ETERNAL UNIVERSITY

(ESTABLISHED UNDER HIMACHAL PRADESH GOVERNMENT ACT NO.3 OF 2009)

BARU SAHIB
HIMACHAL PRADESH

WORLD PEACE THROUGH VALUE BASED EDUCATION

DR. KHEM SINGH GILL AKAL COLLEGE OF AGRICULATURE

B. TECH. FOOD TECHNOLOGY CURRICULUM (SEMESTER I TO VIII)

APPROVED VIDE ANNEXURE 4.1.2 OF 87TH ACADEMIC COUNCIL MEETING HELD ON 25TH JULY, 2025

TO BE IMPLEMENTED FROM THE ACADEMIC SESSION 2025-26

Dean
Academic Affairs
Eternal University
Baru Sahib (H.P.) 173101

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ETERNAL UNIVERSITY

BARU SAHIB, RAJGARH, SIRMOUR
HIMACHAL PRADESH

Study Scheme & Syllabus

For

B.Tech. Food Technology
(I to VIII Semester)

Syllabi Applicable for Admissions in 2025 onwards as per 6th Deans Committee Report of ICAR (NEP-2020)

Dr. Khem Singh Gill Akal College of Agriculture

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Aim of Restructuring Food Technology Education

In an era marked by rapid population growth, changing dietary patterns, and environmental concerns, the significance of food technology cannot be overstated. Food Technology course is designed to address the multifaceted challenges facing the food industry today. It recognizes the need for a holistic approach to food technology education that encompasses theoretical knowledge, practical skills, and ethical considerations. At its core, the course aims to produce graduates who are well-equipped to address issues such as food security, safety, new product development, sustainability, and innovation.

The National Education Policy (NEP) serves as a guiding framework aimed at revolutionizing education in this critical field. This comprehensive policy not only emphasizes theoretical knowledge but also underscores the importance of practical application, interdisciplinary learning, innovation, and critical thinking. In view of these, the restructuring of under-graduate programs in Food Technology have been carried out. More emphasis has been given on basic skill enhancement courses, exposure visits and case studies, industry attachments, flexibility in choice of courses through electives and also through online courses. Provision has also been made for advanced skill development through project work or experiential learning/ incubation, etc. These activities have been intended at conceptual learning than rote learning as well as for inculcating ingenuity and analytical thinking. Besides, as per NEP-2020, provision for multiple exit and entry options have also been included. One of the fundamental pillars of the program on Food Technology course is the emphasis on practical application. Recognizing the importance of hands-on learning experiences, laboratory work, and industry internships, the course has been designed to provide students with real-world exposure to the complexities of food processing, preservation, and quality assurance. By integrating practical training into the curriculum, students can develop essential skills that are crucial for success in the food industry. Two exit options, one after first year as a Certificate and the other after the second year as Diploma in Food Technology, have been provided, so that the students can look for employment at any point of their career.

The course on Food Technology advocates for an interdisciplinary approach to education. It recognizes that food technology is inherently multidisciplinary, drawing upon principles from fields such as biology, chemistry, microbiology, engineering, and nutrition. By incorporating elements from these diverse disciplines, students gain a comprehensive understanding of food science and are better equipped to tackle complex challenges in the field. This modified Food Technology course has far-reaching implications for the future of food. By equipping students with comprehensive knowledge, practical skills, and ethical principles, the syllabus lays the foundation for a sustainable, resilient, and equitable food system. Graduates of the program are poised to make meaningful contributions to the food industry, driving innovation, promoting food security, and ensuring the safety and integrity of the global food supply. Entrepreneurship in food technology is an aspect that is characterized by a spirit of innovation and disruption. Entrepreneurs in this field leverage cutting-edge technologies, scientific advancements, and creative thinking to develop novel solutions that revolutionize the way we produce, process, and consume food. These entrepreneurs are driving forward-thinking initiatives that have the potential to reshape the future of food.

The details of the course structure for the Undergraduate courses in Food Technology (UG Certificate, UG-Diploma and B. Tech.) have been prepared after having multistage in-depth deliberations and discussions with the Deans' and faculty members of the Food Technology discipline of different SAUs, stakeholders from related industries and alumni. It is expected that the course curriculum will strengthen the knowledge and skill base of the students and meet the expectations of the NEP-2020.

This course on Food Technology represents a landmark initiative aimed at transforming education in this critical field. By emphasizing practical application, interdisciplinary learning, innovation, and food safety, the program seeks to empower students with the knowledge and skills needed to address the complex challenges facing the food industry. As we look towards the future, the course curricula on Food Technology holds immense promise for shaping a more sustainable, resilient, and equitable food system for generations to come.

Introduction

New Education Policy-2020 (NEP-2020) of India proposed many changes in the education system of India, including higher agriculture education system. A national level Committee was constituted by ICAR to develop an implementation strategy to comply with various provisions of National Education Policy (NEP-2020). ICAR constituted the Sixth Deans' Committee to restructure the existing course curricula so as to enable implementation of NEP-2020 in agricultural education. As per the NEP- 2020 recommendations, the Sixth Deans' Committee has incorporated following several new initiatives in the proposed restructured UG curricula.

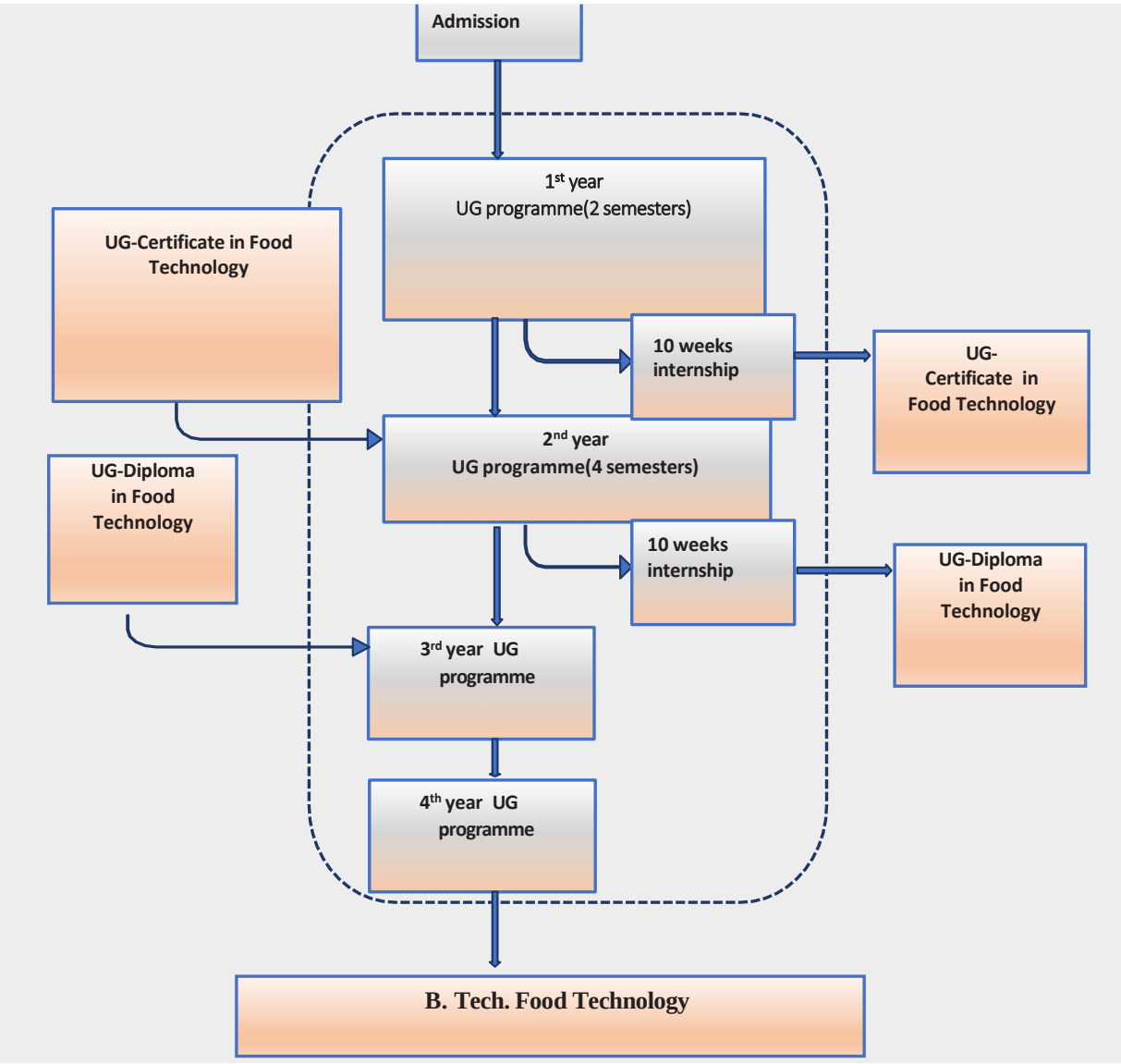

Figure-1 Framework of Undergraduate Programmes

PROGRAM OUTCOMES FOR B.TECH. FOOD TECHNOLOGY

On successful completion of the B.Tech. Food Technology program, the students are expected to attain the following:

PO No.	Attribute	Competency
PO1	Engineering Knowledge	Apply knowledge of mathematics, science, and engineering fundamentals to solve complex problems in food technology, including food processing, preservation, and product development.
PO2	Problem Analysis	Identify, formulate, and analyze food-related engineering problems using principles of food science, microbiology, and technology to draw valid conclusions.
PO3	Design/Development of Solutions	Design innovative food products, processes, and systems that meet desired specifications while considering safety, sustainability, nutrition, and regulatory compliance.
PO4	Modern Tool Usage	Use modern engineering and food analysis tools, including computational techniques, laboratory equipment, and simulation software, for food product design and quality assurance.
PO5	Environment and Sustainability	Understand the impact of food processing and packaging on the environment and demonstrate knowledge of sustainable practices in food production and waste management
PO6	Self-directed and Life- long Learning	Develop a habit of continuous self-learning via various online/offline educational platforms, including retention of the same and nurturing critical thinking skills, further, use them to update scientific knowledge and apply them in day-to-day life and business.

PROGRAM SPECIFIC OUTCOMES

PSO No.	Competency
PSO1	Graduates will have strong foundational knowledge in food chemistry, microbiology, food engineering, and nutrition for the development and processing of safe, high-quality food products.
PSO2	Graduates will be able to use modern tools and techniques for food analysis, quality control, process optimization, and research in food product development.
PSO3	Graduates will understand and apply food safety regulations, quality management systems (like HACCP, FSSAI, ISO), and industry standards in food production and packaging.
PSO4	Graduates will develop eco-friendly, cost-effective, and innovative food technologies by integrating principles of sustainability and emerging trends in food science.
PSO5	Graduates will demonstrate the ability to communicate effectively, work in multidisciplinary teams, and initiate entrepreneurial ventures in the food sector with social and ethical responsibility.
PSO6	Students will be exposed to various evolving technologies in the food sector for problem solving aptitude by implementing the scientific knowledge and skills for producing quality wise healthy food products and its assessment.

General Credits Allocation Scheme of UG Programs (Credit hours)

Semester	Core Courses (Major + Minor)	Multi-Disciplinary Course (MDC)	Value Added Course (VAC)	Ability Enhancement Course (AEC)	Skill Enhancement Course (SEC)	Internship/ Project/ Student READY	Total Credits	Non-Gradial	Online Courses/ MOOC
I	12	3(2)		1(3) + 2(4)	4	-	22	2(1)	6
II	15	-	3(6)	1(3)	4	-	23	-	
Post-II semester						10(12)			
III	16	----	3 (10)	2(8)	2	-	23		
IV	13	3(5)		2(7)	2	-	20	-	
Post-IV semester						10(13)			
V	19	2(9)	-	-	-	-	22	2(11)	
VI	21	-	-	-	-	-	21	-	
VII	20	-	-	-	-	-	20	-	
VIII	-	-	-	-	-	20	20	-	
Total	**116**	**8**	**6**	**8**	**12**	**20**	**170**	**4**	**6**

1. *Deeksharambh* (Induction-cum-Foundation Course) of 2 credits (2 weeks duration).
2. Farming based Livelihood systems
3. NCC/NSS
4. Communication Skills
5. Entrepreneurship Development and Business Management
6. Environmental Studies and Disaster Management;
7. Personality Development
8. Physical Education, First Aid, Yoga Practices and Meditation.
9. Agricultural Marketing and Trade
10. Agricultural Informatics and Artificial Intelligence
11. (Study tour (10-14 days).
12. Only for those opting for an exit with UG-Certificate.
13. Only for those opting for an exit with UG-Diploma
14. One multidisciplinary course in Agricultural Engineering discipline is different from the above common courses keeping in view the discipline specific requirement.

There will be a uniform system of the evaluation and grading to be followed with Grade point average (GPA) system. The following pattern of examination is recommended (Table 1)

Table 1: Evaluation system as per ICAR Pattern

	External Theory	Internal Theory (Mid-term)	Quiz/Progressive Assessment	Final Practical
For courses having both theory and practical components	40%	20%	20%	20%
For courses with theory only	50%	30%	20%	-
Courses with practical only	-	30%	20%	50% (Internal)

Table: 2 SCHEME OF EXAMINATION
(Continuous Assessment and End-Semester Examination)

MARKS DISTRIBUTION FOR DIFFERENT CREDIT HOUR COURSES

CREDITS		**THEORY**					**PRACTICALS**		
T+P	**Total (T+P)**	**Total (Theory)**	**End Term**	**Mid-Session**	**Quiz/Progressive Assessment**	**Total (Practical)**	**Mid-Session**	**Quiz/Progressive Assessment**	**End Term**
1+0	40	40	20	12	8	-	-	-	-
2+0	80	80	40	24	16	-	-	-	-
3+0	120	120	60	36	24	-	-	-	-
4+0	160	160	80	48	32	-	-	-	-
5+0	200	200	100	60	40	-	-	-	-
0+1	40	0	0	0	0	40	12	8	20
1+1	80	40	32	16	16	40	-	-	16
2+1	120	80	48	24	24	40	-	-	24
3+1	160	120	64	32	32	40	-	-	32
4+1	200	160	80	40	40	40	-	-	40
0+2	80	0	0	0	0	80	24	16	40
1+2	120	40	48	24	24	80	-	-	24
2+2	160	80	64	32	32	80	-	-	32
3+2	200	120	80	40	40	80	-	-	40
0+3	120	0	0	0	0	120	36	24	60

Department/Section wise course breakup

Sr. No.	Course Title	Credit hours	Total
Department of Food Technology			
1	Fundamentals of Food Processing	3 (2+1)	**33 (21+12)**
2	Processing Technology of Fruits and Vegetables	3 (2+1)	
3	Processing Technology of Liquid Milk	2 (1+1)	
4	Food Packaging Technology and Equipment	2 (1+1)	
5	Processing Technology of Cereals	3 (2+1)	
6	Processing Technology of Legumes and Oilseed	3 (2+1)	
7	Processing Technology of Dairy Products	3 (2+1)	
8	Processing of Meat, Fish and Poultry Products	3 (2+1)	
9	Bakery, Confectionary and Snack Products	3 (2+ 1)	
10	Processing of Spices and Plantation Crops	3 (2+1)	
16	Sensory evaluation of Food Products	2 (1+1)	
11	Processing Technology of Beverages	3 (2+1)	
12	Internship (at Industry/ Research Institutes, etc.) (20 weeks)	20 (0+20)	
Skill Enhancement Courses			
1	Introduction to Drying Technology and Dryers	2 (0+2)	**6 (0+6)**
2	Introduction to Processing of Extruded Foods	2 (0+2)	
3	Introduction to Milling (Rice, Dal, Spices, etc.)	2 (0+2)	
Department of Food Engineering			
1	Workshop Technology	3 (1+2)	**41(24+17)**
2	Engineering Drawing and Graphics	3 (1+2)	
3	Basic Electrical Engineering	3 (2+1)	
4	Food Thermodynamics	3 (2+1)	
5	Post-Harvest Engineering	3 (2+1)	
6	Fluid Mechanics	3 (2+1)	
7	Heat and Mass Transfer in Food Processing	3 (2+1)	
8	Basic Electronic Engineering	2 (1+1)	
9	Unit Operations in Food Processing	3 (2+1)	
10	Fundamentals of Food Engineering	3 (2+1)	
11	Food Refrigeration and Cold Chain	3 (2+1)	
12	Food Storage Engineering	3 (2+1)	
13	Food Process Equipment Design	3 (2+1)	
14	Instrumentation and Process Control in Food Industry	3 (1+2)	
Skill Enhancement Courses			
1	Introduction to Electrical and Control Systems in Food Industry	2 (0+2)	**6 (0+6)**
2	Introduction to Mechanical Systems in Food Industry	2 (0+2)	
3	Introduction to AutoCAD	2 (0+2)	
Department of Food Quality Assurance			
1	Food Chemistry I	3 (2+1)	**31(21+10)**
2	Food Chemistry II	3 (2+1)	
3	General Microbiology	3 (2+1)	
4	Food Microbiology	3 (2+1)	
5	Industrial Microbiology	3 (2+1)	

6	Food Biochemistry and Nutrition	3 (2+1)	
7	Food Plant Sanitation	3 (2+1)	
8	Introduction to Food Biotechnology	3 (2+1)	
9	Instrumental Techniques in Food Analysis	2 (1+1)	
10	Food Additives and Preservatives	3 (2+1)	
11	Food Quality, Safety Standards and Certification	2 (2+0)	
	Skill Enhancement Courses		
1	Introduction to Food Safety and Sanitation	2 (0+2)	
2	Introduction to Good Laboratory Practices	2 (0+2)	**6 (0+6)**
3	Basic Food Analysis Laboratory Techniques	2 (0+2)	
Department of Food Business Management			
1	Business Management and Economics	2 (2+0)	
2	Engineering Mathematics- I	2 (2+0)	
3	Engineering Mathematics- II	2 (2+0)	
4	Statistical Methods and Numerical Analysis	2 (1+1)	**13 (9+4)**
5	ICT Applications in Food Industry (Informatics)	3 (1+2)	
6	Project Preparation and Management	2 (1+1)	
	Common Courses		
1	Deeksharambh (Induction cum Foundation course)	2 (0+2) NG	
2	Farming Based Livelihood System	3 (2+1)	
3	Communication Skills	2 (1+1)	
4	Personality Development		**16 (9+7)**
5	Environmental Science and Disaster Management	3 (2+1)	
6	Entrepreneurship Development and Business Management	3 (2+1)	
7	Agricultural Marketing and Trade	3 (2+1)	
Department of Food Plant Operations			
1	Food Plant Utilities and Services	3 (2+1)	**3 (2+1)**
	Skill Enhancement Courses		
1	Maintenance of Food Processing Equipment	2 (0+2)	
2	Introduction to Bottling and Canning Line	2 (0+2)	**26 (0+26)**
3	Introduction to Manufacturing of Bakery Products	2 (0+2)	
4	Internship (only for exit option for award of UG-Certificate) 10 weeks	10 (0+10)*	
5	Internship (only for exit option for award of UG- Diploma)	10 (0+10)*	
Students' Welfare			
1.	NCC/NSS	1 (0+1)	**6 (0+6)**
2.	NCC/NSS	1 (0+1)	
3.	Physical Education, First Aid and Yoga Practices	2 (0+2)	
4.	Study Tour	2 (0+2)	

Methodology for Course Code of Courses of B.Tech. Food Technology

Faculty Code:

Faculty	Code
Dr. Khem Singh Gill Akal College of Agriculture	01

Department:

Name of Discipline/Department	Code
No. Deptt.	0
Agronomy	1
Entomology	2
Agricultural Extension	3
Food Technology and Animal Husbandry	4
(A)GPB (B) Biotechnology / (C) Biochemistry / (D) Crop Physiology	5
Horticulture	6
Plant Pathology	7
(A)Soil Science /(B) Agricultural Engineering / (C)Environmental Sciences	8
Agricultural Economics	9

Programme of Study:

Common programme courses (MDC, VAC, AEC and SEC)	00
B.Tech. Food Technology	02

Semester Code:

Semester	Code
SEM I	1
SEM II	2
SEM III	3
SEM IV	4
SEM V	5
SEM VI	6
SEM VII	7
SEM VIII	8
SEM IX	9
SEM X	10

Code for Category of course:

Category of Courses	Code
Non gradial courses / NGC	1
MDC (Multi-disciplinary course)	2
VAC (Value added course)	3
AEC (Ability enhancement course)	4

SEC (Skill enhancement course)	5
CC (Core Courses)	6
EC (Elective courses)	7
READY	8
MOOC / Swayam	9

Code for Course number:

Course No.	**Code**
First	01
Second	02
Third	03
Fourth	04
Five	05
Six	06
Seven	07
Eight	08
Nine	09
Ten	10
Eleven	11
Twelve	12
Thirteen	13
Fourteen	14

Code for type of course (T & P)

Type of Course	**Code**
Theory	0
Practical	1
Theory + Practical	2

Semester-wise Course Distribution

S. No.	Course Code	Subject Code	Course Title	Credit hours	Total Credit hours
First Year					
Semester-I					
1.	0100111011	IFC 111	*Deeksharambh* (Induction-cum-Foundation Course of 2 weeks)	2 (0+2) Non-Gradial	**22 (10+12) +2 (Non-Gradial)**
2.	0140211012	FT 111	Fundamentals of Food Processing	3 (2+1)	
3.	0140211022	EE 111	Workshop Technology	3 (1+2)	
4.	0140211032	ETE 111	Basic Electrical Engineering	3 (2+1)	
5.	0140211042	MIC 111	General Microbiology	3 (2+1)	
6.	0110012012	AGRON 111	Farming Based Livelihood System	3 (2+1)	
7.	0130014012	EXT 111	Communication Skills	2 (1+1)	
8.	0100014011	NCC-I	NCC-I	1 (0+1)	
9.	0100014021	NSS-I	NSS-I		
10.		SEC I*	Skill Enhancement Course- I	2 (0+2)	
11.		SEC II*	Skill Enhancement Course - II	2 (0+2)	
Semester-II					
1.	0140221012	FT 121	Post-Harvest Engineering	3 (2+1)	**23 (11+12)**
2.	0140221022	FT 122	Food Chemistry I	3 (2+1)	
3.	0140221032	FT 123	Unit Operations in Food Processing	3 (2+1)	
4.	0140221042	FT 124	Food Thermodynamics	3 (2+1)	
5.	0140221052	EE 121	Engineering Drawing and Graphics	3 (1+2)	
6.	0130024032	EXT 121	Personality Development	2 (1+1)	
7.	0180023112	ENV 121	Environmental Studies and Disaster Management	3 (2+1)	
8.	0100024031	NCC-II	National Cadet Corps-II	1 (0+1)	
9.	0100024041	NSS-II	National Service Scheme-II		
10.		SEC III*	Skill Enhancement Course - III	2 (0+2)	
11.		SEC IV*	Skill Enhancement Course - IV	2 (0+2)	
Second Year **SEMESTER-III**					
1.	0140231012	FT 211	Food Chemistry II	3 (2+1)	**23 (13+10)**
2.	0140231022	EE 211	Fluid Mechanics	3 (2+1)	
3.	0140231032	FT 212	Heat and Mass Transfer in Food Processing	3 (2+1)	
4.	0140231042	ETE 211	Basic Electronic Engineering	2 (1+1)	
5.	0140231052	FT 213	Food Microbiology	3 (2+1)	
6.	0140231060	MATH 211	Engineering Mathematics- I	2 (2+0)	
7.	0190132012	ECON-211	Entrepreneurship Development and Business Management	3 (2+1)	
8.	0100034011	PHE 211	Physical Education, First Aid, Yoga Practice and Meditation	2 (0+2)	
9.		SEC V*	Skill Enhancement Course-V	2 (0+2)	
SEMESTER-IV					
1.	0140241012	FT 221	Fundamentals of Food Engineering	3 (2+1)	**20 (13+7)**
2.	0140241022	FT 222	Food Plant Sanitation	3 (2+1)	
3.	0140241030	FT 223	Food Quality, Safety Standards and	2 (2+0)	

			Certification		
4.	0140241040	MATH 221	Engineering Mathematics- II	2 (2+0)	
5.	0140241052	FT 224	Food Plant Utilities and Services	3 (2+1)	
6.	0100043012	STAT-221	Agricultural Informatics and Artificial Intelligence	3 (2+1)	
7.		SEC VI*	Skill Enhancement Course-VI	2 (0+2)	
Third Year					
SEMESTER-V					
1.	0140251012	FT 311	Food Biochemistry and Nutrition	3 (2+1)	**22 (14+8) +2 (Non-Gradial)**
2.	0140251022	FT 312	Processing Technology of Cereals	3 (2+1)	
3.	0140251032	FT 313	Processing Technology of Fruits and Vegetables	3 (2+1)	
4.	0140251042	FT 314	Food Packaging Technology and Equipment	2 (1+1)	
5.	0140251052	FT 315	Processing of Spices and Plantation Crops	3 (2+1)	
6.	0140251062	FT 316	Food Storage Engineering	3 (2+1)	
7.	0140251072	FT 317	Project Preparation and Management	2 (1+1)	
8.	0190052032	ECON 311	Agricultural Marketing and Trade	3 (2+1)	
9.	0140251091	CAC 311	Study tour (10-12 days during the semester)	2 (0+2) NG	
SEMESTER-VI					
1.	0140261012	FT 321	Food Additives and Preservatives	2 (1+1)	**21 (13+8)**
2.	0140261022	FT 322	Sensory Evaluation of Food Products	2 (1+1)	
3.	0140261032	FT 323	Processing Technology of Legumes and Oilseed	3 (2+1)	
4.	0140261042	FT 324	Food Refrigeration and Cold Chain	3 (2+1)	
5.	0140261052	FT 325	Processing of Meat, Fish and Poultry Products	3 (2+1)	
6.	0140261062	FT 326	Processing Technology of Beverages	3 (2+1)	
7.	0140261072	FT 327	Bakery, Confectionary and Snack Products	3 (2+ 1)	
8.	0140261082	FT 328	Processing Technology of Liquid Milk	2 (1+1)	
Fourth Year					
SEMESTER-VII					
1.	0140271012	FT 411	Food Process Equipment Design	3 (2+1)	**20**
2.	0140271022	FT 412	Processing Technology of Dairy Products	3 (2+1)	
3.	0140271032	FT 413	ICT Applications in Food Industry	3 (1+2)	
4.	0140271042	FT 414	Seminar	1 (0+1)	
5.		ELECT**	Elective Courses	10	
SEMESTER-VIII					
1.	0140288012	READY 421	Student Ready / Internship (at Industry/ Research Institutes, etc.) (20 weeks)	20 (0+20)	**20 (0+20)**
		MOOC etc	**Online courses**	6	**6**

***** Students can choose the SEC from the bouquet of SKILL ENHANCEMENT COURSES provided in the even and odd semesters as notified by the department in that semester. Student taking various SKILL ENHANCEMENT COURSES will be eligible to get a Certificate with Nomenclature as follows provided the student has selected courses as mentioned against the nomenclature of the UG-Certificate.

