4. Zeuthen P. (2003) Food Preservation Techniques, CRC Press.

5. Rahman M.S. (2020) Handbook of food preservation, CRC Press.

6. Hui Y.H. (2003) Handbook Vegetable of Preservation and Processing, CRC Press.

CO-PO Articulation Matrix Principles of Food Preservation Course (OE/FT/61-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	2	2	2	2	2	1	1	1	3	3	2	2	3
CO 2	3	2	2	2	2	2	2	1	1	2	3	3	2	3	2
CO 3	3	2	2	2	2	2	2	1	1	2	3	3	3	1	1
CO 4	3	2	2	2	2	2	2	1	1	1	3	3	3	2	1
CO 5	3	3	2	1	3	3	1	-	1	1	2	3	3	3	2
3-High 2-Medium 1-Low															

Food Laws and Regulations

General Course Information

Course Code: OE/FT/62-T **Course Credits: 3** **Type: Open Elective Courses** **Contact Hours per week: 3** **Mode: Lectures (L)** **Examination Duration: 3 hours**	**Course Assessment Method: Max. Marks: 100** **Internal Evaluation (30 marks):** • Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks). • Assignments, quiz etc. will have weightage of 06 marks. **End semester examination (70 marks):** • Nine questions are to be set by the examiner. A candidate is required to attempt 05 questions in all, question number one is compulsory and remaining four questions by selecting one question from each of the four units. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions of 2 marks each. • Question numbers 2 to 9 are to be set by selecting 2 questions from each unit.

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	RBT Level
CO1	Know different food laws and their importance	**L2: Understand**
CO2	Discuss different adulterants and hazards and their safety measures	**L2: Understand**
CO3	Implement different safety tools and regulation in food industry to produce safe products	**L3: Apply**
CO4	Gain knowledge of international food laws.	**L3: Apply**
CO5	Gain knowledge of safety regulations and their implementation criteria.	**L3: Apply**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-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.

UNIT-II

Food Laws and Standards in India and their requirements: Food Safety and Standards (FSS) Act, 2006, FSSA2008 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).

International food laws and regulatory agencies: International Organizations – FAO (Food & Agriculture Organization), WHO (World Health Organization), Codex Alimentarius Commission (CAC), ISO-9000-01 certification.

UNIT-III

Food Safety regulations: Hazard Analysis Critical Control Points (HACCPs), ISO- 22000, ISO-14000, GHP, planning, application, Implementation criteria, 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.

UNIT-IV

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.

Recommended Readings:

1. Ronald S. (1991). Pearson's Composition and Analysis of foods, 9th edition, Longman.

2. Ranganna S. (1986) Handbook of Analysis of Fruit and Vegetable and their Products, Tata McGraw-Hill.

3. Pomeranz and Meloan (2013) Food Analysis, 3rd edition Springer US.

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

CO-PO Articulation Matrix Food Laws and Regulations Course (OE/FT/62-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	1	2	-	3	1	-	1	-	-	-	3	2	2	2	2
CO 2	1	2	1	2	2	1	-	2	-	1	2	1	2	2	1
CO 3	3	-	2	2	3	3	1	3	1	2	1	3	3	2	2
CO 4	2	2	2	1	2	1	2	3	1	2	2	3	3	2	3
CO 5	1	-	-	2	-	3	1	1	2	1	2	3	3	3	2
3-High 2-Medium 1-Low															

Basics of Food Technology

General Course Information

Course Code: OE/FT/71-T **Course Credits: 3** **Type: Open Elective Courses** **Contact Hours per week: 3** **Mode: Lectures (L)** **Examination Duration: 3 hours**	**Course Assessment Method: Max. Marks: 100** **Internal Evaluation (30 marks):** • Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks). • Assignments, quiz etc. will have weightage of 06 marks. **End semester examination (70 marks):** • Nine questions are to be set by the examiner. A candidate is required to attempt 05 questions in all, question number one is compulsory and remaining four questions by selecting one question from each of the four units. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions of 2 marks each. • Question numbers 2 to 9 are to be set by selecting 2 questions from each unit.