** Students can choose the ELECTIVE courses from the bouquet of elective courses as notified by the department in that semester.

Proposed Basket of Skill Enhancement Course Modules for Semester I to IV

Discipline/ Department	Course Code	Subject Code	Course Title	Credit hours
Food Technology	0140215011	SEC 111	Introduction to Drying Technology and Dryers	2 (0+2)
	0140215021	SEC 112	Introduction to Processing of Extruded Foods	2 (0+2)
	0140215031	SEC 113	Introduction to Milling (Rice, Dal, Spices, etc.)	2 (0+2)
Food Quality	0140215041	SEC 114	Introduction to Food Safety and Sanitation	2 (0+2)
	0140215051	SEC 115	Introduction to Good Laboratory Practices	2 (0+2)
	0140215061	SEC 116	Basic Food Analysis Laboratory Techniques	2 (0+2)
Food Engineering	0140215071	SEC 117	Introduction to Electrical and Control Systems in Food Industry	2 (0+2)
	0140215081	SEC 118	Introduction to Mechanical Systems in Food Industry	2 (0+2)
	0140215091	SEC 119	Introduction to AutoCAD	2 (0+2)
Food Plant Operations	0140225011	SEC 121	Maintenance of Food Processing Equipment	2 (0+2)
	0140225021	SEC 122	Introduction to Bottling and Canning Line	2 (0+2)
	0140225031	SEC 123	Introduction to Manufacturing of Bakery Products	2 (0+2)

Student taking various SKILL ENHANCEMENT COURSES will be eligible to get a Certificate with Nomenclature as follows provided the student has selected courses as mentioned against the nomenclature of the UG-Certificate. The students has to follow the following combination.

Nomenclature of Certificate	Skill Enhancement Courses to be selected from the respective disciplines	
	Semester-I	**Semester-II**
UG-Certificate in Food Technology (Food Plant Operations)	Food Engineering	Food Plant Operations
UG-Certificate in Food Technology (Food Manufacturing)	Food Technology	Food Plant Operations
UG-Certificate in Food Technology (Food Quality Testing)	Food Quality Assurance	Food Plant operations

ELECTIVE COURSES

Sr. No.	Course Code	Subject Code	Course Title	Credit hours
Food Technology				
1	0140277012	FTE 411	Introduction to Food Biotechnology	3 (2+1)
2	0140277022	FTE 412	Design and Formulation of Foods	3 (2+1)
3	0140277032	FTE 413	Traditional Indian Dairy Products	2 (1+1)
4	0140277042	FTE 414	Ice-cream and Frozen Desserts	3 (2+1)
5	0140277052	FTE 415	Instrumental Techniques in Food Analysis	2 (1+1)
6	0140277062	FTE 416	Food Plant Design and Layout	3 (2+1)
7	0140277072	FTE 417	Waste and By-Products Utilization	3 (2+1)
Food Quality Assurance				
1	0140277082	FQE 411	Industrial Microbiology	3 (2+1)
Food Engineering and Renewable				
1	0140277092	FEE 411	Instrumentation and Process Control in Food Industry	3 (1+2)
2	0140277102	FEE 412	Energy Conservation and Management	2 (1+1)
3	0140277112	FEE 413	Applications of Renewable Energy in Food Processing	2 (1+1)
Food Business Management				
1	0140277122	FBE 411	Business Management and Economics	2 (2+0)
2	0140277132	FBE 412	Statistical Methods and Numerical Analysis	2 (1+1)

Value Added Course (VAC)

S. No.	Course Code	Subject Code		Credit hours	Semester
1.	0180023112	ENV 121	Environmental Studies and Disaster Management	3 (2+1)	II
2.	0100043012	STAT-221	Agricultural Informatics and Artificial Intelligence	3 (2+1)	IV

Multi-Disciplinary Course (MDC)

1.	0110012012	AGRON 111	Farming based Livelihood systems	3 (2+1)	I
2.	0190132012	ECON-211	Entrepreneurship Development and Business Management	3 (2+1)	III
3.	0190052032	ECON-311	Agricultural Marketing and Trade	3 (2+1)	V

Ability Enhancement Course (AEC)

	0100014011/0100024021 and 0100014031/0100014041	NCC I/NSS I and NCC II/	National Cadet Corps/National Service Secheme	1 (0+1)	I/II

		NSS II			
	0130014012	EXT 111	Communication Skills	2 (1+1)	I
	0130024032	EXT 121	Personality development	2 (1+1)	II
	0100034011	PHE-211	Physical Education, First Aid and Yoga Practices	2 (0+2)	III

Non Gradial

1.	01000111011	IFC 111	*Deeksharambh* (Induction-cum-Foundation Course) of 2 credits (2 weeks duration)	2	I
2.	0140251091	CAC-311	Study tour (10-14 days)	2 (0+2)	V
3.			Online Course	06	

B.Tech. Food Technology – I Year				
Semester-I				
S. No.	**Course Code**	**Subject Code**	**Course Title**	**Credit hours**
1.	0100111011	IFC 111	*Deeksharambh* (Induction-cum-Foundation Course of 2 weeks)	2 (0+2) Non-Gradial
2.	0140211012	FT 111	Fundamentals of Food Processing	3 (2+1)
3.	0140211022	EE 111	Workshop Technology	3 (1+2)
4.	0140211032	ETE 111	Basic Electrical Engineering	3 (2+1)
5.	0140211042	MIC 111	General Microbiology	3 (2+1)
6.	0110012012	AGRON 111	Farming Based Livelihood System	3 (2+1)
7.	0130014012	EXT 111	Communication Skills	2 (1+1)
8.	0100014011	NCC-I	National Cadet Corps-I	1 (0+1)
9.	0100014021	NSS-I	National Service Scheme-I	1 (0+1)
10.		SEC I*	Skill Enhancement Course- I	2 (0+2)
11.		SEC II*	Skill Enhancement Course - II	2 (0+2)

***** Students can choose the SEC from the bucket of SKILL ENHANCEMENT COURSES provided in the even and odd semesters as notified by the department in that semester

Detailed Syllabi

Eternal University, Baru Sahib

Dr. Khem Singh Gill Akal College of Agriculture

1.	**Course Code: 0100111011**	**Subject Code: IFC-111**	**Course Title: Deeksharambh (Induction-cum-Foundation Course)**	
2.	**Semester: I**		**Credits: 2 (0+2)**	
3.	**Contact Hours:**		**P: 4**	
4.	**Relative weightage:**	**MTE: 24**	**Quiz/PA: 16**	**FPE: 40**
5.	**Objective:**			
I.	To familiarize students with the University system, academic environment, campus facilities, and institutional policies.			
II.	To orient students about the structure, credit system, and academic expectations of the B.Sc. (Hons.) Agriculture program under NEP 2020.			
III.	To help students develop essential life skills including communication, time management, and emotional well-being for personal and academic growth.			
IV.	To create awareness among students about the role of agriculture in national development and introduce them to basic farming practices and agri-based opportunities.			
6.	**Course Outcomes:**			
CO1	Students will understand the University's vision, mission, rules, and support systems, enabling smooth integration into campus life.			
CO2	Students will be able to navigate the academic structure, credit system, and evaluation methods of the B.Sc. (Hons.) Agriculture program.			
CO3	Students will build confidence, leadership, stress and time management skills while upholding empathy, ethics, and core human values for personal and professional growth.			
CO4	Students will gain basic awareness of rural agricultural systems, farmers' challenges, and the importance of agriculture in India's economy.			

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PO1**
CO1	1	1	1	1	2	3	1	1	1	1	2	1
CO2	2	2	1	1	2	3	1	1	1	1	1	2
CO3	1	1	1	1	3	3	1	1	1	2	3	1
CO4	2	2	1	1	3	2	2	1	1	3	2	2
Average	**1.5**	**1.5**	**1**	**1**	**2.5**	**2.75**	**1.25**	**1**	**1**	**1.75**	**2**	**1.5**

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

7.	**Details of Course:**	
Units	**Particulars**	**No. of Lectures**
I	**Institutional Orientation** • **Introduction to the University:** Understanding the vision, mission,	**8**

	departments, academic structure, and key administrative units. • **Rules and Regulations:** Overview of institutional policies, academic regulations, and student responsibilities. • **Faculty and Peer Interaction:** Meet-and-greet sessions with faculty members, department heads, and fellow students. • **Campus Familiarization:** Guided tour of campus facilities including research farms, laboratories, library, IT services, hostels, health center, and sports amenities. • **Student Support Services:** Awareness about career counseling, student welfare units, grievance redressal mechanisms, anti-ragging committee, and mentorship programs. • **Holistic Development Platforms:** Introduction to co-curricular and extracurricular clubs, NSS/NCC units, and cultural committees. • **University Code of Conduct:** Briefing on discipline, ethical conduct, safety protocols, and digital responsibility on campus.	
II	**Academic Orientation** • **Program Overview:** Introduction to the structure, duration, curriculum, and expected outcomes of the B.Sc. (Hons.) Agriculture program. • **Academic System:** Understanding the credit system, course registration process, grading patterns, attendance norms, and academic progression. • **Curriculum Framework:** Overview of the New Education Policy (NEP 2020) and ICAR's Sixth Deans Committee recommendations and their implementation in the academic structure. • **Academic Integrity:** Emphasis on ethics in academics, awareness about plagiarism, correct citation methods, and responsible use of academic materials. • **Digital Literacy:** Introduction to Learning Management Systems (LMS), online academic resources, e-books, databases, and digital tools to enhance learning. • **Experiential Learning:** Briefing on RAWE (Rural Agricultural Work Experience), internships, research projects, and hands-on training programs integrated into the curriculum. • **Mentorship and Academic Support:** Explanation of the student mentorship system, progress monitoring mechanisms, academic counseling, and remedial support services.	**7**
III	**Personality and Skill Development** • **Time Management and Goal Setting:** Strategies for effective time planning, prioritization, and achieving academic and personal goals. • **Stress Management Techniques:** Methods to manage academic pressure and personal stress through practical exercises and positive coping mechanisms. • **Soft Skills Development:** Enhancing communication, teamwork, leadership,	**8**

	and interpersonal skills to build confidence and professionalism. • **Yoga and Meditation:** Incorporation of mindfulness practices for improving concentration, emotional balance, and mental wellness. • **Motivational Sessions and Self-Awareness Activities:** Engaging sessions to foster self-reflection, confidence building, and personal growth. • **Ethics and Human Values:** Understanding the importance of honesty, empathy, respect, and ethical behavior in academic and social settings. • **Cyber Safety and Digital Responsibility:** Awareness about cybercrime, safe digital practices, and responsible online behavior.	
IV	**Rural and Agricultural Orientation** • **Overview of Indian Agriculture:** Introduction to the role and significance of agriculture in the Indian economy and rural development. • **Exposure to Practical Agriculture:** Visits to university research farms, demonstration plots, and agricultural laboratories. • **Farming Systems and Sustainability:** Basics of diverse farming systems, natural resource management, and principles of sustainable agriculture. • **Interaction with Experts:** Guest lectures by progressive farmers, successful alumni, and agri-entrepreneurs to share real-world experiences. • **Farmer Field Visits:** Hands-on exposure through visits to fields of progressive farmers and direct interaction on innovative practices. • **Skill-Based Learning:** Promotion of agricultural entrepreneurship and skill development through live demonstrations and workshops. • **Agri-Institutional Awareness:** Understanding the role of agricultural institutions, rural development programs, and entrepreneurship models.	**7**
	Total Lectures:	**30**

Eternal University, Baru Sahib
Dr. Khem Singh Gill Akal College of Agriculture

1.	**Course Code: 0140211012**	**Subject Code: FT 111**	**Course Title: Fundamentals of Food Processing**		
2.	**Semester: I**		**Credits: 3 (2+1)**		
3.	**Contact Hours:**	**L: 2**	**P: 2**		
4.	**Relative weightage:**	**MTE: 24**	**ETE: 48**	**Quiz/PA: 24**	**FPE: 24**
5.	**Objectives:**				
I.	Understand the classification of foods, their sources, perishability, and causes of spoilage.				
II.	Learn the principles, methods, and equipment used in heat and cold preservation.				
III.	Explore different preservation techniques like drying, dehydration, irradiation, and chemical preservation.				
IV.	Study fermentation-based preservation and emerging non-thermal food processing technologies.				
6.	**Course Outcomes:**				
CO1	Students will have ability to classify foods, identify spoilage types, and understand the need for preservation				
CO2	Students will gain knowledge of heat and cold-based preservation techniques and their impact on food quality.				
CO3	Students will have proficiency in using drying, dehydration, irradiation, and chemical methods for food preservation				
CO4	Students will have capability to evaluate food quality and determine the shelf-life of preserved products				

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	3	3	2	1	2	1	3	2	2	2	1	1
CO2	3	3	3	2	2	1	3	3	2	2	1	1
CO3	3	3	3	2	2	1	3	3	3	3	2	2
CO4	2	3	3	2	2	2	3	3	3	3	2	2
Average	**2.75**	**3**	**2.75**	**1.75**	**2**	**1.25**	**3**	**2.75**	**2.5**	**2.5**	**1.5**	**1.5**

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

7. Details of Course:

Units	**Particulars**	**No. of Lectures**
I	Food: Definition and Functions, Classification of foods, sources, types and perishability of foods; Causes and types of food spoilage; Scope and benefit of food preservation. Food processing: Introduction, levels and techniques; Methods of food preservation; Preservation by salt and sugar: Principle, method and effect on food quality	**8**
II	Preservation by heat treatment: Principle, process and equipment for blanching, canning, pasteurization, sterilization. Preservation by use of low temperature: Principle, methods, equipment.	**7**
III	Preservation by drying, dehydration and concentration: Principle, methods, equipment. Preservation by irradiation: Principle, methods, equipment.	**8**

	Preservation by chemicals- antioxidants, mould inhibitors, antibodies, acidulants, Hurdle technology etc	
IV	Preservation by fermentation: Principles, methods, equipment. Non-thermal preservation processes: Principles, equipment – Pulsed electric field and pulsed intense light, ultrasound, dielectric heating, ohmic and infrared heating, high pressure processing, microwave processing, Cold Plasma technology, etc. Quality tests and shelf-life of preserved foods.	**7**
	Total Lectures:	**30**

8 Practical

Units	**Content of Practical's**	**No. of Practicals**
I	Demonstration of various perishable food items and degree of spoilage; Blanching of selected food items.	**3**
II	Preservation of food by heat treatment- pasteurization; Preservation of food by high concentration of sugar: Jam; Preservation of food by using salt: Pickle.	**3**
III	Preservation of food by using acidulants i.e. pickling by acid, vinegar or acetic acid; Preservation of food by using chemical preservatives.	**3**
IV	Preservation of bread, cake using mold inhibitors; Drying of fruit slices pineapple slices, apple slices in cabinet drier; Drying of green leafy vegetables; Drying of mango/ other pulp by foam-mat drying.	**3**
V	Drying of semisolid foods using roller dryers. Drying of foods using freeze-drying process. Demonstration of preserving foods under cold vs. freezing process; Processing of foods using fermentation technique, i.e. preparation of sauerkraut. Study on effect of high pressure on microbe. Study on effect of pulse electric field on food.	**3**
	Total Practical's:	**15**

9. Suggested Books/Readings:

S. No.	**Authors/ Name of Books/Publishers**
1.	Brennan, J. G. (2006). *Food Processing handbook*. Wiley-VCH Verlag GmbH & Co. KGaA.
2.	Fellows, P. (2000). *Food Processing Technology: Principles and Practice* (2nd ed.). CRC Press.
3.	Karel, M., & Lund, D. B. (2003). *Physical Principles of Food Preservation* (2nd ed.). Marcel Dekker.
4.	Potter, N. N., & Hotchkiss, J. H. (1995). *Food Science* (5th ed.). Chapman & Hall.
5.	Rahman, M. S. (2007). *Handbook of Food Preservation* (2nd ed.). CRC Press.
6.	Tewari, G., & Juneja, V. K. (2007). *Advances in Thermal and Non-Thermal Food Preservation*. Blackwell Publishing.
7.	Yanniotis, S. (2008). *Solving Problems in Food Engineering*. Springer Science + Business Media.

Eternal University, Baru Sahib
Dr. Khem Singh Gill Akal College of Agriculture

1.	**Course Code: 0140211022**	**Subject Code: EE 111**	**Course Title: Workshop Technology**		
2.	**Semester: I**		**Credits: 3(1+2)**		
3.	**Contact Hours:**	**L: 1**	**P: 4**		
4.	**Relative weightage:**	**MTE: 24**	**ETE: 48**	**Quiz/PA: 24**	**FPE: 24**
5.	**Objectives:**				
I.	To familiarize students with various engineering materials, including their properties, classifications, and industrial applications.				
II.	To provide knowledge of workshop safety, measurement techniques, and Indian Factory Acts related to safety practices				
III.	To introduce basic workshop operations such as welding, forging, carpentry, machining, and sheet metal work, including tools and equipment used.				
IV.	To enable students to estimate cost and machining time for different manufacturing operations				
6.	**Course Outcomes:**				
CO1	Identify and classify various ferrous, non-ferrous, and non-metallic engineering materials along with their properties and practical applications.				
CO2	Demonstrate awareness of workshop safety protocols and apply basic measuring and gauging techniques in mechanical operations				
CO3	Apply appropriate tools, techniques, and processes in welding, forging, carpentry, machining, and sheet metal work				
CO4	Estimate material requirements, machining time, and cost for different manufacturing and fabrication processes using workshop calculations				

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	3	2	2	1	2	1	3	2	2	2	1	1
CO2	2	3	2	2	2	2	2	2	1	1	1	1
CO3	3	3	3	3	2	2	3	3	2	2	2	2
CO4	3	3	3	2	2	2	3	3	2	2	2	2
Average	**2.75**	**2.75**	**2.5**	**2**	**2**	**1.75**	**2.75**	**2.5**	**1.75**	**1.75**	**1.5**	**1.5**

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

7. Details of Course:

Units	**Particulars**	**No. of Lectures**
I	Introduction to basic materials: Ferrous and non-ferrous metals, timber, abrasives, silica, ceramics, glasses, graphite, diamond, plastics, polymers, and composite materials — their properties and applications. Workshop safety measures and Indian Factory Acts related to safety. Measuring and gauging: Basic measuring instruments and gauges used in workshops	**5**
II	Heat treatment processes: Hardening, tempering, annealing, normalizing — definitions and applications. Welding: Types of welding (gas and arc), types of joints, electrodes, flames, edge preparation, welding equipment and techniques. Soldering and brazing: Introduction, uses, and cost estimation	**4**

	methods	
III	Smithy and forging: Tools, equipment, and types of forging operations. Carpentry: Carpentry tools, types of wood and their characteristics, machines like band saw, wood lathe, circular saw, wood planer, etc. Sheet metal work: Types of operations, joints, allowances, and estimation of sheet metal work cost.	**3**
IV	Machinery: Introduction and use of lathe, power hacksaw, shaper and planner, drilling, grinder, and CNC machines. Concepts of length of cut, feed, depth of cut, RPM, cutting speed, time, and allowances. Estimation of machining time for lathe, shaping, slotting, and planning operations. Work holding and tool holding devices.	**3**
	Total Lectures:	**15**

8. Practical

Units	**Content of Practical's**	**No. of Practicals**
I	Identification of different materials of manufacture. Demonstration of different measuring instruments and measurement techniques. Identification of various hand tools. Demonstration of various power tools and machine tools	**8**
II	Simple exercises in filing, fitting, chipping, hack sawing, chiseling, tapping, etc.	**2**
III	Introduction to welding machines, processes, tools, their use, and safety precautions. Simple exercises on arc welding. Simple exercises in gas welding	**6**
IV	Demonstration of various casting processes, equipment, tools, and their use. Exercises on mould making using one-piece and two-piece patterns. Demonstration of mould making using sweep and match plate patterns.	**6**
V	Simple exercises on turning: Step turning, taper turning, drilling, and threading. Introduction to shaper and plan////C/.,VV,,V,,,,C88VOO er machines and preparation of jobs on them. Introduction to drilling machines and preparation of related jobs. Demonstration of other important operations and preparation of additional jobs	**8**
	Total Practicals:	**30**

9. Suggested Books/Readings:

S. No.	**Authors/ Name of Books/Publishers**
1.	Chapman, W. A. J. (2009). *Workshop Technology: Parts I and II*. Arnold Publishers (India) Pvt. Ltd.
2.	Hazra Choudari, S. K., & Bose, S. K. (2003). *Elements of Workshop Technology: Vols. I and II*. Media Promoters and Publishers Pvt. Ltd.
3.	Raghuwansi, B. S. (1996). *A Course in Workshop Technology: Vols. I and II*. Dhanpat Rai and Sons.

Eternal University, Baru Sahib
Dr. Khem Singh Gill Akal College of Agriculture

1.	**Course Code: 0140211032**	**Subject Code: ETE 111**	**Course Title: Basic Electrical Engineering**		
2.	**Semester: I**		**Credits: 3(2+1)**		
3.	**Contact Hours:**	**L: 2**	**P: 2**		
4.	**Relative weightage:**	**MTE: 24**	**ETE: 48**	**Quiz/PA: 24**	**FPE: 24**
5.	**Objectives:**				
I.	To familiarize students with various engineering materials, including their properties, classifications, and industrial applications.				
II.	To provide knowledge of workshop safety, measurement techniques, and Indian Factory Acts related to safety practices				
III.	To introduce basic workshop operations such as welding, forging, carpentry, machining, and sheet metal work, including tools and equipment used.				
IV.	To enable students to estimate cost and machining time for different manufacturing operations				
6.	**Course Outcomes:**				
CO1	Identify and classify various ferrous, non-ferrous, and non-metallic engineering materials along with their properties and practical applications.				
CO2	Demonstrate awareness of workshop safety protocols and apply basic measuring and gauging techniques in mechanical operations				
CO3	Apply appropriate tools, techniques, and processes in welding, forging, carpentry, machining, and sheet metal work				
CO4	Estimate material requirements, machining time, and cost for different manufacturing and fabrication processes using workshop calculations				

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	3	2	2	1	2	1	3	2	1	1	1	1
CO2	2	3	2	2	2	2	2	2	1	1	1	1
CO3	3	3	3	3	2	2	3	3	2	2	2	2
CO4	3	3	3	2	2	2	3	3	2	2	2	2
Average	**2.75**	**2.75**	**2.5**	**2**	**2**	**1.75**	**2.75**	**2.5**	**1.5**	**1.5**	**1.5**	**1.5**

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

7. Details of Course:

Units	**Particulars**	**No. of Lectures**
I	Definitions of cycle, frequency, time period, amplitude, Peak value, RMS value, Average value, Electromotive force. Magnetic circuits: composite magnetic circuits, magnetic leakage, hysteresis, and eddy currents. Phase relations and vector representation. AC through resistance, inductance, and capacitance. AC series and parallel circuits (Simple R-L, R-C, and R-L-C circuits). Current, Voltage, Power, Circuit elements, Ohm's law	**8**
II	Star and Delta connections: relationship between line and phase voltages and currents. Methods of single and three-phase power measurement. Working	**7**

	principle and construction of single-phase transformers (core type and shell type). EMF equation, phasor diagrams, no-load and loaded conditions. Ideal transformers, equivalent circuits, transformer losses, efficiency, and regulation. Open and short circuit tests	
III	Single-phase induction motors: Double field revolving theory, characteristics, phase split, and shaded pole motors. Poly-phase induction motors: Construction, operation, equivalent circuit, production of rotating magnetic field, torque equation, rotor resistance effect, starting and speed control. Alternators: Principle, rotor types, EMF equation. DC Machines (Generator and Motor): Construction, types, operation, EMF equation, armature reaction, commutation, characteristics, starting, and speed control. Concepts of maximum demand charge. Load factor, Power factor and its improvement techniques.	**8**
IV	Electric Power Economics: Maximum demand charge, Load factor, Power factor and power factor improvement, Measuring Equipment's: Classification, Characteristics of different electrical measuring systems and equipment's. Electrical Wiring: system of wiring, domestic wiring installation, industrial electrification. Protection devices: Earthing, Circuit protection devices, fuses, ELCB and relays.	**7**
	Total Lecture:	**30**

8 Practical

Units	**Content of Practical's**	**No. of Practicals**
I	Study of voltage resonance in L.C.R. circuits at constant frequency: (a) Star connection study of voltage and current relation. (b) Delta connection study of voltage and current relation. Measurement of Power in 3 phase circuit by wattmeter and energy meter: (a) for balanced loads, (b) for unbalanced loads.	**3**
II	Polarity test, no-load test, efficiency and regulation test of single-phase transformer, starting of induction motors by; (a) D.O.L. (b) Manual star delta (c) Automatic star delta starts. Starting of slip ring induction motors by normal and automatic rotor resistance starters.	**3**
III	Test on 3 phase induction motor- determination of efficiency, line current, speed slip and power factor at various outputs. Determination of relation between the induced armature voltage and speed of separately excited D.C. generator.	**3**
IV	Magnetization characteristics of D.C. generator. Study the starter connection and started reversing and adjusting speed of a D.C. motor.	**3**
V	Problems on Industrial Electrification. Study of various circuit protection devices. Study of various measuring instruments.	**3**
	Total Practical's:	**15**

9 Suggested Books/Readings:

S. No.	**Authors/ Name of Books/Publishers**
1.	Theraja, B. L., & Theraja, A. K. (2005). *A Textbook of Electrical Technology: Vol. II*. S. Chand and Company Ltd.
2.	Toro, V. D. (2000). *Electrical Engineering Fundamentals*. Prentice-Hall India Private Ltd.

Eternal University, Baru Sahib
Dr. Khem Singh Gill Akal College of Agriculture

1.	**Course Code: 0140211042**	**Subject Code: MIC 111**	**Course Title: General Microbiology**		
2.	**Semester: I**		**Credits: 3(2+1)**		
3.	**Contact Hours:**	**L: 2**	**P: 2**		
4.	**Relative weightage:**	**MTE: 24**	**ETE: 48**	**Quiz/PA: 24**	**FPE: 24**
5.	**Objectives:**				
I.	Understand the historical development and classification of microorganisms, including contributions of key scientists like Leeuwenhoek, Pasteur, and Koch.				
II.	Explore the structural features, metabolic functions, and growth patterns of microbial cells				
III.	Learn the techniques for cultivation, isolation, enumeration, and preservation of microorganisms				
IV.	Gain knowledge of microbial control methods, microscopy techniques, and the basics of bacterial genetics and molecular biology.				
6.	**Course Outcomes:**				
CO1	Students will understand the historical evolution of microbiology and classification of micro-organisms based on their characteristics and taxonomy.				
CO2	Students will describe the ultrastructure of microbial cells and interpret microbial growth dynamics and metabolic processes.				
CO3	Students will gain the ability to demonstrate the ability to cultivate, isolate, enumerate, and preserve microorganisms using appropriate laboratory techniques.				
CO4	Students will apply knowledge of microbial control methods, microscopy, and molecular genetics in identifying and studying microorganisms.				

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO5**	**PSO6**
CO1	3	2	1	1	2	1	3	2	2	2	1	1
CO2	3	3	2	2	2	1	3	3	2	2	1	1
CO3	3	3	3	3	2	2	3	3	3	2	2	2
CO4	3	3	3	3	2	2	3	3	3	3	2	2
Average	**3**	**2.75**	**2.25**	**2.25**	**2**	**1.5**	**3**	**2.75**	**2.5**	**2.25**	**1.5**	**1.5**

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

7. Details of Course:

Units	**Particulars**	**No. of Lectures**
I	Scope and history of microbiology: (notable contributions of Leeuwenhoek, Pasteur, Koch, etc.), Place of Microorganisms in living world; Groups of microorganisms; Applied area of microbiology, Classification and identification of micro-organism; Major Characteristics of Microorganisms, Methods of classification of bacteria.	**8**
II	Microscopy: Introduction to microscope; Component of microscope; Types of	**7**

	microscope and Microscopic techniques. Microbial Ultra Structure and Functions: Morphological features; Structures external to cell wall, Cell wall; Structures internal to cell wall.	
III	Bacterial Metabolism and Growth: Reproduction of bacteria; Growth of bacteria: growth curve, continuous culture, synchronous culture. Cultivation and preservation of micro-organisms: Nutritional requirements; Types of media. Physical condition required for the growth; Enumeration methods for micro-organisms. Methods of isolation of pure cultures; Maintenance and preservation of pure cultures; Culture collections.	**8**
IV	Control of microorganisms: Physical and Chemical agents. Bacterial genetics. Structure and functions of DNA and RNA; Overview of replication and regulation.	**7**
	Total Lectures:	**30**

8. Practical

Units	**Content of Practical's**	**No. of Practical's**
I	Microscopy; Micrometry; Cleaning and sterilization of glassware and acquainting with equipment used in microbiology.	**3**
II	Preparation of nutrient agar media and techniques of inoculation.	**3**
III	Staining methods (monochrome staining, gram staining, negative staining, capsule- staining, flagella staining and endospore staining).	**3**
IV	Pure culture techniques (streak plate/pour plate/spread plate); Identification procedures (morphology and cultural characteristics).	**3**
V	Growth characteristics of fungi: Determination of microbial numbers, direct plate count, generation time; Factors influencing growth: pH, temperature, growth curves for bacteria.	**3**
	Total Practical's:	**15**

9. Suggested Books/Readings:

S. No.	**Authors/ Name of Books/Publishers**
1.	Pelczar, M. J., Jr., Chan, E. C. S., & Krieg, N. R. (1998). *Microbiology* (5th ed.). Tata McGraw-Hill Education.
2.	Tortora, G. J., Funke, B. R., & Case, C. L. (2014). *Microbiology: An Introduction* (12th ed.). Prentice-Hall.
3.	Willey, J. M., Sherwood, L. M., & Woolverton, C. J. (2013). *Prescott's Microbiology* (9th ed.). McGraw-Hill Higher Education.

Eternal University, Baru Sahib
Dr. Khem Singh Gill Akal College of Agriculture

1.	**Course Code: 0110012012**	**Subject Code: AGRON-111**	**Course Title: Farming Based Livelihood Systems**		
2.	**Semester: I**		**Credits: 3 (2+1)**		
3.	**Contact Hours:**	**L: 2**	**P: 2**		
4.	**Relative weightage:**	**MTE: 24**	**ETE: 48**	**Quiz/PA: 24**	**FPE: 24**
5.	**Objectives:**				
I.	To study about the concept of farming systems and farming-based livelihoods.				
II.	To study about the integrated farming models and aquaculture-based systems				
III.	To evaluate the feasibility of farming systems across different agro-climatic ones				
IV.	To identify and analyze risk and success factors in farming-based livelihoods and to provide knowledge on government schemes and programs				
6.	**Course Outcomes:**				
CO1	Students will understand about the status of agriculture in India and approx state concept of livelihood concept of farming system and their roles in livelihood.				
CO2	Students will understand about the components of farming system, farming waste livelihood and aquaculture system.				
CO3	Students will be able to explain the farming system across different agro-climatic zone and commercial farming waste livelihood model developed by NABARD, ICAR and other Institution.				
CO4	Students will grow knowledge of government scheme, programme and role of public and private organization in promoting farming waste livelihood system.				

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	**PSO 6**
CO1	3	2	1	1	2	2	3	2	2	2	1	1
CO2	3	2	2	1	2	2	3	2	2	2	1	1
CO3	3	3	2	2	2	2	3	3	2	2	1	1
CO4	3	3	2	2	2	2	3	3	2	2	2	2
Average	**3**	**2.5**	**1.75**	**1.5**	**2**	**2**	**3**	**2.5**	**2**	**2**	**1.25**	**1.25**

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

7. Details of Course:

Units	**Particulars**	**No. of Lectures**
I	Status of agriculture in India and different states, Income of farmers and rural people in India, Livelihood-Definition, concept and livelihood pattern in urban and rural areas, Different indicators to study livelihood systems. Agricultural livelihood systems (ALS): Meaning, approach, approaches and framework, Definition of farming systems and farming based livelihood systems Prevalent Farming systems in India contributing to livelihood. Types of traditional and modern farming systems.	**8**
II	Components of farming system/ farming-based livelihood systems- Crops and cropping systems, Livestock (Dairy, Piggery, Goatry, Poultry, Duckery	**7**

	etc.), Horticultural crops, Agro--forestry systems, Aqua culture Duck/Poultry cum Fish, Dairy cum Fish, Piggery cum Fish etc., Small-, medium- and large- enterprises including value chains and secondary enterprises as livelihood components for farmers, Factors affecting integration of various enterprises of farming for livelihood.	
III	Feasibility of different farming systems for different agro-climatic zones, Commercial farming-based livelihood models by NABARD, ICAR and other organizations across the country, Case studies on different livelihood enterprises associated with the farming.	**8**
IV	Risk and success factors in farming-based livelihood systems, Schemes and programs by Central and State Government, Public and Private organizations involved in promotion of farming-based livelihood opportunities. Irrigation- methods, fertilizers application in horticultural crops	**7**
	Total Lectures:	**30**

8. Practical

Units	Content of Practical's	No. of Practicals
I	Survey of farming systems and agricultural based livelihood enterprises. Study of components of important farming based livelihood models/ systems in different agro-climatic zones	**3**
II	Study of production and profitability of crop based, livestock based, processing based and integrated farming based livelihood models.	**3**
III	Field visit of innovative farming system models.	**2**
IV	Visit of Agri-based enterprises and their functional aspects for integration of production, processing and distribution sectors and Study of agri-enterprises involved in industry and service sectors (Value Chain Models)	**4**
V	Learning about concept of project formulation on farming-based livelihood systems along with cost and profit analysis. Case study of Start-Ups in agri-sectors	**3**
	Total Practicals:	**15**

9. Suggested Books/Readings:

S. No.	Authors/ Name of Books/Publishers
1.	Panwar, P. (2020). *Integrated Farming System Models for Agricultural Diversification, Enhanced Income and Employment*. Indian Council of Agricultural Research.
2.	Reddy, S. R. (2016). *Farming System and Sustainable Agriculture*. Kalyani Publishers.
3.	Singh, J. P. (2015). *Region Specific Integrated Farming System Models*. ICAR-Indian Institute of Farming Systems Research.
4.	Walia, S. S., & Walia, U. S. (2020). *Farming System and Sustainable Agriculture*. Scientific Publishers.

Eternal University, Baru Sahib
Dr. Khem Singh Gill Akal College of Agriculture

1.	**Course Code: 0130014012**	**Subject Code: EXT-111**	**Course Title: Communication Skills**		
2.	**Semester: I**		**Credits: 2(1+1)**		
3.	**Contact Hours:**	**L: 1**	**P:2**		
4.	**Relative weightage:**	**MTE: 16**	**ETE: 32**	**Quiz/PA: 16**	**FPE: 16**
5.	**Objectives:**				
I.	To develop an in-depth understanding of the communication process, emphasizing its significance in building self-esteem and overcoming communication barriers				
II.	To familiarize learners with various forms and models of communication and to identify barriers that lead to communication gaps or miscommunication.				
III.	To equip learners with fundamental skills in listening, speaking, reading and writing, along with practical exposure to précis writing, resume writing and vocabulary enhancement.				
IV.	To strengthen grammatical competence through the study of sentence structure, parts of speech and correct usage for effective written communication.				
6.	**Course Outcomes:**				
CO1	Learners will be able to comprehend the nature and importance of effective communication and apply it to enhance personal confidence and interpersonal effectiveness.				
CO2	Learners will be able to differentiate between verbal and non-verbal communication, analyze communication models and recognize linguistic and non-linguistic barriers.				
CO3	Learners will demonstrate the ability to apply basic communication skills and techniques relevant to academic, personal and professional contexts.				
CO4	Learners will be able to construct grammatically accurate sentences, apply rules of syntax and agreement and avoid common sentence faults in technical writing.				

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	2	2	1	2	3	2	2	1	1	3	3
CO2	2	2	2	1	2	2	2	2	1	1	2	2
CO3	3	3	3	2	2	3	3	2	2	2	3	3
CO4	3	2	3	1	2	2	3	2	2	2	2	2
Average	**2.5**	**2.25**	**2.5**	**1.25**	**2**	**2.5**	**2.5**	**2**	**1.5**	**1.5**	**2.5**	**2.5**

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

7. Details of Course:

Units	Particulars	No. of Lectures
I	Communication Process: The magic of effective communication; Building self-esteem and overcoming fears; Concept, nature and significance of communication process;	**3**
II	Meaning, types and models of communication; Verbal and non-verbal communication; Linguistic and non-linguistic barriers to communication and reasons behind communication gap/ miscommunication.	**4**

III	Basic Communication Skills: Listening, Speaking, Reading and Writing Skills; Precis writing/ Abstracting/ Summarizing; Style of technical communication Curriculum vitae/resume writing; Innovative methods to enhance vocabulary, analogy questions.	**4**
IV	Structural and Functional Grammar: Sentence structure, modifiers, connecting words and verbal's; phrases and clauses; Case: subjective case, possessive case; Objectives case; Correct usage of nouns, pronouns and antecedents, adjectives, adverbs and articles; Agreement of verb with the subject: tense, mood, voice; Writing effective sentences; Basic sentence faults	**4**
	Total Lectures:	**15**

8. Practical

Units	**Content of Practical's**	**No. of Practical's**
I	Listening and note taking. Precis writing. Summarizing and abstracting	**3**
II	Reading and comprehension (written) of general and technical articles. Reading and comprehension (oral) of general and technical articles. Micro-presentations	**3**
III	Impromptu presentations. Feedback on presentations. Public speaking exercises	**3**
IV	Grooming and body language. Voice modulation and speed. Group discussions	**3**
V	Vocabulary building. Interview techniques. Organization of events	**3**
	Total Practical's:	**15**

9. Suggested Books/Readings:

S. No.	**Authors/ Name of Books/Publishers**
1.	Brown, M., & Brandreth, G. (1994). *How to Interview and Be Interviewed*. Sheldon Press.
2.	Carnegie, D. (1997). *The Quick and Easy Way to Effective Speaking*. Pocket Books.
3.	Francis, P. S. J. (2012). *Soft Skills and Professional Communication*. Tata McGraw Hill.
4.	Krishnaswamy, N., & Krishnaswamy, L. (2021). *The Story of English in India*. Foundation Books.
5.	Kumar, S., & Pushpa Lata. (2011). *Communication Skills*. Oxford University Press.
6.	Mehrotra, R. R. (2020). *English Language Teaching: Approaches, Methods & Techniques*. Orient Blackswan.
7.	Neuliep, J. W. (2003). *Intercultural Communication: A Contextual Approach*. Houghton Mifflin Co.
8.	Pease, A. (1998). *Body Language*. Sudha Publications.
9.	Rai, U. S., & Rai, S. M. (2022). *Business Communication* (Revised ed.). Himalaya Publishing House.
10.	Raman, M., & Sharma, S. (2023). *Technical Communication: Principles and Practice* (3rd ed.). Oxford University Press.
11.	Raman, M., & Singh, P. (2000). *Business Communication*. Oxford University Press.
12.	Seely, J. (2013). *Oxford Guide to Effective Writing and Speaking*. Oxford University Press.
13.	Thomson, A. J., & Martinet, A. V. (1977). *A Practical English Grammar*. Oxford University Press.
14.	Brown, M., & Brandreth, G. (1994). *How to Interview and Be Interviewed*. Sheldon Press.

Eternal University, Baru Sahib
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1.	**Course Code: 0100014021**	**Subject Code: NSS-I**	**Course Title: National Service Scheme-I**	
2.	**Semester: I**		**Credits: 1(0+1)**	
3.	**Contact Hours:**	**P:2**		
4.	**Relative weightage:**	**MTE: 12**	**Quiz/PA: 08**	**FPE: 20**
5.	**Objectives:**			
I.	To introduce students to the foundational philosophy, structure, symbols, code of conduct and health awareness aspects of the National Service Scheme (NSS).			
II.	To acquaint students with planning and execution of various NSS activities, including special camping, adoption of villages/slums and integration with youth programs and financial management.			
III.	To provide an understanding of youth characteristics, their role as change agents and strategies for effective community mobilization through culturally appropriate communication.			
IV.	To instill values of social unity, cultural understanding and peaceful coexistence through the study of Indian history and the constructive role of youth in nation-building.			
V.	To promote the spirit of volunteerism, civic awareness, constitutional values and community engagement with emphasis on family, society and grassroots governance.			
6.	**Course Outcomes:**			
CO1	Learners will be able to explain the history, Objectivess, organizational structure and ethical code of NSS and demonstrate awareness of personal and community health as NSS volunteers.			
CO2	Learners will be able to design and organize NSS programs, conduct community surveys and coordinate effectively with government schemes and agencies.			
CO3	Learners will be able to analyze youth-related issues and implement community mobilization strategies involving stakeholder mapping and youth-adult collaboration.			
CO4	Learners will be able to demonstrate the significance of social harmony, resolve conflicts constructively and promote peace and national integration through NSS activities.			

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	2	2	3	2	3	2	2	2	3	2	3
CO2	2	3	2	3	3	3	2	3	2	3	3	3
CO3	2	3	2	3	3	3	2	3	2	3	3	3
CO4	2	2	2	3	2	3	2	2	2	3	2	3
CO5	2	3	2	3	3	3	2	3	2	3	3	3
Avg.	**2.0**	**2.6**	**2.0**	**3.0**	**2.6**	**3.0**	**2.0**	**2.6**	**2.0**	**3.0**	**2.6**	**3.0**

1= Weak Correlation 2 = Moderate Correlation 3 = Strong Correlation

7. Practical

Units	Content of Practical's	No. of Practicals
I	Orientation: history, Objectives, principles, symbol, badge; regular programs under NSS. Organizational structure of NSS, Code of conduct for NSS volunteers, points to be considered by NSS volunteers' awareness about health.	**3**
II	NSS program activities: Concept of regular activities, special camping, day camps, basis of adoption of village/slums, conducting survey, analyzing guiding financial patterns of scheme, youth program/ schemes of GOI, coordination with different agencies and maintenance of diary.	**3**
III	Understanding youth. Definition, profile, categories, issues and challenges of youth; and opportunities for youth who is agent of the social change. Community mobilization: Mapping of community stakeholders, designing the message as per problems and their culture; identifying methods of mobilization involving youth-adult partnership.	**3**
IV	Social harmony and national integration. Indian history and culture, role of youth in nation building, conflict resolution and peace- building.	**3**
V	Volunteerism and shramdaan. Indian tradition of volunteerism, its need, importance, motivation and constraints; shaman as part of volunteerism. Citizenship, constitution and human rights: Basic features of constitution of India, fundamental rights and duties, human rights, consumer awareness and rights and rights to information. Family and society. Concept of family, community (PRIs and other community- based organizations) and society	**3**
	Total Practicals:	**15**

8. Suggested Books/Readings:

S. No.	Authors/ Name of Books/Publishers
1.	Basu, D. D. (2021). *Introduction to the Constitution of India* (26th ed.). LexisNexis.
2.	Government of India. (2021). *National Service Scheme: Manual for NSS Functionaries* (Revised ed.). Ministry of Youth Affairs and Sports.
3.	Hasnain, N. (2021). *Indian Society and Culture* (Revised ed.). Jawahar Publishers & Distributors.
4.	IGNOU. (2022). *NSS Study Material (BES-016)*. Indira Gandhi National Open University.
5.	Kapoor, S. K. (2022). *Human Rights and Duties*. Central Law Agency.
6.	Ministry of Youth Affairs and Sports. (2023). *Annual Report 2022–23*. Government of India.
7.	NITI Aayog. (2020). *Strategy for New India @75*. Government of India.
8.	UNESCO. (2021). *Global Citizenship Education: Topics and Learning Objectives*. UNESCO Publishing.
9.	United Nations Volunteers (UNV). (2022). *State of the World's Volunteerism Report 2022: Building Equal and Inclusive Societies*. United Nations.
10.	Youth Ki Awaaz. (2023). *Youth and Civic Engagement in India: A Report on Perception and Participation*. Youth Ki Awaaz Publications.

Eternal University, Baru Sahib
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1.	**Course Code: 0100014011**	**Subject Code: NCC-I**	**Course Title: National Cadet Corps-I**	
2.	**Semester: I**		**Credits: 1 (0+1)**	
3.	**Contact Hours:**	**P: 2**		
4.	**Relative weightage:**	**MTE: 30**	**Quiz/PA: 20**	**FPE: 50**
5.	**Objectives:**			
I.	To develop character, comradeship, discipline, leadership and secular outlook			
II.	To provide training to youth to develop qualities that make them useful citizens			
III.	To create a human resource of organized, trained and motivated youth			
IV.	To provide a suitable environment to motivate young people to join the Armed Forces			
6.	**Course Outcomes:**			
CO1	Understand the basic concept of NCC and its importance in national aspects.			
CO2	Practice togetherness, teamwork and empathy in all walks of their life.			
CO3	*Do* their own self-analysis and will work out to overcome their weakness for better performance in all aspects of life.			
CO4	Respect the diversity of different Indian culture.			