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	RBT Level
CO1	Recite food, food technology, food processing.	**L1: Remember**
CO2	Explain functions of food and status of food Industry in Haryana and India.	**L2: Understand**
CO3	Describe nutritive value of food and various unit operations in food technology.	**L2: Understand**
CO4	Outline of food deterioration.	**L4: Analyse**
CO5	Illustrate food processing and preservation.	**L3: Apply**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

Introduction: Definition of Food, food technology, food processing, functions of foods - energy giving, body building, protecting and regulating. Status of food industry in Haryana and India.

Nutritive value of food: Food energy, carbohydrates, fats, vitamins, minerals, proteins, additional food constituents.

UNIT-II

Unit operations in food technology: Material handling, cleaning, separation, disintegration, mixing, heating, cooling, evaporation, types of evaporators, drying, types of dryers packaging, primary, secondary and tertiary packaging.

UNIT-III

Food deterioration and its control: Introduction, classification of food on the basis of its shelf life, major causes of deterioration of food, types of food spoilage (physical, chemical and

microbiological), control of food deterioration (temperature, light, RH, bacteria, fungus, enzymes and other factors).

UNIT-IV

Food Processing and Preservation: Principals of food processing & preservation, methods of food processing, refrigeration and cold storage, freezing and frozen storage, IMF (intermediate moisture foods), canning, pickling process,

Recommended Readings:

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

2. M. Swaminathan, Vol I & II Foods and Nutrition NIN Publications

3. Manay S., and Shadaksharaswamy M., Food: Facts and Principles, New Age International Pvt. Ltd., New Delhi.

CO-PO Articulation Matrix Basics of Food Technology Course (OE/FT/71-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	2	1	1	1	2	1	1	-	-	-	1	1	2	2
CO 2	3	2	-	1	1	1	1	1	-	-	-	1	2	2	2
CO 3	2	2	1	-	1	1	1	-	-	-	-	1	2	2	1
CO 4	2	1	1	1	-	1	1	1	-	1	-	1	3	3	3
CO 5	2	1	1	1	1	2	1	1	-	-	-	1	2	1	3
3-High 2-Medium 1-Low															

Food Packaging

General Course Information

Course Code: OE/FT/72-T **Course Credits: 3** **Type: Open Elective Courses** **Contact Hours per week: 3** **Mode: Lectures (L)** **Examination Duration: 3 hours**	**Course Assessment Method: Max. Marks: 100** **Internal Evaluation (30 marks):** • Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered. • Class Performance will be measured through percentage of lectures attended (04 marks). • Assignments, quiz etc. will have weightage of 06 marks. **End semester examination (70 marks):** • Nine questions are to be set by the examiner. A candidate is required to attempt 05 questions in all, question number one is compulsory and remaining four questions by selecting one question from each of the four units. All questions carry equal marks. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions of 2 marks each. • Question numbers 2 to 9 are to be set by selecting 2 questions from each unit.

Course Outcomes:

S. No.	After the completion of the course, the students will be able to:	RBT Level
CO1	Describe packaging terminologies, its type and functions.	**L1: Remember**
CO2	Explain the manufacturing of packaging materials based on paper, glass, metal and plastic.	**L2: Understand**
CO3	Classify the traditional and modern types of food packaging.	**L3: Apply**
CO4	Identify suitable packaging materials for given food items	**L4: Analyse**
CO5	Assessment of different packaging materials for different foods	**L6: Create**

***Revised Bloom's Taxonomy Action verbs/Levels**

UNIT-I

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

UNIT-II

Different type of packaging materials: Advantages and disadvantages. Paper and paper-based packaging materials: types and properties. Metal packaging materials: manufacture of tin plate, electrolytic chromium coated steel (ECCS), aluminium and container making process. Corrosion and corrosiveness of foods and lacquers; Glass packaging materials: composition, properties, manufacture and closures; Plastic polymer as packaging materials: processing, classification and properties of polymers. Additives in plastics.