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	3	2	1	1	3	3	2	1	1	1	3	3
CO2	2	2	1	1	3	3	2	1	1	1	3	3
CO3	2	2	2	1	3	3	2	1	1	1	3	3
CO4	2	2	1	1	3	3	2	1	1	1	3	3
Average	**2.25**	**2**	**1.25**	**1**	**3**	**3**	**2**	**1**	**1**	**1**	**3**	**3**

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

7. Practical

Units	**Content of Practical's**	**No. of Practical's**
I	Introduction, Aims and Objectives of NCC, Organization of NCC viz., Drill, Drill without Arms, Foot drill, General and Words of Command, Ceremonial Drill, Attention, Stand at Ease and Stand Easy, turning and inclining at the halt, Sizing, forming up in three ranks and numbering, open and close order merchant dressing, Saluting at the halt, Marching, length of pace and time of marching in quick time and halt, slow march and halt, Turning on the march and wheeling	**6**
II	Incentives by the central Government and State Governments, Financial Assistance/Scholarships, Admission in Educational Institutes, Duties and Responsibilities of Cadets, Types of camps and Training activities in camp.	**3**
III	Importance and Essence of National Integration, Factor affecting National Integration, Measure to achieve National Integration, National Security and classification of threat	**4**

IV	Fundamentals of Unity in Diversity, Role of NCC in National Building, Drug Abuse, HIV AIDS, Introduction to home nursing, the roller bandage and mental and physical health studies.	**2**
	Total Practicals:	**15**

8. Suggested Books/Readings:

S. No.	Authors/ Name of Books/Publishers
1.	Directorate General National Cadet Corps. (2019). *Cadet's Handbook – Common Subjects: All Wings* (English ed.). DG NCC.
2.	Directorate General National Cadet Corps. (2019). *Cadet's Handbook – Specialized Subjects: Army, Navy, and Air Wing*. DG NCC.
3.	Gupta, R. K. (Ed.). (2023). *R. Gupta's National Cadet Corps: A Concise Handbook of NCC Cadets for 'A,' 'B,' and 'C' Certificate Examinations, Including Model Papers and Solved Questions* (26th ed.). Ramesh Publishing House.

S. No.	Course Code	Subject Code	Course Title	Credit hours	Total Credit hours
Semester-II					
1.	0140221012	FT 121	Post-Harvest Engineering	3 (2+1)	**23 (11+12)**
2.	0140221022	FT 122	Food Chemistry I	3 (2+1)	
3.	0140221032	FT 123	Unit Operations in Food Processing	3 (2+1)	
4.	0140221042	FT 124	Food Thermodynamics	3 (2+1)	
5.	0140221052	EE 121	Engineering Drawing and Graphics	3 (1+2)	
6.	0130024032	EXT 121	Personality Development	2 (1+1)	
7.	0180023112	ENV 121	Environmental Studies and Disaster Management	3 (2+1)	
8.	0100024031	NCC-II	National Cadet Corps-II	1 (0+1)	
9.	0100024041	NSS-II	National Services Secheme-II	1 (0+1)	
10.		SEC III*	Skill Enhancement Course - III	2 (0+2)	
11.		SEC IV*	Skill Enhancement Course - IV	2 (0+2)	

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1.	**Course Code: 0140221012**	**Subject Code: FT 121**	**Course Title: Post-Harvest Engineering**		
2.	**Semester: II**		**Credits: 3(2+1)**		
3.	**Contact Hours:**	**L: 2**	**P: 2**		
4.	**Relative weightage:**	**MTE: 24**	**ETE: 48**	**Quiz/PA: 24**	**FPE: 24**
5.	**Objectives:**				
I.	To introduce the fundamental concepts of post-harvest technology and provide an overview of agricultural crops, their production patterns, and associated post-harvest losses.				
II.	To impart knowledge on water activity, its control, and its impact on food quality, texture, and biochemical reactions during storage and processing.				
III.	To develop understanding of the engineering properties of food materials and familiarize students with cleaning, peeling, sorting, grading, shelling, and milling operations.				
IV.	To provide insight into the types, design, and functioning of material handling systems used in post-harvest processing for effective and efficient movement of produce.				
6.	**Course Outcomes:**				
CO1	Understand the concept of post-harvest technology, identify major agricultural crops, and analyze the causes and implications of post-harvest losses.				
CO2	Explain the principles of water activity, its influence on food quality and texture, and the techniques for moisture control in post-harvest handling				
CO3	Describe and evaluate the engineering properties of food materials and apply knowledge of cleaning, peeling, sorting, grading, shelling, and milling equipment used in post-harvest operations.				
CO4	Demonstrate the ability to select and design appropriate material handling systems including belt, screw, chain conveyors, bucket elevators, and pneumatic systems for efficient post-harvest management.				

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	3	2	2	1	2	2	3	2	2	2	1	1
CO2	3	3	2	2	2	2	3	3	2	2	1	1
CO3	3	3	3	3	2	2	3	3	3	3	2	2
CO4	3	3	3	3	2	2	3	3	3	3	2	2
Average	**3**	**2.75**	**2.5**	**2.25**	**2**	**2**	**3**	**2.75**	**2.5**	**2.5**	**1.5**	**1.5**

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

7. Details of Course:

Units	**Particulars**	**No. of Lectures**
I	Overview of Post-Harvest Technology. Concept and science, Introduction to different agricultural crops, their cropping pattern, production, harvesting and post-harvest losses, reasons for losses, importance of loss reduction, Post-Harvest Handling operations. Water Activity; Water binding and its effect on enzymatic and non-enzymatic reactions and food texture, control of water activity and moisture.	**8**
II	Engineering Properties of Food Materials; physical, thermal, aerodynamic,	**7**

	optical, mechanical, rheological and electromagnetic properties and their measurement. Cleaning; Cleaning of grains, washing of fruits and vegetables, types of cleaners, screens, types of screens, rotary screens, vibrating screens, machinery for cleaning of fruits and vegetables (air cleaners, washers), cleaning efficiency, care and maintenance; Peeling, Sorting, grading, methods of grading; Grading- Size grading, colour grading, specific gravity grading; screening, equipment for grading of fruits and vegetables, grading efficiency, care and maintenance	
III	Magnetic separator, destoners, electrostatic separators, pneumatic separator Decorticating and Shelling; Principles of working, design and constructional details, operating parameters, maintenance, etc. of various decorticators/dehullers/shellers, description of groundnut decorticators, maize shellers, etc.	**8**
IV	Milling, polishing, grinding, milling equipment, de-huskers, polishers (abrasion, friction, water jet), flour milling machines, pulse milling machines, grinders, cutting machines, oil expellers, machine efficiency and power requirement. Materials Handling; Introduction to different conveying equipment used for handling of grains; Scope and importance of material handling devices. Study of different Material Handling systems; Classification, principles of operation, conveyor system selection/design; Belt conveyor, Chain conveyor, Screw conveyor, Bucket elevator: Principle, characteristics, design, advantages, disadvantages.	**7**
	Total Lectures:	**30**

8. Practical

Units	Content of Practical's	No. of Practical's
I	Study of cleaners for grains; Study of washers for fruits and vegetables; Study of graders for grains; Study of graders for fruits and vegetables.	**3**
II	Study of decorticators; Study of a maize/ sunflower sheller.	**3**
III	Study of crop dryers; Study of a RF/MW/tray dryer; Study of hot air dryer and modelling drying kinetics; Study of vacuum dryer and modelling drying kinetics; Study of working principle of spray dryer and spray drying process.	**3**
IV	Study of drum dryer and liquid food dehydration using drum drying;. Study of fluidized bed dryer and drying process; Study of freeze dryer and freeze drying process.	**3**
V	Study of rice milling machines; Study of pulse milling machines; Study of different components of flour mill; Study of different materials handling equipment.	**3**
	Total Practical's:	**15**

9. Suggested Books/Readings:

S. No.	Authors/ Name of Books/Publishers
1.	Brennan, J. G. (2006). *Food Processing Handbook*. Wiley-VCH Verlag GmbH & Co. KGaA.
2.	Chakraverty, A. (2008). *Post Harvest Technology of Cereals, Pulses, and Oilseeds* (3rd ed.). Oxford and IBH Publishing Co. Pvt. Ltd.
3.	Dash, S. K., Bebartta, J. P., & Kar, A. (2012). *Rice Processing and Allied Activities*. Kalyani Publishers.
4.	Pandey, H., Sharma, H. K., Chauhan, R. C., Sarkar, B. C., & Bera, M. B. (2010). *Experiments in Food Process Engineering*. CBS Publishers & Distributors Pvt. Ltd.
5.	Sahay, K. M., & Singh, K. K. (2001). *Unit Operations of Agricultural Processing*. Vikas Publishing House Pvt. Ltd.

Eternal University, Baru Sahib
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1.	**Course Code: 0140221022**	**Subject Code: FT 122**	**Course Title: Food Chemistry I**		
2.	**Semester: II**		**Credits: 3(2+1)**		
3.	**Contact Hours:**	**L: 2**	**P: 2**		
4.	**Relative weightage:**	**MTE: 24**	**ETE: 48**	**Quiz/PA: 24**	**FPE: 24**
5.	**Objectives:**				
I.	To understand the role, types, and functional properties of water in foods, including concepts of water activity, sorption isotherms, and their impact on food stability and texture.				
II.	To study the structure, classification, and chemical and enzymatic reactivity of carbohydrates, including modifications and their digestibility.				
III.	To explore the structure, classification, functional properties, and nutritional aspects of proteins, along with changes induced by processing and methods of protein modification.				
IV.	To gain knowledge on the classification, chemical characteristics, and technological roles of lipids in foods, including oil processing, reactions affecting lipid stability, and use of antioxidants.				
6.	**Course Outcomes:**				
CO1	Students will explain the types, roles, and functional properties of water in foods, and analyze the effects of water activity and molecular mobility on food stability.				
CO2	Students will describe the structure, classification, and modifications of carbohydrates, and interpret their chemical and enzymatic behaviour in food systems				
CO3	Students will discuss the structural and functional properties of proteins, and evaluate the effects of food processing on protein quality and nutritional value.				
CO4	Students will analyze the structure, chemical properties, and reactions of lipids, including oil processing techniques and the role of antioxidants in lipid stabilization.				

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	3	3	2	1	2	2	3	2	2	2	1	1
CO2	3	3	2	1	2	2	3	3	2	2	1	1
CO3	3	3	3	2	2	2	3	3	3	2	1	1
CO4	3	3	3	2	2	2	3	3	3	2	1	1
Average	**3**	**3**	**2.5**	**1.5**	**2**	**2**	**3**	**2.75**	**2.5**	**2**	**1**	**1**

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

7. Details of Course:

Units	**Particulars**	**No. of Lectures**
I	Water; Moisture in foods, role and type of water in foods, functional properties of water, water activity and sorption isotherm, molecular mobility and foods stability; Dispersed systems of foods: Physicochemical aspects of food dispersion system (Sol, gel, foam, emulations); Rheology of diphase systems.	**8**
II	Carbohydrates; Monosaccharaides, disaccharides and polysaccharides, modification of carbohydrates, dietary fibres and carbohydrates digestibility; Enzymatic and chemical reactions of carbohydrates.	**7**
III	Proteins in foods: Proteins: Classification, structure and properties, Proteins and nutrition, Functional properties of proteins, Processing induced, physical, chemical and nutritional	**8**

	changes in protein, chemical and enzymatic modification of protein.	
IV	Lipids in foods: Classification, structure and properties of lipids; Role and use of lipids/ fat, crystallization and consistency, chemical aspects of lipids, lipolysis, auto-oxidation, thermal decomposition, chemistry of frying technology of fat and oil. Oil processing: Refining, hydrogenations, inter esterification, use of oils and fats in food formulation. Enzymatic and chemical reactions of fats; Rancidity and its types, detection techniques, chemical aspects of lipids, antioxidants	**7**
	Total Lectures:	**30**

8. Practical

Units	**Content of Practical's**	**No. of Practical's**
I	Determination of moisture content of foods using different methods	**3**
II	Studies of sorption isotherms of different foods; Swelling and solubility characteristics of starches; Rheological properties of food systems	**3**
III	Determination of crude proteins by micro-Kjeldhal method	**3**
IV	Determination of essential amino acids i.e. lysine, tryptophan, methionine, etc.; Isolation of egg and milk protein; Preparation of protein isolate and concentration of proteins	**3**
V	Determination of acid value, saponification value and iodine number of fat/oil; Assay of amylases, papain and lipases.	**3**
	Total Practicals:	**15**

9. Suggested Books/Readings:

S. No.	**Authors/ Name of Books/Publishers**
1.	Belitz, H. D., Grosch, W., & Schieberle, P. (2009). *Food Chemistry* (4th ed.). Springer-Verlag Berlin Heidelberg.
2.	Brady, J. W. (2013). *Introductory Food Chemistry*. Comstock Publishing Associates, Cornell University Press.
3.	Fennema, O. R. (1996). *Food Chemistry* (3rd ed.). Marcel Dekker, Inc.
4.	Meyer, L. H. (1974). *Food Chemistry*. The AVI Publishing Co., Inc.

Eternal University, Baru Sahib
Dr. Khem Singh Gill Akal College of Agriculture

1.	**Course Code: 0140221032**	**Subject Code: FT 123**	**Course Title: Unit Operations in Food Processing**		
2.	**Semester: II**		**Credits: 3(2+1)**		
3.	**Contact Hours:**	**L: 2**	**P: 2**		
4.	**Relative weightage:**	**MTE: 24**	**ETE: 48**	**Quiz/PA: 24**	**FPE: 24**
5.	**Objectives:**				
I.	To provide a comprehensive understanding of the principles and applications of evaporation, including system design, heat and mass transfer, and equipment used in food processing.				
II.	To impart knowledge on food freezing and freeze-drying techniques, including thermodynamic principles, freezing time estimation, equipment design, and quality changes during storage.				
III.	To introduce the concepts and equipment used in extraction, leaching, crystallization, and distillation, focusing on their principles, kinetics, and industrial applications.				
IV.	To familiarize students with key thermal processing methods such as baking, frying, blanching, pasteurization, sterilization, and aseptic processing, and understand their effects on food safety and quality.				
6.	**Course Outcomes:**				
CO1	Students will explain principles, design, and operation of evaporation systems, and analyze factors affecting heat and mass transfer during evaporation processes.				
CO2	Students will describe the science and technologies behind food freezing, freeze drying, and freeze concentration, including equipment, quality changes, and freezing time calculations.				
CO3	Apply principles of expression, extraction, leaching, crystallization, and distillation to food processing and evaluate relevant equipment and process kinetics				
CO4	Demonstrate understanding of various thermal and mechanical food processing methods such as baking, frying, blanching, pasteurization, sterilization, and aseptic processing, including the principles, equipment, and microbial effects.				

Mapping of Course Outcomess (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	3	3	3	2	2	2	3	3	2	2	1	1
CO2	3	3	3	2	2	2	3	3	2	2	1	1
CO3	3	3	3	3	2	2	3	3	3	3	2	2
CO4	3	3	3	3	2	2	3	3	3	3	2	2
Average	**3**	**3**	**3**	**2.5**	**2**	**2**	**3**	**3**	**2.25**	**2.25**	**1.5**	**1.5**

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

7. Details of Course:

Units	**Particulars**	**No. of Lectures**
I	Evaporation: Principles of evaporation, mass and energy balance, factors affecting rate of evaporation, thermodynamics of evaporation (phase change, boiling point elevation, Dühring plot; Heat and mass transfer in evaporator, factors influencing the overall heat transfer coefficient, influence of feed liquor properties on evaporation. Evaporation equipment: Natural circulation evaporators, horizontal/vertical short tube, natural circulation with external calandria, long tube, forced circulation; Evaporator ancillary plant, design of evaporation systems, single effect, multiple	**8**

	effect evaporators, feeding methods of multiple effect evaporation systems, feed preheating, vapour recompression systems; Fouling of evaporators and heat exchangers; Recompression heat and mass recovery and vacuum creating devices.	
II	Food freezing: Introduction, freezing point curve for food and water, freezing points of common food materials, Principles of food freezing, Freezing time calculation by using Plank's equation; Freezing systems; Direct contact systems, air blast immersion; Changes in foods; Frozen food properties; freezing time, factors influencing freezing time, freezing/thawing time; Freeze concentration: Principles, process, methods; Frozen food storage: Quality changes in foods during frozen storage; Freeze drying: Heat mass transfer during freeze drying, equipment and practice.	**7**
III	Expression and Extraction: liquid-liquid extraction processes, types of equipment and design for liquid-liquid extraction, continuous multistage counter current extraction; Leaching: process, preparation of solids, rate of leaching, types of equipment, equilibrium relations. Crystallization and dissolution: Theory and principles, kinetics, applications in food industry, equipment for crystallization. Distillation: Principles, vapour-liquid equilibrium, continuous flow distillation, batch/ differential distillation, fractional distillation, steam distillation, distillation of wines and spirits.	**8**
IV	Baking: Principles, baked foods, baking equipment; Roasting: Principles of roasting, roasting equipment. Frying: theory and principles, shallow or contact frying and deep fat frying, heat and mass transfer in frying, frying equipment; Puffing: Puffing methods, puffing equipment. Blanching: Principles and equipment; Pasteurization: Purpose, microorganisms and their reaction to temperature and other influences. Sterilization: Principles, process time, T-evaluation, design of batch and continuous sterilization, different methods and equipment, Aseptic processing: principles, analysis of thermal resilience, duration mathematics of conduction heating; Thermal processing and microbial death curves; Homogenization, Emulsification.	**7**
	Total Lectures:	**30**

8. Practical

Units	**Content of Practical's**	**No. of Practical's**
I	Study of working principle open pan and vacuum evaporator and estimation of heat/mass balance during concentration of liquid foods.	**3**
II	Study of single effect evaporator and estimation of heat/mass balance during concentration of liquid foods. Multiple effect evaporator and estimation of heat/mass balance during concentration of liquid foods.	**3**
III	Effect of sample particle size and time on solvent extraction process. Effect of temperature on crystallization rate of sugar. Study of freezers/ Design problems on freezers; To study freezing of foods by different methods IQF freezing. Determination of freezing time of a food material.	**3**
IV	To study simple distillation process and determine the rate of distillation. To study the process of roasting. To study the effect of time- temperature combination on roasting. Determination of oil uptake by the food product during frying.	**3**
V	To determine the efficacy of a blanching process; time-temperature combination for a blanching process; efficacy of a sterilization process. Determination of F value for a product in can/ retortable pouch; Study of sterilizer /blancher/ pasteurizers/ fryers/ homogenizers/ irradiators.	**3**
	Total Practical's:	**15**

9. Suggested Books/Readings:

S. No.	Authors/ Name of Books/Publishers
1.	Earle, R. L. (2004). *Unit Operations in Food Processing*. The New Zealand Institute of Food Science and Technology.
2.	Fellows, P. (2000). *Food Processing Technology: Principles and Practice* (2nd ed.). CRC Press.
3.	Ibarz, A., & Barbosa-Cánovas, G. V. (2003). *Unit Operations in Food Engineering*. CRC Press.

Eternal University, Baru Sahib
Dr. Khem Singh Gill Akal College of Agriculture

1.	**Course Code: 0140221042**	**Subject Code: FT 124**	**Course Title: Food Thermodynamics**		
2.	**Semester: II**		**Credits: 3(2+1)**		
3.	**Contact Hours:**	**L: 2**	**P: 2**		
4.	**Relative weightage:**	**MTE: 24**	**ETE: 48**	**Quiz/PA: 24**	**FPE: 24**
5.	**Objectives:**				
I.	To introduce the fundamental concepts of thermodynamics, including systems, properties, laws, and processes, with a focus on energy, heat, and temperature relationships.				
II.	To understand and apply the first and second laws of thermodynamics to various processes, including steady and unsteady flow, entropy, and energy availability				
III.	To analyze thermodynamic cycles, properties of pure substances, and psychrometric processes relevant to food and agricultural systems.				
IV.	To provide knowledge on steam generation, boiler operations, types, and draught systems, including steam properties and their practical applications using steam tables				
6.	**Course Outcomes:**				
CO1	Students will explain basic concepts and laws of thermodynamics, including energy, heat, work, enthalpy, and entropy, and apply them to various engineering systems.				
CO2	Students will Analyze thermodynamic cycles such as Carnot, Rankine, Otto, Diesel, and refrigeration cycles, and interpret phase diagrams and properties of pure substances.				
CO3	Evaluate psychrometric properties and processes including heating, cooling, humidification, and dehumidification using psychrometric charts and humidity concepts.				
CO4	Describe the types and components of boilers, steam generation systems, and draught mechanisms, and apply steam properties and calculations using steam tables.				

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	3	3	3	2	2	2	3	3	2	2	1	3
CO2	3	3	3	2	2	2	3	3	2	2	1	3
CO3	3	3	3	2	2	2	3	3	2	2	1	3
CO4	3	3	3	2	2	2	3	3	2	2	1	3
Average	**3**	**3**	**3**	**2**	**2**	**2**	**3**	**3**	**2**	**2**	**1**	**3**

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

7. Details of Course:

Units	**Particulars**	**No. of Lectures**
I	Basic concepts: definitions, approaches, thermodynamic systems, thermodynamic properties and equilibrium, state of a system, state diagram, path and process, different modes of work, Zeroth law of thermodynamics, concept of temperature, heat.	**8**
II	First law of thermodynamics: Energy, enthalpy, specific heats, applications of first law, steady and unsteady flow analysis. Second law of thermodynamics: Kelvin-Planck and Clausius statements, reversible and irreversible processes, entropy, availability and irreversibility.	**7**

III	Properties of Pure Substances: Thermodynamic properties of pure substances in solid, liquid and vapor phases, P-V-T behaviour of simple compressible substances, phase rule. Thermodynamic cycles: Carnot vapor power cycle, ideal Rankine cycle, air standard Otto cycle, air standard Diesel cycle, vapor-compression refrigeration cycle.	**8**
IV	Psychometry: thermodynamic properties of moist air, perfect gas relationship, absolute humidity, relative humidity, percentage humidity, humid volume, total heat, enthalpy, dry bulb temperature, wet bulb temperature, dew point temperature, adiabatic processes, wet bulb depression, humid heat, specific volume, heating, cooling, dehumidifying, sorption isotherms. Boilers and steam generation: fuels for boilers and steam generation, boiler types, boiler mountings and accessories, Introduction to Indian Boiler Regulation Act. Boiler Draught: Definition, importance and classification of draught, Properties of steam: Wet, dry saturated, superheated steam, use of steam table	**7**
	Total Lectures:	**30**

8. Practical

Units	**Content of Practical's**	**No. of Practical's**
I	Demonstration and application of zeroth law of thermodynamics;	**3**
II	First law of thermodynamics; and second law of thermodynamics.	**3**
III	Study of different types of boilers; boiler mounting and accessories; various types of burners and fuels; Determination of calorific values of different fuels.	**3**
IV	Study of vapour compression refrigeration test rig; heat pump; properties of wet, dry, saturated and superheated steam.	**3**
V	Use of steam tables and Moiler charts; dryness fraction of steam; use of psychometric chart for humidification, dehumidification, heating and drying.	**3**
	Total Practical's:	**15**

9. Suggested Books/Readings:

S. No.	**Authors/ Name of Books/Publishers**
1.	Brooker, D. B., Bakker-Arkema, F. W., & Hall, C. W. (1976). *Drying Cereal Grains*. The AVI Publishing Company, Inc.
2.	Geankoplis, C. J. (2003). *Transport Processes and Separation Process Principles (Includes Unit Operations)* (4th ed.). Prentice-Hall.
3.	McCabe, W. L., Smith, J., & Harriott, P. (2004). *Unit Operations of Chemical Engineering* (7th ed.). McGraw-Hill, Inc.
4.	Nag, P. K. (2005). *Engineering Thermodynamics* (3rd ed.). Tata McGraw-Hill Education.
5.	Pandey, H., Sharma, H. K., Chauhan, R. C., Sarkar, B. C., & Bera, M. B. (2010). *Experiments in Food Process Engineering*. CBS Publishers & Distributors Pvt. Ltd.
6.	Rajput, R. K. (2007). *Engineering Thermodynamics* (3rd ed.). Laxmi Publications (P) Ltd.

Eternal University, Baru Sahib
Dr. Khem Singh Gill Akal College of Agriculture

1.	**Course Code: 0140221052**	**Subject Code: EE 121**	**Course Title: Engineering Drawing and Graphics**		
2.	**Semester: II**		**Credits: 3(1+2)**		
3.	**Contact Hours:**	**L: 1**	**P: 4**		
4.	**Relative weightage:**	**MTE: 24**	**ETE: 48**	**Quiz/PA: 24**	**FPE: 24**
5.	**Objectives:**				
I.	To introduce the fundamental concepts and principles of engineering projection, including orthographic and isometric projections.				
II.	To develop the ability to create accurate and detailed working drawings with proper dimensioning, sectioning, and representation of machine parts				
III.	To familiarize students with the standard conventions for mechanical fasteners, riveted and welded joints, and threaded components.				
IV.	To provide an overview of Computer-Aided Design (CAD), its benefits, and the hardware components used in modern design processes				
6.	**Course Outcomes:**				
CO1	Students will explain the fundamental principles of projection and apply orthographic, isometric, and sectional drawing techniques for representing engineering components.				
CO2	Students will Demonstrate various methods of dimensioning, sectioning, and preparation of working drawings from models and isometric views.				
CO3	Identify and illustrate different mechanical fasteners such as bolts, nuts, screws, riveted and welded joints using standard conventions.				
CO4	Understand the basic concepts and advantages of Computer-Aided Design (CAD) and describe its components and hardware requirements in engineering applications.				

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	3	3	3	2	2	2	3	3	2	2	1	1
CO2	3	3	3	2	2	2	3	3	2	2	1	1
CO3	3	3	3	2	2	2	3	3	2	2	1	1
CO4	3	3	3	2	2	2	3	3	2	2	1	1
Average	**3**	**3**	**3**	**2**	**2**	**2**	**3**	**3**	**2**	**2**	**1**	**1**

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

7. Details of Course:

Units	**Particulars**	**No. of Lectures**
I	Definition of projection, Principle of projection, Methods of projections, Orthographic projection, plane of projection, First and third angle of projection.	**3**
II	Different methods of dimensioning; Isometric scale, Isometric axes, Isometric projection, Preparation of working drawing from models and isometric views	**3**
III	Concept of sectioning; Revolved and oblique section; Sectional drawing of simple machine parts; Types of rivet heads and riveted joints, Symbols for different types of welded joints; Processes for producing leak proof joints.	**4**
IV	Nomenclature, thread profiles, multi-start threads, left and right-hand thread; Square headed and hexagonal nuts and bolts; Conventional representation of	**5**

	threads; Different types of lock nuts, studs, machine screws, cap screws and wood screws; Foundation bolts; Drawing of missing views.	
	Total Lectures:	**15**

8. Practical

Units	Content of Practical's	No. of Practical's
I	Introduction of drawing scales; Principles of orthographic projections; References planes. Points and lines in space and traces of lines and planes; Auxiliary planes and true shapes of oblique plain surface.	**6**
II	True length and inclination of lines; Projections of solids: Change of position method, alteration of ground lines; Section of solids and interpenetration of solid-surfaces. Development of surfaces of geometrical solids; Isometric projection of geometrical solids.	**6**
III	Preparation of manual drawings with dimensions from models and isometric drawings of objects and machine components. Preparation of sectional drawings of simple machine parts; Drawing of riveted joints and thread fasteners.	**6**
IV	Computer graphics for food engineering applications; Interpretation of sectional views of food equipment and components.	**6**
V	Demonstration on computer graphics and computer aided drafting use of standard software; Sectional drawings of engineering machines.	**6**
	Total Practical's:	**30**

9 Suggested Books/Readings:

S. No.	Authors/ Name of Books/Publishers
1.	Bhat, N. D., & Panchal, V. M. (1995). *Machine Drawing*. Charotar Publishing House.
2.	Bhat, N. D. (1995). *Elementary Engineering Drawing*. Charotar Publishing House.
3.	Lee, K. (1999). *Principles of CAD/CAM/CAE Systems*. Prentice-Hall.
4.	Zeid, I. (2004). *Mastering CAD/CAM*. McGraw-Hill Book Co.

Eternal University, Baru Sahib
Dr. Khem Singh Gill Akal College of Agriculture

1.	**Course Code: 0130024032**	**Subject Code: EXT-121**	**Course Title: Personality Development**		
2.	**Semester: II**		**Credits: 2(1+1)**		
3.	**Contact Hours:**	**L: 1**	**P: 2**		
4.	**Relative weightage:**	**MTE: 16**	**ETE: 32**	**Quiz/PA: 16**	**FPE: 16**
5.	**Objectives:**				
I.	To introduce the concept of personality, its nature, determinants and theoretical frameworks including humanistic perspectives like Maslow's theory of self-actualization.				
II.	To understand personality assessment tools and behavioral frameworks including Myers-Briggs Typology, Locus of Control and individual behavior models relevant to organizational settings.				
III.	To explore the concepts of perception, attribution, learning theories and the formation of attitudes and values in the context of individual and organizational behavior.				
IV.	To examine the nature, types and theories of intelligence and motivation and their applications in organizational behavior including teamwork and group dynamics.				
6.	**Course Outcomes:**				
CO1	Learners will be able to explain the nature and types of personality, analyze major personality theories and apply Maslow's self-actualization theory in understanding personality development.				
CO2	Learners will be able to interpret personality types using MBTI, distinguish between Type A and Type B behaviors and evaluate the influence of personality on organizational behavior.				
CO3	Learners will be able to analyze factors influencing perception and learning, apply attribution theory and examine the role of attitude and values in shaping organizational behavior.				
CO4	Learners will be able to evaluate different types of intelligence and motivation theories and demonstrate understanding of emotional intelligence, group behavior and effective teamwork in organizational settings.				

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	2	1	2	3	2	1	1	1	3	3
CO2	3	3	2	1	2	3	2	1	1	1	3	3
CO3	3	3	2	1	2	3	2	1	1	1	3	3
CO4	3	3	2	1	2	3	2	1	1	1	3	3
Average	**3**	**2.75**	**2**	**1**	**2**	**3**	**2**	**1**	**1**	**1**	**3**	**3**

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

7.	**Details of Course:**	
Units	**Particulars**	**No. of Lectures**
I	Personality Definition, Nature of personality, theories of personality and its types. The humanistic approach - Maslow's self-actualization theory, shaping of	**3**

	personality, determinants of personality,	
II	Myers-Briggs Typology Indicator, Locus of control and performance, Type A and Type B Behaviours, personality and Organizational Behaviour. Foundations of individual behavior and factors influencing individual behavior, Models of individual behaviour.	**4**
III	Perception and attributes and factors affecting perception, Attribution theory and case studies on Perception and Attribution. Learning: Meaning and definition, theories and principles of learning, Learning and organizational behavior, Learning and training, learning feedback. Attitude and values.	**4**
IV	Intelligence- types of Intelligence, theories of intelligence, measurements of intelligence, factors influencing intelligence, intelligence and Organizational behavior, emotional intelligence. Motivation- theories and principles, Teamwork and group dynamics.	**4**
	Total Lectures:	**15**

8. Practical

Units	**Content of Practical's**	**No. of Practical's**
I	MBTI personality analysis, Learning Styles and Strategies.	**3**
II	Motivational needs, Firo-B, Interpersonal Communication.	**3**
III	Teamwork and team building, Group Dynamics.	**3**
IV	Win-win game, Conflict Management, Leadership styles.	**3**
V	Case studies on Personality and Organizational Behavior.	**3**
	Total Practical's:	**15**

9. Suggested Books/Readings:

S. No.	**Authors/ Name of Books/Publishers**
1.	Andrews, S. (1988). *How to Succeed at Interviews* (21st rep.). Tata McGraw Hill.
2.	Chadha, N. K. (2015). *Organizational Behavior*. Galgotia Publishing Company.
3.	Greenberg, J., & Baron, R. A. (2021). *Behavior in Organizations*. Pearson Education.
4.	Heller, R. (2002). *Effective Leadership: Essential Manager Series*. DK Publishing.
5.	Hindle, T. (2003). *Reducing Stress: Essential Manager Series*. DK Publishing.
6.	Kumar, P. (2005). *All About Self-Motivation*. Goodwill Publishing House.
7.	Lucas, S. (2001). *The Art of Public Speaking*. Tata McGraw Hill.
8.	Mangal, S. K. (2015). *General Psychology*. Sterling Publishers.
9.	Mile, D. J. (2004). *Power of Positive Thinking*. Rohan Book Company.
10.	Parikh, M., & Gupta, R. (2010). *Organizational Behaviour*. Tata McGraw-Hill Education.
11.	Robbins, S. P., & Judge, T. A. (2022). *Organizational Behavior*. Pearson Education.
12.	Shaffer, D. R. (2009). *Social and Personality Development* (6th ed.). Wadsworth.
13.	Smith, B. (2004). *Body Language*. Rohan Book Company.

Eternal University, Baru Sahib
Dr. Khem Singh Gill Akal College of Agriculture

1.	**Course Code: 0180023112**	**Subject Code: ENV-121**	**Course Title: Environmental Studies and Disaster Management**		
2.	**Semester: II**		**Credits: 3 (2+1)**		
3.	**Contact Hours:**	**L: 2**	**P: 2**		
4.	**Relative weightage:**	**MTE: 24**	**ETE: 48**	**Quiz/PA: 24**	**FPE: 24**
5.	**Objectives:**				
I.	To develop an understanding of the environment, its components, and the importance of sustainable utilization of natural resources.				
II.	To introduce the structure and function of ecosystems, biodiversity, and the need for their conservation.				
III.	To educate about environmental pollution, its impacts, control measures, and relevant environmental legislation.				
IV.	To provide knowledge on disaster types, their causes, impacts, and strategies for effective disaster management and mitigation.				
6.	**Course Outcomes:**				
CO1	Students will gain a fundamental understanding of the environment, natural resources, ecosystems, and biodiversity.				
CO2	They will learn about various types of pollution, waste management techniques, and important environmental laws.				
CO3	The course also covers social and ethical issues, population impacts, and the role of technology in protecting the environment.				
CO4	Students will understand different types of disasters, along with preparedness and management strategies to support sustainable development and resilience.				

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	2	1	3	2	2	1	1	1	2	2
CO2	3	3	2	1	3	2	2	1	1	1	2	2
CO3	3	3	2	1	3	2	2	1	1	1	2	2
CO4	3	2	2	1	3	2	2	1	1	1	2	2
Average	**3**	**2.5**	**2**	**1**	**3**	**2**	**2**	**1**	**1**	**1**	**2**	**2**

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

7.	**Details of Course:**	
Units	**Particulars**	**No. of Lectures**
I	Introduction to Environment - Environmental studies - Definition, scope and importance - Multidisciplinary nature of environmental studies - Segments of Environment - Spheres of Earth - Lithosphere - Hydrosphere - Atmosphere - Different layers of atmosphere. Natural Resources: Classification - Forest resources. Water resources. Mineral resources. Introduction to Environment - Environmental studies-Definition, scope and importance -Multidisciplinary nature of environmental studies -	**8**

	Segments of Environment - Spheres of Earth - Lithosphere - Hydrosphere - Atmosphere - Different layers of atmosphere. Natural Resources: Classification - Forest resources. Water resources. Mineral resources Food resources. Energy resources. Land resources. Soil resources.	
II	Ecosystems - Concept of an ecosystem - Structure and function of an ecosystem - Energy flow in the ecosystem. Types of ecosystem. Biodiversity and its conservation: Introduction, definition, types. Biogeographical classification of India. Importance and Value of biodiversity. Biodiversity hot spots. Threats and Conservation of biodiversity. Environmental Pollution: Definition, cause, effects and control measures of: a. Air pollution. b. Water pollution. c. Soil pollution. d. Marine pollution. e. Noise pollution. f. Thermal	**7**
III	Solid Waste Management: Classification of solid wastes and management methods, Composting, Incineration, Pyrolysis, Biogas production, Causes, effects and control measures of urban and industrial wastes. Social issues and the Environment: Urban problems related to energy. Water conservation, rain water harvesting, watershed management. Environmental ethics: Issues and possible solutions, climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust.	**7**
IV	Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act. Human Population and the Environment: Environment and human health: Human Rights, Value Education. Women and Child Welfare. Role of Information Technology in Environment and human health. Disaster management - Disaster definition - Types - Natural Disasters - Floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, Heat and cold waves. Man Made Disasters - Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, road accidents, rail accidents, air accidents, sea accidents. International and National strategy for disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, community-based organizations and media in disaster management. Central, state, district and local administration in disaster control; Armed forces in disaster response; Police and other organizations in disaster management.	**8**
	Total Lectures:	**30**

8. Practical

Units	Content of Practical's	No. of Practical's
I	Visit to a local area to document environmental assets (river/forest/grassland/hill/mountain), Energy: Biogas production from organic wastes,Visit to wind mill / hydro power / solar power generation units	**6**
II	Biodiversity assessment in farming system, Floral and faunal diversity assessment in polluted and un polluted system.	**3**
III	Visit to local polluted site - Urban/Rural/ Industrial/Agricultural to study of common plants, insects and birds, Water quality analysis: pH, EC and TDS. Estimation of Acidity, Alkalinity. Estimation of water hardness. Estimation of DO and BOD in water samples. Estimation of COD in water samples. Enumeration of E. coli in water sample. Assessment of Suspended Particulate Matter (SPM).	**4**
IV	Study of simple ecosystem – Visit to pond/river/hills,	**1**

V	Visit to areas affected by natural disaster	**1**
	Total Practical's:	**15**

10 Suggested Books/Readings:

S. No.	**Authors/ Name of Books/Publishers**
1.	De, A. K. (2010). *Environmental Chemistry*. New Age International Publishers.
2.	Dhar Chakrabarti, P. G. (2011). *Disaster Management - India's Risk Management Policy Frameworks and Key Challenges* (36 pp.). Centre for Social Markets (India).
3.	Miller, T., & Spoolman, S. (2009). *Living in the Environment: Concepts, Connections, and Solutions*. Brooks/Cole, Cengage Learning.
4.	Parthiban, K. T., Vennila, S., Prasanthrajan, M., Umesh, & Kanna, S. (2023). *Forest, Environment, Biodiversity and Sustainable Development*. Narendra Publishing House.
5.	Prasanthrajan, M., & Mahendran, P. P. (2008). *A Textbook on Ecology and Environmental Science* (ISBN 81-8321-104-6). Agrotech Publishing Academy.
6.	Sharma, P. D. (2009). *Ecology and Environment*. Rastogi Publications.

Eternal University, Baru Sahib
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1.	**Course Code: 0100024041**	**Subject Code: NSS-II**	**Course Title: National Service Scheme-II**	
2.	**Semester: II**		**Credits: 1 (0+1)**	
3.	**Contact Hours:**	**P:2**		
4.	**Relative weightage:**	**MTE: 12**	**Quiz/PA: 08**	**FPE: 20**
5.	**Objectives:**			
I.	To enable students to understand the meaning, traits and importance of youth leadership, along with the essential life competencies for effective personal and social functioning.			
II.	To develop key life skills such as decision-making, problem-solving and interpersonal communication essential for youth in their personal and professional lives.			
III.	To provide an overview of youth development programs and policies at national and state levels, including the role of youth-led and youth-focused organizations in nation-building.			
IV.	To raise awareness among students regarding health education, hygiene, sanitation and the importance of national programs like Swachh Bharat Abhiyan in promoting public health.			
V.	To promote awareness of healthy lifestyles, issues related to youth health such as HIV/AIDS and substance abuse and to introduce the philosophy and practice of yoga for preventive and curative health.			
6.	**Course Outcomes:**			
I.	Students will be able to identify the qualities of good leaders, distinguish between types of leadership and demonstrate basic life competencies essential for youth empowerment and leadership development.			
II.	Students will be able to apply critical thinking, make informed decisions and engage in effective interpersonal communication across diverse contexts.			
III.	Students will be able to analyze various youth development initiatives and explain the role of governmental and non-governmental organizations in youth policy implementation and advocacy.			
IV.	Students will be able to understand the linkage between health, nutrition, safe drinking water, sanitation and public health and demonstrate knowledge of relevant national health schemes.			
V.	Students will be able to identify healthy lifestyle practices, understand the risks associated with substance abuse and explain the relevance of yoga in promoting holistic well-being and health management.			

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	3	2	2	3	3	2	2	2	2	3	3
CO2	2	3	3	2	2	3	2	2	3	2	2	3
CO3	2	3	2	3	3	3	2	3	2	3	3	3
CO4	2	2	2	3	2	3	2	2	2	3	2	3
CO5	2	2	2	3	2	3	2	2	2	3	2	3
Avg.	**2.0**	**2.6**	**2.2**	**2.6**	**2.4**	**3.0**	**2.0**	**2.2**	**2.2**	**2.6**	**2.4**	**3.0**

1= Weak Correlation 2 = Moderate Correlation 3 = Strong Correlation

7. Practical

Units	Content of Practical's	No. of Practical's
I	Importance and role of youth leadership, Meaning, types and traits of leadership, qualities of good leaders; importance and roles of youth leadership, Life competencies	**3**
II	Definition and importance of life competencies, problem-solving and decision-making Interpersonal communication.	**3**
III	Youth development programs. Development of youth programs and policy at the national level, state level and voluntary sector; youth-focused and youth-led organizations	**3**
IV	Health, hygiene and sanitation. Definition needs and scope of health education; role of food, nutrition, safe drinking water, water borne diseases and sanitation (Swachh Bharat Abhiyan) for health; national health programs and reproductive health.	**3**
V	Youth health, lifestyle, HIV AIDS and first aid. Healthy lifestyles, HIV AIDS, drugs and substance abuse, home nursing and first aid. Youth and yoga. History, philosophy, concept, myths and misconceptions about yoga; yoga traditions and its impacts, yoga as a tool for healthy lifestyle, preventive and curative method.	**3**
	Total Practical's:	**15**

8. Suggested Books/Readings:

S. No.	Authors/ Name of Books/Publishers
1.	Goleman, D. (2021). *Emotional Intelligence: Why It Can Matter More Than IQ*. Bloomsbury Publishing.
2.	Klaus, G. R. (2020). *Interpersonal Communication: Everyday Encounters* (9th ed.). Cengage Learning.
3.	Ministry of Youth Affairs and Sports. (2023). *National Youth Policy 2021 (Draft)*. Government of India.
4.	Narayan, K. V. (2023). *Public Health in India: Insights and Innovations*. Oxford University Press.
5.	Patanjali, M. (2021). *The Yoga Sutras of Patanjali: Commentary by Swami Satchidananda*. Integral Yoga Publications.
6.	Rajiv, M. (2022). *Youth Empowerment and Leadership: Strategies for Engagement*. Sage Publications.
7.	Singh, Y. (2022). *Youth and Nation Building in India*. Rawat Publications.
8.	UNICEF. (2022). *Adolescents and Youth Engagement: A Strategic Framework*. United Nations Children's Fund.
9.	WHO. (2023). *Adolescent Health and Development: Global Strategy for Women's, Children's, and Adolescents' Health (2016–2030)*. World Health Organization.
10.	Yadav, R. (2023). *Health, Hygiene and Sanitation in India: Policy and Practice*. Concept Publishing Company.

Eternal University, Baru Sahib
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1.	**Course Code: 0100024031**	**Subject Code: NCC-II**	**Course Title: National Cadet Corps - II**	
2.	**Semester: II**		**Credits: 1 (0+1)**	
3.	**Contact Hours:**		**P: 2**	
4.	**Relative weightage:**	**MTE: 12**	**Quiz/PA: 08**	**FPE: 20**
5.	**Objectives:**			
I.	To develop character, comradeship, discipline, leadership and secular outlook			
II.	To provide training to youth to develop qualities that make them useful citizens			
III.	To create a human resource of organized, trained and motivated youth			
IV.	To provide a suitable environment to motivate young people to join the Armed Forces			
6.	**Course Outcomes:**			
CO1	Understand the basic concept of NCC and its importance in national aspects.			
CO2	Practice togetherness, teamwork and empathy in all walks of their life.			
CO3	*Do* their own self-analysis and will work out to overcome their weakness for better performance in all aspects of life.			
CO4	Respect the diversity of different Indian culture.			

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	3	2	1	1	3	3	2	1	1	1	3	3
CO2	2	2	1	1	3	3	2	1	1	1	3	3
CO3	2	2	2	1	3	3	2	1	1	1	3	3
CO4	2	2	1	1	3	3	2	1	1	1	3	3
Average	**2.25**	**2**	**1.25**	**1**	**3**	**3**	**2**	**1**	**1**	**1**	**3**	**3**

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

7. Details of Course:

Units	**Content of Practical's**	**No. of Practical's**
I	Understand personality of an individual and its development, Analyse the different factors that influence personality and shape it, Appreciate the diversity in personality of individuals and its influence on their behaviour, Self-Awareness, Empathy, Critical and Creative Thinking, Decision Making and Problem Solving.	**5**
II	Analyse the leadership traits and its effectiveness in management, Understand the importance of communication in daily life, Examine the principles of effective communication and the barriers in communication, Appreciate the need of communication	**4**
III	Civil defence organization and NDMA, Understand the types of emergencies and natural disasters, Examine the causes and effects of natural disaster.	**3**
IV	Learn about national emergencies, Infer the concept of disaster management Assistance during natural and other calamities: Floods, cyclones, earth quakes,	**3**

	accidents	
	Total Practical's:	**15**

8. Suggested Books/Readings:

S. No.	Authors/ Name of Books/Publishers
1.	Gupta, R. (Ed.). (2010). *National Cadet Corps: A Concise Handbook of NCC Cadets for 'A,' 'B,' and 'C' Certificate Examinations Including Model Papers and Solved Questions*. Ramesh Publishing House.
2.	Director General NCC. (2015). *DG NCC Cadet's Handbook: Common Subjects - All Wings (in English)*.
3.	Director General NCC. (2017). *DG NCC Cadet's Handbook: Specialized Subjects – Army, Navy, and Air Wing*.