UNIT –III

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

UNIT –IV

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

Recommended Readings:

1. Robertson G. L., (2006) Food Packaging: Principles and Practice. 2nd edition, Taylor and Francis Group.
2. Mattsson B., and Sonesson U., (2000) Environmentally-friendly food processing Woodhead Publishing Ltd.
3. Ahvenainen R., (2003) Novel food packaging techniques. Woodhead Publishing Ltd.

CO-PO Articulation Matrix Food Packaging Course (OE/FT/72-T)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	-	-	-	-	2	-	-	-	-	-	-	-	2	3
CO 2	2	1	2	-	-	-	-	-	-	-	-	-	2	2	-
CO 3	-	1	-	-	-	-	-	-	-	-	-	-	-	3	-
CO 4	-	1	2	-	-	-	2	1	-	-	-	-	1	3	2
CO 5	-	-	2	-	-	-	2	2	-	-	-	-	-	2	2
3-High 2-Medium 1-Low															

List of Common Courses: 2023-24

Course Code	Definition / Category
BSC	Basics Science Courses
ESC	Engineering Science Courses
HSMC	Humanities and Social Sciences Including Management Courses
MC	Mandatory Courses
PC	Programme Core Courses
PE	Programme Elective Courses
OE	Open Elective Courses
EEC	Employability Enhancement Courses (Project Work/ Summer Training/ Industrial Training/ Practical Training/ Internship/ Seminar, etc.)

BSC

	Course Title	Course Code (T)	Course Code(P)
1.	Physic	BSC/1-T(i-vii)	BSC/1-P
2.	Chemistry	BSC/2-T	BSC/2-P
3.	Mathematics-I	BSC/3-T	
4.	Mathematics-II	BSC/4-T	
5.	Mathematics-I (CSE/IT)	BSC/5-T	
6.	Mathematics-II (CSE/IT)	BSC/6-T	
7.	Mathematics-III	BSC/7-T	
8.	Introduction to Food Biotechnology	BSC/8-T	BSC/8-P

ESC

	Course Title	Course Code (T)	Course Code(P)
1.	Basics Electrical Engineering	ESC/1-T	ESC/1-P
2.	Engineering Graphics and Design Lab	-	ESC/2-P
3.	Programming for Problem Solving	ESC/3-T	ESC/3-P
4.	Workshop/ Manufacturing Practices	ESC/4-T	ESC/4-P
5.	Analog Electronics Circuit	ESC/5-T	
6.	Engineering Properties of Food	ESC/6-T	
7.	Civil Engineering Mats Testing Evaluation-I Lab	-	ESC/7-P
8.	Civil Engineering Mats Testing Evaluation-II Lab	-	ESC/8-P
9.	Engineering Mechanics	ESC/9-T	
10.	Workshop Technology-II Lab		ESC/10-P
11.	Basics of Machine Drawing		ESC/11-P

HSMC

	Course Title	Course Code (T)	Course Code(P)
1.	English	HSMC/1-T	HSMC/1-P
2.	Human Values & Personality Development	HSMC/2-T	
3.	Fundamentals of Management for Engineers	HSMC/3-T	
4.	Economics for Engineers	HSMC/4-T	
5.	Industrial Physiology	HSMC/5-T	

MC

	Course Title	Course Code (T)	Course Code(P)
1.	Induction Training	MC/1	
2.	Environmental Sciences	MC/2-T	
3.	Indian Constitution	MC/3-T	
4.	Essence of Indian Traditional Knowledge	MC/4-T	
5.	Technical Presentation		MC/5-P
6.	Entrepreneurship	MC/6-T	
7.	Disaster Preparedness & Planning Management	MC/7-T	
8.	General Proficiency		MC/8-P