Second Year SEMESTER-III					
S. No.	**Course Code**	**Subject Code**	**Course Title**	**Credit hours**	**Total Credit hours**
1.	0140231012	FT 211	Food Chemistry II	3 (2+1)	**23 (13+10)**
2.	0140231022	EE 211	Fluid Mechanics	3 (2+1)	
3.	0140231032	FT 212	Heat and Mass Transfer in Food Processing	3 (2+1)	
4.	0140231042	ETE 211	Basic Electronic Engineering	2 (1+1)	
5.	0140231052	FT 213	Food Microbiology	3 (2+1)	
6.	0140231060	MATH 211	Engineering Mathematics- I	2 (2+0)	
7.	0190132012	ECON-211	Entrepreneurship Development and Business Management	3 (2+1)	
8.	0100034011	PHE 211	Physical Education, First Aid, Yoga Practices a Meditation	2 (0+2)	
9.		SEC V*	Skill Enhancement Course-V	2 (0+2)	

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1.	**Course Code: 0140231012**	**Subject Code: FT 211**	**Course Title: Food Chemistry II**		
2.	**Semester: III**		**Credits: 3 (2+1)**		
3.	**Contact Hours:**	**L: 2**	**P: 2**		
4.	**Relative weightage:**	**MTE: 24**	**ETE: 48**	**Quiz/PA: 24**	**FPE: 24**
5.	**Objectives:**				
I.	Study chemical aspects of food and bio- materials and their importance in food processing				
II.	Gain an understanding of chemicals responsible for flavor, pigments and colorants				
III.	Have an idea of about the effect of processing on these biomolecules				
IV.	To gain the knowledge about role of enzymes in food processing				
V.	Study effects of thermal processing on pigments and dye				
6.	**Course Outcomes**:				
CO1	Understand food chemistry like functional properties of food, and technology of processing.				
CO2	Learn methods for, Regulatory use of regulatory dyes; Color losses during thermal processing.				
CO3	Explore Important minerals and their function in body and deficiency conditions				
CO4	Technology for retention of natural colors of food stuffs.				
CO5	Role of endogenous enzymes in food quality, enzymes use as processing aid, enzyme specificity				

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	1	1	1	1	1	2	1	1	1	1
CO2	1	1	1	1	1	1	1	3	1	1	1	1
CO3	2	2	1	1	2	1	1	1	1	1	1	1
CO4	2	2	1	1	1	1	1	2	2	1	2	1
CO5	3	2	1	2	2	2	1	3	1	1	1	1
Avg.	**2.2**	**1.8**	**1.0**	**1.2**	**1.4**	**1.2**	**1.0**	**2.2**	**1.2**	**1.0**	**1.2**	**1**

1= Weak Correlation 2 = Moderate Correlation 3 = Strong Correlation

7. Details of Course:

Units	Particulars	No. of Lectures
I	Philosophy and definitions of flavor, Chemistry of food flavor; flavourmatics/ flavoring compounds, sensory assessment of flavor, technology for flavour retention.	5
II	Pigments in animal and plants kingdoms: Heme pigments, chlorophyll, carotenoids, phenolic and flavonoids, betalins, effect of processing on pigment behavior; Technology for retention of natural colors of food stuffs. Popular colors used in food and their fictional properties; Regulatory use of regulatory dyes;Colour losses during thermal processing.	7
III	Vitamin functions in body and deficiency conditions, Requirement allowances, enrichment, restorations, and fortifications, losses of vitamins, optimization and retention of vitamins.	6
IV	Important minerals and their function in body and deficiency conditions, Requirements, allowances, enrichment, restorations, fortifications, losses of minerals, optimization and retention of minerals. Various anti-nutritional factor their mode of action and inactivation.	6
V	Enzymes in Food Processing: Carbohydrases, proteasase, lipases; Modification of	6

	food using enzymes: Role of endogenous enzymes in food quality, enzymes use as processing aid, enzyme specificity, Michaelis-Menten equation, regulation mechanism.	
	Total Lectures:	**30**

8. Practical

S. No.	**Content of Practicals**	**No. of practical's**
1	Preparation of mineral solution by using ash and tri-acid method (dry and wet oxidations).	2
2	Estimation of calcium, phosphorus, iron and magnesium.	2
3	Estimation of tannins and phytic acid from food.	2
4	Determination of vitamin A (Total carotenoids) and C, E; Determination of ascorbic acid by dye method;	3
5	Determination of thiamin and riboflavin; Determination of food colors; Assessment of hydrocolloids as food additives.	3
6	Assessment of hydrocolloids as food additives; Assessment of various pectinases from fruits and vegetables	3
	Total Practical's	**15**

9. Suggested Books/Readings:

S. No.	**Authors/ Name of Books/Publishers**
1.	Belitz, H.-D., Grosch, W., & Schieberle, P. (2009). *Food Chemistry* (4th ed.). Springer-Verlag.
2.	Fennema, O. R. (1996). *Food Chemistry* (3rd ed.). Marcel Dekker, Inc.
3.	Lund, D. B. (2013). *Food Science and Technology: An Overview*. Springer Science & Business Media.
4.	Damodaran, S., Parkin, K. L., & Fennema, O. R. (2007). *Fennema's Food Chemistry* (4th ed.). CRC Press.
5.	Haug, W. (2009). *Food Chemistry: A Textbook*. Springer Science & Business Media.
6.	Marangoni, A. G., & Viegas, J. R. (2016). *Food Structure and Design: A Molecular Level Approach*. CRC Press.

Eternal University, Baru Sahib
Dr. Khem Singh Gill Akal College of Agriculture

1.	**Course Code: 0140231012**	**Subject Code: EE 211**	**Course Title: Fluid Mechanics**		
2.	**Semester: III**		**Credits: 3(2+1)**		
3.	**Contact Hours:**	**L: 2**	**P: 2**		
4.	**Relative weightage:**	**MTE:24**	**ETE: 48**	**Quiz/PA: 24**	**FPE:24**
5.	**Objectives:**				
I.	To understand the fundamental principles and concepts related to fluid properties, pressure measurement, and fluid behavior in static and dynamic conditions.				
II.	To develop a conceptual and mathematical understanding of fluid statics and dynamics, including floating body behavior, fluid flow types, and foundational fluid motion equations.				
III.	To equip students with the knowledge and skills to analyze and measure fluid flow in pipes and open channels, understand flow losses, and apply dimensional analysis for modelling and similitude in fluid systems.				
IV.	Differentiate about various types of pumps and their use in food processing				
6.	**Course Outcomes:**				
CO1	Develop a comprehensive understanding of different **ty**pes of fluids (e.g., ideal fluids, real fluids, compressible, incompressible fluids) and their key characteristics.				
CO2	Students will be able to analyze fluid systems by calculating pressures (absolute, gauge, hydraulic), understanding fluid behavior (viscous vs. non-viscous, compressible vs. incompressible), and applying appropriate instruments (manometers, piezometers, mechanical gauges) for accurate pressure measurement				
CO3	Gain an understanding of the types of fluid flow, including laminar, turbulent, and transitional flow, and their significance in food processing applications such as pumping, mixing, and filtration.				
CO4	Understand the working principles, advantages, limitations, and applications of each pump type, especially in the context of food processing (e.g., for transporting liquids, slurries, or pastes).				

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	1	1	1	1	3	2	1	1	1	1
CO2	3	3	2	3	1	2	3	3	2	2	1	2
CO3	2	3	2	2	2	1	2	3	2	2	1	2
CO4	2	2	3	3	1	2	2	3	2	2	1	2
Avg.	**2.5**	**2.5**	**2**	**2.25**	**1.25**	**1.5**	**2.5**	**2.75**	**1.75**	**1.75**	**1**	**1.75**

1= Weak Correlation 2 = Moderate Correlation 3 = Strong Correlation

7. Details of Course:

S. No.	Particulars	No. of Lectures
1.	Units and dimensions; Properties of fluids; Static pressure of liquids: Hydraulic pressure, absolute and gauge pressure, pressure head of a liquid; Pressure on vertical rectangular surfaces, Flow behavior of viscous fluids; Compressible and non-compressible fluids; Surface tension, capillarity, Pressure measuring devices: Simple, differential, micro-, inclined manometer, mechanical gauges, piezometer;	6
2.	Floating bodies: Archimedes principle, stability of floating bodies; Equilibrium of floating bodies, metacentric height; Fluid flow: Classification, steady, uniform and non-uniform, laminar and turbulent, continuity equation; Bernoulli's theorem and its applications; Navier-Stokes equations in cylindrical co-ordinates, boundary conditions; Simple application of Navier-Stokes	6

	equation: Laminar flow between two straight parallel boundaries;	
3.	Flow through pipes: Loss of head, determination of pipe diameter; Determination of discharge, friction factor, critical velocity; Flow through orifices, mouthpieces, notches and weirs; Vena contracta, hydraulic coefficients, discharge losses; Time for emptying a tank; Loss of head due to contraction, enlargement at entrance and exit of pipe; External and internal mouthpieces, types of notches, rectangular and triangular notches, rectangular weirs; Venturimeters, pitot tube, rotameter; Water level point gauge, hook gauge ;Dimensional analysis: Buckingham's theorem application to fluid flow phenomena, Froude Number, Reynolds number, Weber number and hydraulic similitude;	10
4.	Pumps: classification, centrifugal pumps, submersible pumps, reciprocating pumps, positive displacement pump; Centrifugal pumps: Pumps in series and parallel, basic equations applied to centrifugal pump, loss of head due to changed discharge, static head, total head, manometric head, manometer efficiency, operating characteristics of centrifugal pumps, Submersible pumps; Reciprocating pumps: Working of reciprocating pump, double acting pump, instantaneous rate of discharge, acceleration of piston and water, gear pump; Pressure variation, work efficiency; Pressure requirements for viscous foods to lift them to different heights and selection of pumps.	8
	Total Lectures	**30**

8. Practical's

S. No.	Content of Practical's	No. of Practical's
1.	Study of different tools and fittings; Study on flow rate versus pressure drop with U-tube manometer; Verification of Bernoulli's theorem.	3
2.	Determination of discharge co-efficient for venturi, orifice, V-notch.	3
3.	Verification of emptying time formula for a tank.	3
4.	Determination of critical Reynold's number by Reynold apparatus.	3
5.	Study of reciprocating, centrifugal and gear pump; Calibration of rotameter; Study of different types of valves; Study of pumps for viscous fluid; Floating bodies, liquid f low, venturimeter, orifice, weir, flow through pipes; Study and operation of centrifugal and other pumps used in dairy and food processing plants.	3
	Total Practical's	**15**

9. Suggested Books/Readings:

S.No.	Authors /Name of Books/ Publishers
1.	Bird, R. B., Stewart, W. E., & Lightfoot, E. N. (2002). *Transport Phenomena* (2nd ed.). John Wiley & Sons.
2.	Çengel, Y. A., & Cimbala, J. M. (2006). *Fluid Mechanics: Fundamentals and Applications*. McGraw-Hill.
3.	Finnemore, E. J., & Franzini, J. B. (2002). *Fluid Mechanics with Engineering Applications* (10th ed.). McGraw-Hill.
4.	Munson, B. R., Young, D. R., & Okiishi, T. H. (2002). *Fundamentals of Fluid Mechanics* (4th ed.). John Wiley & Sons.
5.	Nevers, N. D. (1991). *Fluid Mechanics for Chemical Engineers*. McGraw-Hill.
6.	Pandey, H., Sharma, H. K., Chauhan, R. C., Sarkar, B. C., & Bera, M. B. (2010). *Experiments in Food Process Engineering*. CBS Publishers & Distributors.
7.	Streeter, V. L. (1962). *Fluid Mechanics* (3rd ed.). McGraw-Hill.

Eternal University, Baru Sahib
Dr. Khem Singh Gill Akal College of Agriculture

1.	**Course Code: 0140231032**	**Subject Code: FT 212**	**Course Title: Heat and Mass Transfer in Food Processing**		
2.	**Semester: III**		**Credits: 3(2+1)**		
3.	**Contact Hours:**	**L: 2**	**P:2**		
4.	**Relative weight age:**	**MTE:24**	**ETE: 48**	**Quiz/PA: 24**	**FPE:24**
5.	**Objectives:**				
I.	To understand the fundamental principles of heat transfer, including conduction, and to develop analytical skills for evaluating temperature distribution and heat flow in various geometries under steady-state conditions.				
II.	To explore advanced concepts of steady and unsteady heat conduction, particularly in extended surfaces, and to understand the fundamentals of convective heat transfer, including the role of dimensional analysis.				
III.	To understand the use of dimensionless numbers and empirical correlations in convective heat transfer, and to study the fundamentals of thermal radiation and its application to engineering systems.				
IV.	To provide knowledge of heat exchanger types, design principles, and performance evaluation, along with an introduction to mass transfer concepts relevant to food and dairy processing.				
6.	**Course Outcomes:**				
CO1	Students will be able to apply Fourier's law to solve one-dimensional heat conduction problems, analyze heat transfer through composite walls and pipelines, model systems using thermal-electric analogies, and develop temperature distribution equations for materials with internal heat generation under various boundary conditions.				
CO2	Students will be able to derive and solve temperature distribution equations for fins with various boundary conditions, evaluate fin efficiency and effectiveness, model unsteady-state heat conduction in simple systems, and apply principles of forced and free convection using dimensional analysis to correlate heat transfer parameters.				
CO3	Students will be able to calculate convective heat transfer coefficients using empirical relations and dimensionless numbers like Nusselt, Prandtl, Reynolds, and Grashof numbers; use Heisler charts for transient conduction analysis; and evaluate radiative heat exchange involving black and grey surfaces, including determining shape factors and understanding emissivity, absorptivity, and transmissivity.				
CO4	Students will be able to calculate convective heat transfer coefficients using empirical relations and dimensionless numbers like Nusselt, Prandtl, Reynolds, and Grashof numbers; use Heisler charts for transient conduction analysis; and evaluate radiative heat exchange involving black and grey surfaces, including determining shape factors and understanding emissivity, absorptivity, and transmissivity.				

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3	2	3	1	2	3	3	2	1	1	2
CO2	3	3	2	3	1	2	3	3	2	1	1	2
CO3	2	3	1	3	2	2	2	3	3	1	1	2
CO4	2	3	1	3	2	2	2	3	3	1	1	2
Avg.	**2.5**	**3**	**1.5**	**3**	**1.5**	**2**	**2.5**	**3**	**2.5**	**1**	**1**	**2**

1= Weak Correlation	2 = Moderate Correlation	3 = Strong Correlation
7.	**Details of Course:**	
S. No.	**Particulars**	**No. of Lectures**
1.	Basic heat transfer processes, heat transfer coefficients, properties related to heat transfer, food properties measurements and errors; One-dimensional steady state conduction: Theory of heat conduction, Fourier's law and its derivation, Concept of electrical analogy and its application for thermal circuits, heat transfer through composite walls and insulated pipelines; One-dimensional steady state heat conduction with heat generation: Heat flow through slab, hollow sphere and cylinder with linear heat transfer, uniform/non-uniform heat generation, development of equations of temperature distribution with different boundary conditions;	7
2.	Steady-state heat conduction with heat dissipation to environment: Introduction to extended surfaces (fins) of uniform area of cross-section and with Equation of temperature distribution with different boundary conditions; Effectiveness and efficiency of the fins; Introduction to unsteady state heat conduction: System with negligible internal resistance and in various geometries; Convection: Forced and free convection, use of dimensional analysis for correlating variables affecting convection heat transfer;	8
3.	Dimensionless numbers: Concept of Nusselt number, Prandtl number, Reynolds number, Grashoff number, some important empirical relations used for determination of heat transfer coefficient; Heisler charts and calculations; Heat transfer to flowing fluids; Radiation: Heat radiation, emissivity, absorptivity, transmissivity, radiation through black and grey surfaces, determination of shape factors;	7
4.	Heat Exchangers: General discussion, fouling factors, jacketed kettles, LMTD, parallel and counter flow heat exchangers, shell and tube and plate heat exchangers, heat exchanger design; Efficiency and NTU analysis; Application of different types of heat exchangers in dairy and food industry; Mass transfer: Fick's law of diffusion, steady state diffusion of gases and liquids through solids, equimolal diffusion, isothermal evaporation of water into air, mass transfer coefficient, application in dairy and food industry.	8
	Total Lectures	**30**

8. Practical's

S. No.	Contents of Practical's	No. of Practical's
1.	Heat transfer analysis during conduction and convection; Study on various types of heat exchangers used in food industry.	3
2.	Preparation and calibration of thermocouples; Determination of thermal conductivity of different food products.	3
3.	Study of working principle and constructional details of plate heat exchanger; Study of working principle and constructional details of shell and tube heat exchanger.	3
4.	Determination of overall heat transfer coefficient of shell and tube, plate heat exchangers, jacketed kettle used in food industry.	3
5.	Studies on heat transfer through extended surfaces; Studies on temperature distribution and heat transfer in HTST pasteurizer; mass transfer coefficient in foods; glass transition temperature of food sample; mass transfer during leaching process.	3
	Total Practical's	**15**

9. Suggested Books/Readings:

S.No.	Authors/ Book Name/ Publishers
1.	Cao, E. (2010). *Heat Transfer in Process Engineering*. McGraw-Hill.
2.	Green, D. W., & Perry, R. H. (2008). *Perry's Chemical Engineers' Handbook*. McGraw-Hill.
3.	Geankoplis, C. J. (2003). *Transport Processes and Separation Process Principles (Includes Unit Operations)* (4th ed.). Prentice Hall.
4.	Holman, J. P. (2010). *Heat Transfer* (10th ed.). McGraw-Hill.
5.	Lienhard IV, J. H., & Lienhard V, J. H. (2008). *A Heat Transfer Textbook*. Phlogiston Press.
6.	McCabe, W. L., Smith, J., & Harriott, P. (2004). *Unit Operations of Chemical Engineering* (7th ed.). McGraw-Hill.
7.	Özişik, M. N. (1993). *Heat Conduction* (2nd ed.). John Wiley & Sons.
8.	Pandey, H., Sharma, H. K., Chauhan, R. C., Sarkar, B. C., & Bera, M. B. (2010). *Experiments in Food Process Engineering*. CBS Publishers & Distributors.
9.	Rajput, R. K. (2008). *Heat and Mass Transfer*. S. Chand & Company.
10.	Richardson, J. F., Harker, J. H., & Backhurst, J. R. (1999). *Coulson and Richardson's Chemical Engineering: Vol. 1. Fluid Flow, Heat Transfer and Mass Transfer* (6th ed.). Butterworth-Heinemann.
11.	Treybal, R. E. (1980). *Mass Transfer Operations* (3rd ed.). McGraw-Hill.

Eternal University, Baru Sahib
Dr. Khem Singh Gill Akal College of Agriculture

1.	**Course Code: 0140231042**	**Subject Code: ETE 211**		**Course Title: Basic Electronic Engineering**	
2.	**Semester: III**	**Credits: 2(1+1)**			
3.	**Contact Hours:**	**L: 1**	**P:2**		
4.	**Relative weight age:**	**MTE:16**	**ETE: 32**	**Quiz/PA: 16**	**FPE:16**

5.	**Course Objectives:**
I.	To understand the fundamental principles of semiconductors and the working of diodes and their applications in basic electronic circuits.
II.	To gain knowledge of bipolar junction transistors (BJTs), their operating principles, biasing techniques, and applications in amplifiers and voltage regulation.
III.	To explore the ideal characteristics and applications of operational amplifiers in linear and non-linear configurations.
IV.	To introduce digital electronics concepts, Boolean algebra, logic circuits, and familiarize students with transducers and their real-world applications.
6.	**Course Outcomes:**
CO1	Students will be able to analyze and interpret the characteristics of P-n junction diodes and design basic diode-based circuits such as rectifiers, logic gates, filters, and voltage multipliers
CO2	Students will demonstrate the ability to classify and bias BJTs effectively and design analog circuits such as amplifiers and voltage/current regulators using BJTs and Zener diodes
CO3	Students will be able to design and implement circuits using OP-AMPs for functions such as integration, differentiation, comparison, amplification, rectification, and oscillation.
CO4	Students will be able to construct combinational and sequential logic circuits, perform logic simplification, and understand the working principles and applications of various transducers and sensor-based systems

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	1	2	1	1	2	2	1	1	1	1
CO2	2	3	2	2	1	1	3	3	2	2	1	1
CO3	2	2	2	3	1	2	2	2	2	2	1	1
CO4	2	2	1	3	2	2	2	3	2	2	1	2
Avg.	**2.25**	**2.25**	**1.5**	**2.5**	**1.25**	**1.5**	**2.25**	**2.5**	**1.75**	**1.75**	**1**	**1.25**

1= Weak Correlation 2 = Moderate Correlation 3 = Strong Correlation

7. Details of Course:

S. No.	Particulars	No. of Lectures
1.	Semiconductors, P-n junction, V-I characteristics of P-n junction, diode as a circuit element, rectifier; Diode circuits for OR and AND (both positive and negative logic); voltage multiplier, filter circuits, and Zener diode voltage regulator.	5
2.	Bipolar junction transistor: Operating point, classification (A, B and C) of amplifier, various biasing methods (fixed, self, potential divider); transistor series regulator, current limiters, and OP-AMP voltage regulators.	5

3.	Ideal OP-AMP characteristics, linear and non-linear applications of OP-AMP integrator, active rectifier, comparator, differentiator, differential, instrumentation amplifier and oscillator.	2
4.	Basic theorem of Boolean algebra; Combinational logic circuits (basic gates, SOP rule and K-map) and sequential logic circuits, binary ladder D/A converter and A/D converter; Transducers: Classification, selection criteria, characteristics, sensors and actuators construction, working principles, applications of following transducers- Potentiometers RTD, thermocouples, thermistors, LVDT, strain gauges, capacitive and inductive transducers, piezoelectric transducers, photoelectric transducers, self-generating transducers, variable parameter type, digital, actuating and controlling devices.	3
	Total Lecture's	**15**

8. Practical's

S. No.	Contents of Practical's	No. of Practical's
1.	Study of diode characteristics; Study of triode characteristics; Study of Zener diode; Study of V-I characteristics of P-n junction diode.	3
2.	Study of RC coupled amplifier; Study of RC phase shift oscillator; Study of full wave rectifier; Verification of logic gates.	3
3.	Determination of energy gap in a junction diode; Study of transistor characteristics in CE configuration; Study of OP-Amp IC 741 as differential amplifier; Study of half wave rectifier.	3
4.	Study of OP-AMP IC 741 as an active rectifier; Study of transistor characteristics.	3
5.	Study of temperature characteristics of resistor; Study of diode as clipper and clamper.	3
	Total Practical's	**15**

9. Suggested Books/Readings:

S.No.	Authors/ Book Name/ Publishers
1.	Kumar, A. (2014). *Fundamentals of Digital Circuits*. PHI Learning Pvt. Ltd.
2.	Gupta, S. (2002). *Electronic Devices and Circuits*. Dhanpat Rai Publications (P) Ltd.
3.	Mehta, V. K., & Mehta, R. (2008). *Principles of Electronics*. S. Chand & Co.
4.	Roy, D. C. (2003). *Linear Integrated Circuits*. John Wiley International.
5.	Sawhney, A. K. (2010). *Course in Electrical and Electronics Measurements and Instrumentation*. Dhanpat Rai Publications (P) Ltd.

Eternal University, Baru Sahib
Dr. Khem Singh Gill Akal College of Agriculture

1.	**Course Code: 0140231052**	**Subject Code: FT 213**	**Course Title: Food Microbiology**		
2.	**Semester: III**		**Credits: 3(2+1)**		
3.	**Contact Hours:**	**L: 2**	**P:2**		
4.	**Relative weightage:**	**MTE:24**	**ETE: 48**	**Quiz/PA: 24**	**FPE:24**

5.	**Objectives:**
I.	To understand the role and impact of microorganisms in food systems and the factors influencing their growth and survival.
II.	To assess the microbiological quality standards of different food commodities.
III.	To explore the biochemical transformations caused by microbes and understand the principles of shelf-life determination and extension.
IV.	To study foodborne pathogens, microbial toxins, and associated diseases for effective risk assessment and management.
6.	**Course Outcomes:**
CO1	Students will be able to identify various microbial sources and apply control strategies to ensure food safety and stability.
CO2	Students will be capable of evaluating microbiological profiles in foods and interpreting their significance in food processing and quality control.
CO3	Students will be able to analyze microbial degradation pathways and predict shelf-life using simulation and accelerated testing methods.
CO4	Students will gain knowledge of major microbial toxins, identify symptoms and toxicities related to foodborne illnesses, and propose preventive measures in food safety management systems

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	3	3	2	2	2	2	3	3	2	2	2	3
CO2	2	3	2	3	2	2	3	3	3	2	2	3
CO3	2	2	2	2	3	2	2	2	2	3	2	2
CO4	2	2	3	2	3	2	2	2	3	3	2	2
Avg.	**2.25**	**2.5**	**2.25**	**2.25**	**2.5**	**2**	**2.5**	**2.5**	**2.5**	**2.5**	**2**	**2.5**

1= Weak Correlation 2 = Moderate Correlation 3 = Strong Correlation

7. Details of Course:

S. No.	**Particulars**	**No. of Lectures**
1.	Importance and significance of microbes in food science; Sources of microorganisms in foods and their effective control; Factors affecting growth and survival of microorganisms in foods; Intrinsic factors i.e., pH, water activity, nutrients, redox potential, oxygen etc.; Extrinsic factors: Relative humidity, temperature, gaseous atmosphere etc.	7
2.	Normal Microbiological quality of foods and its significance: milk and milk products, fruits and vegetables, cereals and cereal products, meat and meat products, fish and other sea foods, poultry and eggs; sugar and sugar products, salts and spices, and canned foods.	8
3.	Chemical changes caused by microorganisms: Changes in nitrogenous organic compounds, non-nitrogenous organic compounds, organic acids, other compounds, lipids, pectic substances; Shelf life: Calculation of shelf life, shelf-life requirements, deteriorative reactions, accelerated testing; Simulations of product: Package environment interaction, shelf-life simulation for moisture, oxygen, and light sensitive products.	7

4.	Microbial toxins; Bacterial toxins, fungal toxins, algal toxins and mushroom toxins; Food borne intoxications and infections: types of food involved, toxicity and symptoms, chemical properties, environmental conditions; Food borne viruses: types of food involved, noroviruses, rota viruses, prion diseases, toxicity and symptoms.	8
	Total Lecture's	**30**

8. Practical's

S. No.	Contents of Practicals	No. of Practical's
1.	Isolation of bacteria and molds from foods; Microbial examination of cereal and cereal products: Identification, isolation and confirmation.	3
2.	Microbial examination of vegetable and fruits: Identification, isolation and confirmation; Microbial examination of meat and meat products: Identification, isolation and confirmation	3
3.	Microbial examination of fish and other sea foods: Identification, isolation and confirmation; Microbial examination of eggs and poultry: Identification, isolation and confirmation.	3
4.	Microbial examination of milk and milk products: Identification, isolation and confirmation; Microbial examination of sugar, salts and spices: Microbial examination of canned products: Identification, isolation and confirmation.	3
5.	Determination and enumeration of pathogenic and indicator organisms in foods (Coliform/ Enterococcus); Thermal death time determination; Detection of Salmonella from food sample; Detection of coliforms from water by MPN method; Detection of Staphylococcus aureus from food sample.	3
	Total Practical's	**15**

9. Suggested Books/Readings:

S.No.	Authors/ Book Name/ Publishers
1.	Adams, M. R., & Moss, M. O. (2008). *Food Microbiology* (3rd ed.). The Royal Society of Chemistry.
2.	Banwart, G. J. (1989). *Basic Food Microbiology* (2nd ed.). Chapman and Hall.
3.	Frazier, W. C., & Westhoff, D. C. (1987). *Food Microbiology* (4th ed.). Tata McGraw-Hill Education.
4.	Jay, J. M. (2000). *Modern Food Microbiology* (6th ed.). Aspen Publishers, Inc.
5.	Ray, B., & Bhunia, A. (2008). *Fundamental Food Microbiology* (4th ed.). CRC Press, Taylor and Francis Group.

Eternal University, Baru Sahib
Dr. Khem Singh Gill Akal College of Agriculture

1.	**Course Code: 0140231060**	**Subject Code: MATH 211**	**Course Title: Engineering Mathematics-I**	
2.	**Semester: III**		**Credits: 2(2+0)**	
3.	**Contact Hours:**	**L: 2**		
4.	**Relative weightage:**	**MTE:24**	**ETE: 40**	**Quiz/PA: 16**
5.	**Objectives:**			
I.	To understand Taylor's and Maclaurin's expansions, curvatures, and functions of multiple variables.			
II.	To master integral calculus techniques, including reduction formulae and special functions..			
III.	To solve differential equations using various methods, including exact and Bernoulli's equations.			
IV.	To learn vector calculus, focusing on differentiation and integral theorems.			
6.	**Course Outcomes:**			
CO1	Apply expansions, analyze curvatures, and solve problems in partial differentiation and maxima/minima.			
CO2	Evaluate integrals using reduction formulas, Gamma/Beta functions, and compute areas/volumes with double/triple integrals..			
CO3	Solve exact, Bernoulli's, and higher-order differential equations, including Bessel's and Legendre's equations			
CO4	Use Del operator, compute gradients, divergences, curls, and apply integral theorems like Stoke's and Green's			

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	2	2	1	1	1	2	1	2	1	1	1	1
CO2	2	2	1	1	2	2	1	2	1	1	1	1
CO3	3	2	1	1	1	2	1	2	1	1	1	2
CO4	3	2	1	1	2	2	1	2	2	2	1	2
Avg.	**2.5**	**2**	**1**	**1**	**1.5**	**2**	**1**	**2**	**1.25**	**1.25**	**1**	**1.5**

1= Weak Correlation 2 = Moderate Correlation 3 = Strong Correlation

7. Details of Course:

S. No.	**Particulars**	**Lectures**
1.	Taylor's and Maclaurin's expansions, indeterminate form: Curvature, asymptotes, tracing of curves function of two or more independent variables, partial differentiation, homogeneous functions and Euler's theorem, composite functions, total derivatives, derivative of an implicit function, change of variables, Jacobians, error evaluation, maxima and minima.	7
2.	Reduction formulae, Gamma and Beta functions: Rectification of standard curves, volumes and surfaces of revolution of curves Double and triple integrals, change of order of integration, application of double and triple integrals to find area and volume.	8
3.	Exact and Bernoulli's differential equations, equations reducible to exact form by integrating factors, equations of first order and higher degree, Clairaut's equation; Differential equations of higher orders, methods of finding complementary functions	7

	and particular integrals, Method of variation of parameters simultaneous linear differential equations with constant coefficients, Cauchy's and Legendre's linear equations, Bessel's and Legendre's differential equations series solution techniques.	
4.	Differentiation of vectors, scalar and vector point functions, vector differential operator Del: Gradient of a scalar point function, Divergence and Curl of a vector point function and their physical interpretations, Identities involving Del, second order differential operator Line, Surface and volume integrals, Stoke's, divergence and Green's theorems.	8
	Total lecture's	**30**

9. Suggested Books/Readings:

S.No.	Authors/ Book Name/ Publishers
1.	Grewal, B. S. (2004). *Higher Engineering Mathematics*. Khanna Publishers.
2.	Narayan, S. (2004). *Differential Calculus*. S. Chand and Co. Ltd.
3.	Narayan, S. (2004). *Integral Calculus*. S. Chand and Co. Ltd.
4.	Narayan, S. (2004). *A Textbook of Vector Calculus*. S. Chand and Co. Ltd.

Eternal University, Baru Sahib
Dr. Khem Singh Gill Akal College of Agriculture

1.	**Course Code: 0190132012**	**Subject Code: ECON- 211**	**Course Title: Entrepreneurship Development and Business Communication**		
2.	**Semester: III**		**Credits: 3(2+1)**		
3.	**Contact Hours:**	**L: 2**	**P: 2**		
4.	**Relative weightage:**	**MTE: 24**	**ETE: 48**	**Quiz/PA: 24**	**FPE: 24**
5.	**Objectives:**				
I.	To provide student an insight into the concept and scope of entrepreneurship				
II.	To expose the student to various aspects of establishment and management of a small business unit				
III.	To enable the student to develop financially viable agribusiness proposal				
IV.	To expose the student to various aspects of production, marketing strategies and finance concerning farm business				
6.	**Course Outcomes:**				
CO1	Students will learn the objectives and process of entrepreneurship development				
CO2	Students will understand the role of financial institutions, and other agencies in entrepreneurship development vis a vis the steps involved in execution of an enterprise.				
CO3	Student will be able to identify potential projects, their selection, formulation and preparation of Detailed Project Report (DPR).				
CO4	Students will get acquaintance of accounting, book keeping, financial and taxation management of the farm business/entrepreneurship				

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	2	2	2	1	1	3	1	1	1	1	3	2
CO2	1	2	2	1	1	2	1	1	1	1	2	1
CO3	1	3	3	1	1	2	1	2	2	1	2	1
CO4	1	1	1	1	1	2	1	1	2	1	2	1
Avg.	**1.25**	**2**	**2**	**1**	**1**	**2.25**	**1**	**1.25**	**1.5**	**1**	**2.25**	**1.25**

1= Weak Correlation 2 = Moderate Correlation 3 = Strong Correlation

7. Details of Course:

Units	**Particulars**	**No. of Lectures**
I	Development of entrepreneurship, motivational factors, social factors, environmental factors, characteristics of entrepreneurs, entrepreneurial attributes/competencies. Concept, need for and importance of entrepreneurial development. Evolution of entrepreneurship, objectives of entrepreneurial activities, types of entrepreneurs, functions of entrepreneurs, importance of entrepreneurial development, and process of entrepreneurship development.	8
II	Environment scanning and opportunity identification need for scanning: spotting of opportunity, scanning of environment identification of product / service: starting a project; factors influencing sensing the opportunities.	7

	Infrastructure and support systems: good policies, schemes for entrepreneurship development; role of financial institutions, and other agencies in entrepreneurship development. Steps involved in functioning of an enterprise.	
III	Selection of the product / services, selection of form of ownership; registration, selection of site, capital sources, acquisition of manufacturing know how, packaging and distribution. Planning of an enterprise, project identification, selection, and formulation of project; project report preparation. Enterprise Management, production management: product, levels of products, product mix, quality control, cost of production, production controls, material management. Production management: raw material costing, inventory control.	8
IV	Personal management: manpower planning, labour turn over, wages / salaries. Financial management /accounting: funds, fixed capital and working capital, costing and pricing, long term planning and short-term planning, book keeping, journal, ledger, subsidiary books, annual financial statement, taxation. Marketing management: market, types, marketing assistance, market strategies. Crisis management: raw material, production, leadership, market, finance, natural etc.	7
	Total Lectures:	**30**

8. Practical

Units	**Particulars**	**No. of Practical's**
I	Visit to small scale industries/agro-industries nearby industrial areas	3
II	Interaction with successful entrepreneurs/ agri- entrepreneurs	3
III	Visit to financial institutions and support agencies	3
IV	Identification of project proposal following different stages	3
V	Preparation of project proposal for funding by different agencies and its presentation through PPTs	3
	Total Practical's:	**15**

9. Suggested Books/Readings:

S. No.	**Authors/ Name of Books/Publishers**
1.	Harantimath, P. M. (2009). *Entrepreneurship Development and Small Business Enterprises*. Pearson Publications.
2.	Desai, V. (2001). *Entrepreneurship: Development and Management*. Himalaya Publishing House.
3.	Gupta, C. B. (2001). *Management Theory and Practice*. Sultan Chand & Sons.
4.	Grover, I. (2008). *Handbook on Empowerment and Entrepreneurship*. Agrotech Public Academy.
5.	Mehra, P. (2016). *Business Communication for Managers*. Pearson India.
6.	Pandey, M., & Tewari, D. (2010). *The Agribusiness Book*. IBDC Publishers.
7.	Singh, D. (1995). *Effective Managerial Leadership*. Deep & Deep Publications.
8.	Singhal, R. K. (2013). *Entrepreneurship Development & Management*. Katson Books.
9.	Tripathi, P. C., & Reddy, P. N. (1991). *Principles of Management*. Tata McGraw Hill.
10.	Desai, V. (1997). *Small Scale Industries and Entrepreneurship*. Himalaya Publishing House.

Eternal University, Baru Sahib
Dr. Khem Singh Gill Akal College of Agriculture

1.	**Course Code: 0100034011**	**Subject Code: PHE-211**	**Course Title: Physical Education, First Aid, Yoga Practices and Meditation**	
2.	**Semester: III**		**Credits: 2(0+2)**	
3.	**Contact Hours:**		**P: 4**	
4.	**Relative weightage:**	**MTE: 24**	**Quiz/PA: 16**	**FPE: 40**
5.	**Objectives:**			
I.	To understand the importance and scope of physical education in promoting overall health and fitness.			
II.	To explore the different methods and principles of training and coaching in sports for improved performance.			
III.	To learn the various types of yoga practices and their benefits for physical and mental well-being.			
IV.	To acquire essential knowledge and skills for administering first aid in case of sports-related injuries.			
6.	**Subject Outcome:**			
CO1	Students will be able to appreciate the role of physical education in enhancing overall health and fitness.			
CO2	Learners will gain the ability to apply different training methods to improve athletic performance.			
CO3	Participants will be able to practice and apply various yoga techniques to enhance physical and mental health.			
CO4	Individuals will be able to effectively provide first aid in response to common sports injuries and emergencies.			

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	1	1	1	2	2	1	1	1	1	1
CO2	2	3	2	2	1	2	1	3	1	1	1	1
CO3	1	1	1	2	2	3	1	2	1	2	1	1
CO4	1	1	1	1	3	2	1	1	2	1	2	1
Avg.	**1.75**	**1.75**	**1.25**	**1.5**	**1.75**	**2.25**	**1.25**	**1.75**	**1.25**	**1.25**	**1.25**	**1**

1= Weak Correlation 2 = Moderate Correlation 3 = Strong Correlation

7. Practical

Units	Particulars	No. of Practical's
I	Physical education; Training and Coaching - Meaning and Concept; Methods of Training; aerobic and anaerobic exercises; Calisthenics, weight training, circuit training, interval training, Fartlek training; Effects of Exercise on Muscular, Respiratory, Circulatory and Digestive systems; Balanced Diet and Nutrition: Effects of Diet on Performance; Physiological changes due to ageing	6

	and role of regular exercise on ageing process.	
II	Personality, its dimensions and types; Role of sports in personality development; Motivation and Achievements in Sports; Learning and Theories of learning; Adolescent Problems and its Management; Posture; Postural Deformities; Exercises for good posture.	6
III	Yoga; History of Yog, Types of Yog, Introduction to Yog, • Asanas (Definition and Importance) Padmasan, Vajrajasan, Shashankasan, Pashchimotasan, Ushtrasan, Tadasan, Padhastasan, Ardhchandrasan, Bhujangasan, Utanpadasan, Sarvangasan, Parvatasan, Patangasan, Shishupalanasan – left leg-right leg, Pavanmuktasan, Halasan, Sarpasan, Ardhdhanurasan, Sawasan.	6
IV	Suryanamskar Pranayama (Definition and Importance) Omkar, Suryabhedan, Chandrabhedan, AnulomVilom, Shitali, Shitkari, Bhastrika, Bhramari; Meditation (Definition and Importance), Yogic Kriyas (Kapalbhati), Tratak, Jalneti and Tribandh; Mudras (Definition and Importance) Gyanmudra, Dhyanmudra, Vayumudra, Akashmudra, Pruthvimudra, Shunyamudra, Suryamudra, Varunmudra, Pranmudra, Apanmudra, Vyanmudra, Uddanmudra.	6
V	Role of yoga in sports; Teaching of Asanas – demonstration, practice, correction and practice; History of sports and ancient games, Governance of sports in India; Important national sporting events; Awards in Sports; History, latest rules, measurements of playfield, specifications of equipment, skill, technique, style and coaching of major games (Cricket, football, table Tennis, Badminton, Volleyball, Basketball, Kabaddi and Kho-Kho) and Athletics. Need and requirement of first aid. First Aid equipment and upkeep. First aid Techniques, First aid related with Respiratory system. First aid related with Heart, Blood and Circulation. First aid related with Wounds and Injuries. First aid related with Bones, Joints Muscle related injuries. First aid related with Nervous system and Unconsciousness. First aid related with Gastrointestinal Tract. First aid related with Skin, Burns. First aid related with Poisoning. First aid related with Bites and Stings. First aid related with Sense organs, Handling and transport of injured traumatized persons. Sports injuries and their treatments.	6
	Total Practical's:	**30**

8. Suggested Books/Readings:

S. No.	Authors/ Name of Books/Publishers
1.	Sharma, K. K., & Sharma, R. A. (2019). *Essentials Of Physical Education*. New Delhi: Khel Sahitya Kendra.
2.	Harre, D. (1982). *Principles Of Sports Training*. Berlin: Sportverlag.
3.	Sharma, V. K. (2018). *Sports Training And Coaching*. New Delhi: Friends Publications.

SEMESTER-IV					
S. No.	**Course Code**	**Subject Code**	**Course Title**	**Credit hours**	**Total Credit hours**
1.	0140241012	FT 221	Fundamentals of Food Engineering	3 (2+1)	**20 (13+7)**
2.	0140241022	FT 222	Food Plant Sanitation	3 (2+1)	
3.	0140241030	FT 223	Food Quality, Safety Standards and Certification	2 (2+0)	
4.	0140241040	MATH 221	Engineering Mathematics- II	2 (2+0)	
5.	0140241052	FT 224	Food Plant Utilities and Services	3 (2+1)	
6.	0100043012	STAT-221	Agricultural Informatics and Artificial Intelligence	3 (2+1)	
7.		SEC VI*	Skill Enhancement Course-VI	2 (0+2)	
8.					

Eternal University, Baru Sahib
Dr. Khem Singh Gill Akal College of Agriculture

1.	**Course Code: 0140241012**	**Subject Code: FT 221**	**Course Title: Fundamentals of Food Engineering**		
2.	**Semester: IV**		**Credits: 3(2+1)**		
3.	**Contact Hours:**	**L: 2**	**P:2**		
4.	**Relative weightage:**	**MTE:24**	**ETE: 48**	**Quiz/PA: 24**	**FPE:24**
5.	**Objectives:**				
I.	To understand the fundamental principles of drying and dehydration, including heat and mass transfer, drying kinetics, and the design and selection of various dryers used in food and dairy industries.				
II.	To understand the principles, mechanisms, and benefits of size reduction in food processing, and to analyze the performance and efficiency of different size reduction equipment and methods.				
III.	To understand the theory and principles of mixing in food processing, including the factors affecting mixer effectiveness, mixing indices, and power requirements for various types of mixing equipment.				
IV.	To understand and apply the principles of mechanical separations, filtration, and membrane separation techniques in food processing for efficient separation and purification of liquids, solids, and gases.				
6.	**Course Outcomes:**				
CO1	Students will be able to analyze drying rate curves, calculate drying times and efficiencies, and select appropriate drying equipment for both solid and liquid food products based on process requirements.				
CO2	Students will be able to apply Rittinger's, Kick's, and Bond's equations to determine the energy requirements for size reduction, perform sieve analysis to classify ground materials, and select appropriate size reduction equipment				
CO3	Students will be able to evaluate and select appropriate mixing equipment for different materials (liquids, pastes, dry powders) based on viscosity, mixing efficiency, and power requirements, and apply theoretical principles to optimize mixing processes.				
CO4	Students will be able to select and apply appropriate separation techniques such as centrifugation, filtration, and membrane processes (ultrafiltration, reverse osmosis) in food processing, optimizing efficiency and addressing issues like fouling and concentration.				

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	3	2	1	3	2	1	3	2	1	2	1	2
CO2	3	3	1	3	1	1	3	3	1	1	1	2
CO3	2	2	2	3	2	1	2	3	1	2	1	2
CO4	2	3	2	3	3	1	2	3	2	3	1	2
Avg.	**2.5**	**2.5**	**1.5**	**3**	**2**	**1**	**2.5**	**2.75**	**1.25**	**2**	**1**	**2**

1= Weak Correlation 2 = Moderate Correlation 3 = Strong Correlation

7. Details of Course:

S. No.	**Particulars**	**No. of Lectures**
1.	Drying and dehydration: Basic drying theory, heat and mass transfer in drying, drying rate curves, calculation of drying times, dryer efficiencies; classification and selection of dryers; tray, vacuum, osmotic, fluidized bed, pneumatic, rotary, tunnel, trough, bin, belt, microwave, IR, heat pump and freeze dryers;	6

	dryers for liquid: Drum or roller dryer, spray dryer and foam-mat dryers.	
2.	Size reduction: Benefits, classification, determination and designation of the fineness of ground material, sieve/screen analysis, principle and mechanisms of comminution of food, Rittinger's, Kick's and Bond's equations, work index, energy utilization; Size reduction equipment: Principal types, crushers (jaw crushers, gyratory, smooth roll), hammer mills and impactors, attrition mills, buhr mill, tumbling mills, tumbling mills, ultra fine grinders, fluid jet pulverizer, colloid mill, cutting machines (slicing, dicing, shredding, pulping).	7
3.	Mixing: theory of solids mixing, criteria of mixer effectiveness and mixing indices, rate of mixing, theory of liquid mixing, power requirement for liquids mixing; Mixing equipment: Mixers for low- or medium-viscosity liquids (paddle agitators, impeller agitators, powder-liquid contacting devices, other mixers), mixers for high viscosity liquids and pastes, mixers for dry powders and particulate solids.	8
4.	Mechanical Separations: Theory, centrifugation, liquid-liquid centrifugation, liquid-solid centrifugation, clarifiers, desludging and decanting machine. Filtration: Theory of filtration, rate of filtration, pressure drop during filtration, applications, constant-rate filtration and constant-pressure filtration, derivation of equation; Filtration equipment; plate and frame filter press, rotary filters, centrifugal filters and air filters, f ilter aids. Membrane separation: General considerations, materials for membrane construction, ultra-filtration, microfiltration, concentration, polarization, processing variables, membrane fouling, applications of ultra-filtration in food processing, reverse osmosis, mode of operation, and applications; Membrane separation methods, demineralization by electro-dialysis, gel filtration, ion exchange, per-evaporation and osmotic dehydration	9
	Total Lectures	**30**

8. Practical

S. No.	Contents of Practical's	No. of Practical's
1.	Determination of fineness modulus and uniformity index. Determination of mixing index of a feed mixer.	3
2.	Power requirement in size reduction of grain using Ratingen's law, Kick's law and Bond's law. Performance evaluation of hammer mill; Performance evaluation of attrition mill.	3
3.	Study of centrifugal separator.	3
4.	Study of freeze dryer and freeze-drying process; Study on osmosis in fruits.	3
5.	Determination of solid gain and moisture loss during osmosis; Study of reverse osmosis process; Study of ultra-filtration/membrane separation process.	3
	Total Practical's	**15**

9. Suggested Books/Readings:

S.No.	Authors/ Book Name/ Publishers
1.	Earle, R. L. (1983). *Unit Operations in Food Processing*. Pergamon Press.
2.	Geankoplis, C. J. (2003). *Transport Processes and Separation Process Principles (Includes Unit Operations)* (4th ed.). Prentice-Hall.
3.	McCabe, W. L., Smith, J., & Harriott, P. (2004). *Unit Operations of Chemical Engineering* (7th ed.). McGraw-Hill, Inc.
4.	Mohsenin, N. N. (1986). *Physical Properties of Plant and Animal Materials: Structure,*

	Physical Characteristics and Mechanical Properties (2nd ed.). Gordon and Breach Science Publishers.
5.	Mohsenin, N. N. (1984). *Electromagnetic Radiation Properties of Foods and Agricultural Products*. Gordon and Breach Science Publishers.
6.	Mohsenin, N. N. (1980). *Thermal Properties of Foods and Agricultural Materials*. Gordon and Breach Science Publishers.
7.	Pandey, H., Sharma, H. K., Chauhan, R. C., Sarkar, B. C., & Bera, M. B. (2010). *Experiments in Food Process Engineering*. CBS Publishers and Distributors Pvt. Ltd.
8.	Richardson, J. F., Harker, J. H., & Backhurst, J. R. (2002). *Coulson and Richardson's Chemical Engineering, Vol. 2: Particle Technology and Separation Processes* (5th ed.). Butterworth-Heinemann.
9.	Saravacos, G. D., & Kostaropoulos, A. E. (2002). *Handbook of Food Processing Equipment*. Springer Science and Business Media.

Eternal University, Baru Sahib
Dr. Khem Singh Gill Akal College of Agriculture

1.	**Course Code: 0140241022**	**Subject Code: FT 222**	**Course Title: Food Plant Sanitation**		
2.	**Semester: IV**		**Credits: 3 (2+1)**		
3.	**Contact Hours:**	**L: 2**	**P: 2**		
4.	**Relative weightage:**	**MTE: 24**	**ETE: 48**	**Quiz/PA: 24**	**FPE: 24**
5.	**Objectives:**				
I.	To understand sanitation laws, regulations, and the establishment of sanitary practices in the food industry.				
II.	To explore the role of microorganisms and allergens in sanitation and food safety.				
III.	To gain knowledge of contamination sources, personal hygiene, and food handling responsibilities.				
IV.	To learn about cleaning agents, pest control, sanitary facility design, waste management, and HACCP.				
6.	**Course Outcomes**:				
CO1	Students will be able to identify and apply sanitation laws and practices to ensure hygienic food production and handling.				
CO2	Students will understand microbial and allergenic risks, their sources, and methods of control in food environments.				
CO3	Students will demonstrate good hygiene practices, identify contamination risks, and ensure safe food handling through employee supervision and responsibility.				
CO4	Students will be able to select and use appropriate sanitizers, implement pest control strategies, understand sanitary design and waste management, and apply HACCP and GMP practices for sanitation.				

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	3	2	2	2	2	1	3	2	3	2	2	2
CO2	2	3	1	2	1	1	3	2	3	1	1	1
CO3	2	2	2	2	2	1	3	2	3	2	2	2
CO4	2	2	2	3	2	1	3	3	3	2	2	2
Avg.	**2.25**	**2.25**	**1.75**	**2.25**	**1.75**	**1**	**3**	**2.25**	**3**	**1.75**	**1.75**	**1.75**

1= Weak Correlation 2 = Moderate Correlation 3 = Strong Correlation

7. Details of Course:

Units	**Particulars**	**No. of Lectures**
I	Sanitation and food industry: Sanitation, sanitation laws, regulations, and guidelines, establishment of sanitary Practices. Foodborne bioterrorism: Potential risks and protection measures for bioterrorism.	5
II	The Relationship of microorganisms to sanitation: Microbial growth in relation to spoilage and food borne out breaks and its control measures.	5
III	The Relationship of allergens to sanitation: Food allergens and its control measures. Food contamination sources: Sources of contamination, contamination of foods, protection against contamination. Personal hygiene and sanitary food handling: Personal hygiene, employee hygiene, sanitary food	7

	handling, role of employee supervision, employee responsibility	
IV	Cleaning compounds and sanitizers: Classification, selection of cleaning compounds and sanitizers, CIP and COP, handling and storage, precautions. Pest and Rodent Control: Insect infestation, cockroaches, insect destruction, rodents, birds, use of pesticides, integrated pest management.	6
V	Sanitary design and construction for food processing: Site selection, site preparation, building construction considerations, processing and design considerations, pest control design. Waste product handling: solid waste and liquid waste management. Role of HACCP in sanitation: Good manufacturing practices, current good manufacturing practices; Standard operating procedures, good laboratory practices.	7
	Total Lectures:	**30**

9. Practical

S. No.	**Content of Practical's**	**No. of Practicals**
1	Estimation of BOD (Biological Oxygen Demand); Estimation of COD (Chemical Oxygen Demand);	2
2	Determination of hardness of water; Good Manufacturing Practices (GMPs) and personal hygiene; Sewage treatment: Primary, secondary, tertiary and quaternary; Aerobic and anaerobic sludge treatment.	2
3	Lab demonstration on state of water; Study of CIP plant; Isolation and identification of Actinomyces; Enrichment and isolation of cellulose degrading bacteria.	3
4	Biodegradation of phenol compounds; Bacteriological examination of water: Coli form MPN test;	2
5	Sampling of airborne microorganisms; Sampling of surfaces - equipment and physical plant; Aerosol sampling and measurement guidelines.	3
6	Assessment of hydrocolloids as food additives; Assessment of various pectinases from fruits and vegetables	3
	Total Practical's	**15**

10. Suggested Books/Readings:

S.NO.	**Authors/ Name of Books/Publishers**
1.	Cramer, M. M. (2013). *Food Plant Sanitation: Design, Maintenance, and Good Manufacturing Practices*. CRC Press.
2.	Hui, Y. H., Bruinsma, B. L., Gorham, J. R., Nip, W.-K., Tong, P. S., & Ventresca, P. (2003). *Food Plant Sanitation*. Marcel Dekker, Inc.
3.	Mitchell, R., & Gu, J. D. (2010). *Environmental Microbiology* (2nd ed.). John Wiley & Sons, Inc.
4.	Marriott, N. G., & Gravani, R. B. (2006). *Principles of Food Sanitation* (5th ed.). Springer Science and Business Media, Inc.
5.	Pepper, I. L., & Gerba, C. P. (2005). *Environmental Microbiology: Laboratory Manual* (2nd ed.). Elsevier Academic Press.

Eternal University, Baru Sahib
Dr. Khem Singh Gill Akal College of Agriculture

1.	**Course Code: 0140241030**	**Subject Code: FT 223**	**Course Title: Food Quality, Safety Standards and Certification**	
2.	**Semester: IV**		**Credits: 2 (2+0)**	
3.	**Contact Hours:**	**L: 2**		
4.	**Relative weightage:**	**MTE: 24**	**ETE: 40**	**Quiz/PA: 16**
5.	**Objectives:**			
I.	To introduce food quality concepts and their role in the food industry.			
II.	To equip students with techniques for assessing food quality.			
III.	To analyze factors influencing food quality during processing and storage.			
IV.	To provide knowledge of national and international food safety regulations			
6.	**Course Outcomes:**			
CO1	Students will be able to evaluate food quality using various methods.			
CO2	Students will understand the impact of processing on food quality.			
CO3	Students will gain expertise in food laws and certification procedures.			
CO4	Students will apply quality control and assurance in food industries.			

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	3	2	1	3	1	1	3	3	1	1	1	2
CO2	2	2	1	2	2	1	2	2	1	2	1	1
CO3	1	1	2	1	1	1	1	1	3	1	2	1
CO4	2	2	2	3	2	2	2	3	2	2	2	2
Avg.	**2**	**1.75**	**1.5**	**2.25**	**1.5**	**1.25**	**2**	**2.25**	**1.75**	**1.5**	**1.5**	**1.5**

1= Weak Correlation 2 = Moderate Correlation 3 = Strong Correlation

7. Details of Course:

Units	**Particulars**	**No. of Lectures**
I	Introduction: Definition, its role in food industry, Quality attributes; Quality Defects: Classification, Genetic-physiological defects: Structural, off color, character; Entomological defects: Holes, scars, lesions, off coloring, curled aves, pathological defects; Mechanical defects, extraneous or foreign material defects. Measurement of defects by different techniques; Quality Assessment; Quality assessment of food materials on the basis of sensory evaluation, Physical, chemical microbiological methods	7
II	Quality of products during processing and after processing; Factors influencing the food qualities: Soil, field practices, harvesting practices, procedures, packaging, transportation, storage,conditions, processing conditions, packaging and storage conditions of finished products.	7
III	Role of QC and QA Quality: Quality Control, Quality Assurance, Concepts of quality	6

	control and quality assurance functions in food industries; Quality Improvement Total Quality management: Quality evolution, quality gurus, defining TQM, principals of TQM, stages in implementation, TQM road map. Quality improvement tools, customer focus, cost of quality.	
IV	Food Laws; Food Laws and Standards: National and International food laws. Mandatory and voluntary food laws. Indian Food Regulations and Certifications: Food Safety and Standards Act FSSAI Rules, food adulteration, misbranding, common adulterants in foods, Duties and responsibilities of Food Safety Authorities. AGMARK, BIS, FPO, Weights and Measures Act, CODEX; Agricultural Marketing and Grading Standards (AGMARK), Bureau of Indian Standards (BIS) and their certification, FPO –standards and certification process Weights and Measures Act and Packaged commodity rules;	5
V	Role of CODEX in food safety and standards, Food safety issues and risk analysis; FSMS 22000, Food Safety Management Systems, ISO 22000 – 2005 and other Global Food safety management systems. Principles, implementation; documentation, types of records; Auditing, certification procedures, certifying bodies, accrediting bodies.	5
	Total Lectures:	**30**

8. Suggested Books/Readings:

S. No.	Authors/ Name of Books/Publisher
1.	Alli, I. (2004). *Food Quality Assurance: Principles and Practices*. CRC Press.
2.	Hester, R. E., & Harrison, R. M. (2001). *Food Safety and Food Quality*. Royal Society of Chemistry.
3.	Schmidt, R. H., & Rodrick, G. E. (2003). *Food Safety Handbook*. John Wiley & Sons.

Eternal University, Baru Sahib
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1.	**Course Code: 0140241040**	**Subject Code: MATH 221**	**Course Title: Engineering Mathematics-II**	
2.	**Semester: IV**		**Credits: 2(2+0)**	
3.	**Contact Hours:**	**L: 2**	**P:NA**	
4.	**Relative weightage:**	**MTE:24**	**ETE: 40**	**Quiz/PA: 16**
5.	**Objectives:**			
I.	To understand matrix algebra and its applications in solving systems of linear equations and transformations.			
II.	To study functions of a complex variable and their properties.			
III.	To analyze periodic functions using Fourier series.			
IV.	To formulate and solve partial differential equations.			
6.	**Course Outcomes:**			
CO1	Students will solve linear systems, find matrix inverses, eigenvalues, and perform matrix transformations.			
CO2	Students will apply C-R equations, analyze analytic and harmonic functions.			
CO3	Students will compute Fourier series and perform harmonic analysis.			
CO4	Students will solve PDEs and apply them to heat, wave, and Laplace equations.			

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	2	2	1	1	2	2	3	1	1	1	2
CO2	2	2	1	1	1	2	2	2	1	1	1	2
CO3	2	2	2	1	1	2	2	2	1	1	1	2
CO4	2	3	2	1	2	2	2	3	2	2	1	2
Avg.	**2**	**2.25**	**1.75**	**1**	**1.25**	**2**	**2**	**2.5**	**1.25**	**1.25**	**1**	**2**

1= Weak Correlation 2 = Moderate Correlation 3 = Strong Correlation

7. Details of Course:

S. No.	Particulars	No. of Lectures
1.	Elementary transformation and rank of a matrix, reduction to normal form, Gauss-Jordan method to find inverse of a matrix; Consistency and solution of linear equations; Eigen value and vectors, Cayley-Hamilton theorem; Linear and orthogonal transformations; Diagonalization of matrices, Bilinear, Quadratic forms..	7
2.	Limit, continuity, derivative of function of complex variable; Analytical function, C-R equations, conjugate function, harmonic functions..	8
3.	Fourier series: Infinite series and its convergence, periodic function, Euler's formulae for calculating Fourier coefficients, Dirichlet's conditions; Fourier series of functions with arbitrary period; Fourier series of odd and even functions; Half range sine and cosine series, Harmonic analysis..	7
4.	Formation of partial differential equations; Lagrange's linear equation; Higher order linear partial differential equation with constant coefficients; Solution of non-linear partial differential equation (Charpit's method); Application of partial differential equations: One dimensional wave e.g., one dimensional heat	8

	equation, two dimensional steady state heat equation i.e. Laplace equation	
	Total Lectures	**30**

8. Suggested Books/Readings:

S.No.	Authors/ Book Name/ Publishers
1.	Ramana, B. V. (2008). *Engineering Mathematics*. Tata McGraw-Hill Book Co.
2.	Grewal, B. S. (2004). *Higher Engineering Mathematics*. Khanna Publishers.
3.	Narayan, S. (2004). *Integral Calculus*. S. Chand and Co. Ltd.
4.	Narayan, S. (2004). *A Textbook of Matrices*. S. Chand and Co. Ltd.

Eternal University, Baru Sahib
Dr. Khem Singh Gill Akal College of Agriculture

1.	**Course Code: 0140241052**	**Subject Code: FT 224**	**Course Title: Food Plant Utilities and Services**		
2.	**Semester: IV**		**Credits: 3 (2+1)**		
3.	**Contact Hours:**	**L: 2**	**P: 2**		
4.	**Relative weightage:**	**MTE: 24**	**ETE: 48**	**Quiz/PA: 24**	**FPE: 24**
5.	**Objectives:**				
I.	To understand the classification and functioning of various utilities and services in a food plant.				
II.	To study the principles and efficiency factors of electrical systems and motor-driven equipment.				
III.	To learn the working, evaluation, and energy-saving strategies of HVAC, refrigeration, fans, blowers, and pumps.				
IV.	To analyze the combustion systems, steam and boiler operations, and waste heat recovery methods.				
6.	**Course Outcomes**:				
CO1	Students will be able to identify and explain key utilities and their roles in food industry operations.				
CO2	Students will be able to evaluate electrical systems and suggest improvements for energy efficiency.				
CO3	Students will be able to assess performance and recommend conservation measures for thermal and mechanical systems..				
CO4	Students will be able to optimize fuel usage and implement energy-saving opportunities in thermal utility systems				

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	2	2	1	1	3	2	2	1	1	1
CO2	2	3	1	3	1	1	2	3	2	2	1	1
CO3	2	2	1	2	2	1	2	2	2	2	1	1
CO4	3	2	2	3	3	2	3	3	3	3	2	2
Avg.	**2.5**	**2.25**	**1.5**	**2.5**	**1.75**	**1.25**	**2.5**	**2.5**	**2.25**	**2**	**1.25**	**1.25**

1= Weak Correlation 2 = Moderate Correlation 3 = Strong Correlation

7. Details of Course:

Units	Particulars	No. of Lectures
I	Classification of Various Utilities and Services in food Plant/ industry. Commercial energy Pricing; Electrical System- Introduction to electric power supply systems, electrical billing, electrical load management and maximum demand control, power factor improvement and benefits, transformers, system distribution losses, harmonics, trouble shooting of electrical power system..	7
II	Electrical motors- Types, losses in Introduction motor, motor efficiency, factors affecting motor performers, performance, rewinding and motor replacement issues, energy saving opportunities with energy efficient motors. Compressed air system - Requirement, types, compressor efficiency, efficient compressor	7

	operation, compressed air system components, capacity assessment, leakage test, factors affecting the performance and efficiency.	
III	HVAC and Refrigeration system - Requirement, vapor compression refrigeration cycle, refrigerants, coefficient of performance, capacity, factors affecting refrigeration and air conditioning system performance and saving opportunities. Vapor absorption refrigeration system: Working principle, types and comparison with VCR system, saving potential; Fans and blowers - Requirement, types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities, Pumps and pumping systems- Requirement, types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities.	8
IV	DG set system- Requirement, introduction, factors affecting selection; Fuels and combustion - Introduction to fuels; properties of fuel oil, coal and gas; storage; handling and preparation of fuels; principles of combustion, combustion of oil, coal and gas; draft system. Boilers- Boiler specification, Indian boiler regulation, system components, types, combustion in boilers, performance terms, analysis of losses, feed water treatment, blow down, energy conservation opportunities; Steam system - Properties of steam, assessment of steam distribution losses, steam leakage, steam trapping, condensate and flash steam recovery system, opportunities for energy savings; Waste heat recovery - Classification, advantages and application, commercially viable waste heat recovery devices, saving potential; Other utilities and services - Lighting, CIP system, waste water/drainage, water treatment, dust removal, fire protection and maintenance system.	8
	Total Lectures:	**30**

8 Practical

S. No.	**Content of Practical's**	**No. of Practical's**
1	Study on energy basic, types, forms, terms and measuring instruments used in food plant utilities.; electrical power supply system, billing and load estimation.	2
2	Motors and variable speed drives specification, selection, performance terms and definitions; compressed air system components and performance terms and definitions; refrigeration and HVAC system components, performance terms and definitions and load estimation of a plant	2
3	Fans and blowers, types, specification, performance terms and definitions. Pumps types, specification, selection, performance terms and definitions; plant lighting system and their components; DG system their specification and selection.	3
4	Combustion of oil, gas and coal; boiler performance terms and assessment. Study on cost of steam; waste heat recovery devices. Recuperates, Regenerators, Heat wheel, Heat pipes, Economizers, Heat exchanger (Shell and tube, PHE, run around coil exchanger, direct contact HX), Waste heat recovery boilers, Heat pumps and Thermo compressor	5
5	Cleaning in place (CIP) system components; water treatment plant; effluent treatment plant; fire control operations and use of fire extinguishers.	3
	Total Practical's	**15**

9. Suggested Books/Readings:

S.NO.	Authors/ Name of Books/Publishers
1.	Wang, L. (2008). *Energy Efficiency and Management in Food Processing Facilities*. CRC Press.
2.	Casper, M. E. (1977). *Energy-Saving Techniques for the Food Industry*. Noyes Data Corp.
3.	Chilton's Food Engineering. (1979). *Chilton Co*.
4.	Whitman, W. E., & Holdsworth, S. D. (n.d.). *A Survey of Water Use in the Food Industry*. British Food Manufacturing Industries Research Association.

Eternal University, Baru Sahib
Dr. Khem Singh Gill Akal College of Agriculture

1.	**Course Code: 0100043012**	**Subject Code: STAT-221**	**Course Title: Agricultural Informatics and Artificial Intelligence**		
2.	**Semester: IV**	**Credits: 3(2+1)**			
3.	**Contact Hours:**	**L: 2**	**P: 2**		
4.	**Relative weightage:**	**MTE:24**	**ETE:48**	**Quiz/PA:24**	**FPE:24**
5.	**Objectives:**				
I.	To introduce students to fundamental concepts of computer applications in agriculture.				
II.	To develop practical skills in database management and decision-support tools relevant to agriculture.				
III.	To provide insights into artificial intelligence and its role in modern agricultural practices.				
IV.	To familiarize students with geospatial technologies and mobile applications for smart farming.				
6.	**Course Outcomes:**				
CO1	Students will be able to apply computer software tools for data analysis, report generation, and multimedia presentations.				
CO2	Students will gain hands-on experience with crop simulation models and decision-support systems.				
CO3	Students will understand the integration of AI, IoT, and big data analytics in crop and livestock management.				
CO4	Students will be able to design basic geospatial analyses and apply digital tools for precision agriculture.				

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	2	1	1	3	1	2	2	3	2	2	2	2
CO2	1	2	1	3	2	2	2	3	2	2	1	2
CO3	3	3	2	3	3	3	3	3	2	2	3	3
CO4	2	2	2	3	2	2	3	3	2	3	2	2
Avg.	**2**	**2**	**1.5**	**3**	**2**	**2.25**	**2.5**	**3**	**2**	**2.25**	**2**	**2.25**

1= Weak Correlation 2 = Moderate Correlation 3 = Strong Correlation

7. Details of Course:

Units	**Particulars**	**No. of Lectures**
I	Introduction to Agricultural Informatics: Basics of computers, operating systems, MS Office applications, database concepts, internet usage.	**6**
II	Programming and Software Applications: Introduction to programming languages (C, C++, Java, etc.), database management systems, crop simulation models.	**8**
III	AI and Smart Agriculture: AI fundamentals, machine learning, use of AI in crop/livestock health monitoring, predictive analysis, smart devices in agriculture.	**8**
IV	Geospatial and Decision Support Tools: GIS, remote sensing, mobile apps for farm management, decision support systems, preparation of crop calendars using IT tools.	**8**
	Total Lectures:	**30**

9. Practical

Units	Content of Practicals	No. of Practical's
I	Computer Basics and File Management: Hands-on practice in assembling computer components, Creation and management of files and folders using different operating systems (Windows, Linux).	**2**
II	Preparing a scientific report and a presentation using MS Word and MS PowerPoint, Using MS Excel for data entry, creating graphs, applying statistical tools, and generating charts.	**2**
III	Creating a simple agricultural database in MS Access, Querying and generating reports for farm data (e.g., crop yields, soil information).	**2**
IV	Writing simple programs in R or python for basic agricultural computations, Practice of standard input/output operations.	**1**
V	Introduction and hands-on practice with crop simulation software (like DSSAT or CropSyst), Preparing input files and interpreting model outputs for water and nutrient management.	**2**
VI	Browsing and identifying agricultural portals/websites, Practical use of smartphone apps for farm advice and market price updates.	**1**
VII	Basics of GIS: plotting simple maps and analyzing geospatial data, Introduction to remote sensing tools and applications in agriculture.	**1**
VIII	Developing a simple decision support tool for crop selection or pest management, Preparing a contingent crop plan using IT tools.	**2**
IX	Demonstration of AI-based tools (such as yield prediction models or disease detection apps), Introduction to AI tools for smart irrigation and automated weeding.	**2**
	Total Practical's:	**15**

10. Suggested Readings:

S. No.	Authors/ Name of Books/Publishers
1.	Choudhary K. R. *Fundamentals of Artificial Intelligence*. Springer
2.	Date, C. J. 2000. *Introduction to Database Management System*. Addison-Wesley
3.	Kumar, E. 2020. *Artificial Intelligence*. Wiley.
4.	Nilson, N.J. 2001. *Principles of Artificial Intelligence*. Narosa.
5.	Rajaraman, V. and Adabala, N. *Fundamentals of Computers*. PHI Learning Pvt. Ltd, New Delhi.
6.	Russell, Stuart. 2013. *Artificial Intelligence: A Modern Approach*. Pearson Edition.
7.	Sethi, D. P. and Pradhan, M. 2017. *Concepts and Techniques of Programming in C*. I.K. International Publishing House Pvt. Limited.
8.	Vanitha, G. 2023. *Agro-Informatics*. NIPA, New Delhi.

Third Year SEMESTER-V					
S. No.	**Course Code**	**Subject Code**	**Course Title**	**Credit hours**	**Total Credit hours**
1.	0140251012	FT 311	Food Biochemistry and Nutrition	3 (2+1)	**22 (14+8) +2 (Non-Gradial)**
2.	0140251022	FT 312	Processing Technology of Cereals	3 (2+1)	
3.	0140251032	FT 313	Processing Technology of Fruits and Vegetables	3 (2+1)	
4.	0140251042	FT 314	Food Packaging Technology and Equipment	2 (1+1)	
5.	0140251052	FT 315	Processing of Spices and Plantation Crops	3 (2+1)	
6.	0140251062	FT 316	Food Storage Engineering	3 (2+1)	
7.	0140251072	FT 317	Project Preparation and Management	2 (1+1)	
8.	0190052032	ECON 311	Agricultural Marketing and Trade	3 (2+1)	
9.	0140251091	CAC 311	Study tour (10-12 days during the semester)	2 (0+2) NG	

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1.	**Course Code: 0140251012**	**Subject Code: FT 311**	**Course Title: Food Biochemistry and Nutrition**		
2.	**Semester: V**		**Credits: 3(2+1)**		
3.	**Contact Hours:**	**L: 2**	**P:2**		
4.	**Relative weightage:**	**MTE:24**	**ETE: 48**	**Quiz/PA: 24**	**FPE:24**
5.	**Objectives:**				
I.	To understand the basic principles of food and nutrition, including the role of nutrients in maintaining health and the formulation of balanced diets.				
II.	To introduce the concepts of enzyme function, kinetics, and inhibition, and to explore the structures and functions of nucleic acids (DNA and RNA).				
III.	To provide an in-depth understanding of the biochemical pathways involved in the metabolism of carbohydrates, lipids, and proteins				
IV.	To explore the role of macronutrients and micronutrients, including vitamins and minerals, in human health and their impact on various physiological processes.				
6.	**Course Outcomes:**				
CO1	Students will be able to classify food groups, formulate balanced diets for different age groups, and assess nutritional status. They will also understand food-related health issues like malnutrition and food fads				
CO2	Students will be able to explain the mechanism of enzyme action, understand enzyme kinetics, and describe the structure of nucleic acids, along with enzyme inhibition and the role of coenzymes.				
CO3	Students will be able to describe and explain the metabolic processes involved in carbohydrate, lipid, and protein metabolism, including glycolysis, TCA cycle, β-oxidation, and the urea cycle.				
CO4	Students will understand the functions, sources, and absorption processes of carbohydrates, proteins, fats, vitamins, and minerals, and be able to explain the relationship between vitamins and hormones in maintaining overall health.				

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	3	2	2	2	3	2	3	3	2	3
CO2	2	3	2	2	2	3	3	3	3	2	3	2
CO3	3	3	2	3	2	2	3	3	3	3	3	3
CO4	2	2	3	3	3	2	2	3	3	3	3	2
Average	2.6	2.6	2.6	2.6	2.4	2.4	2.8	2.8	3.0	2.8	2.8	2.6

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

7. Details of Course:

S. No.	Particulars	No. of Lectures
1.	Concepts of Food and Nutrition; Functions of food; Basic food groups; nutrients supplied by food; Water and energy balance, water intake and losses, basal metabolism; Formulation of diets, classification of balanced diet, preparation of balanced diet for various groups; Recommended dietary allowances for various age groups; Malnutrition; Assessment of nutritional status; Food fad and faddism; Potentially toxic substance in human food.	6
2.	Mechanism of Enzyme action; Introduction to enzyme and characteristics, coenzymes, kinetics and mechanism of enzyme action; Derivation of Michaelis-Menten Equation, Enzyme inhibition by pH, allosteric enzymes; Nucleic acids, structures of various components of DNA and RNA.	7
3.	Nutrients; Functions, sources, digestion, absorption, assimilation, transport of	8

	carbohydrates; Functions, sources, digestion, absorption, assimilation, transport of proteins; Functions, sources, digestion, absorption, assimilation, transport of fats; Metabolism of carbohydrates. Introduction to carbohydrates metabolism, glycolysis, TCA cycle; Electron transport chain, oxidative and substrate level phosphorylation; Metabolism of Lipids; Introduction to lipid metabolism, β-oxidation of long chain fatty acids, Introduction to protein metabolism, transamination, Urea Cycle.	
4.	Functions, sources, absorption, deficiency of macrominerals, microminerals and trace minerals; Functions, sources, absorption, deficiency of Vitamins A & D, Vitamins E and K and water-soluble vitamins; Information about hormones and relation between vitamins and hormones., ion exchange, per-evaporation and osmotic dehydration	9
	Total Lecture's	**30**

8. Practical

S. No.	Contents of Practical's	No. of Practical's
1.	Preparation of various solutions and buffers; Qualitative and quantitative determination of carbohydrates; Qualitative and quantitative determination of amino acids	3
2.	Qualitative and quantitative determination of proteins; Qualitative and quantitative determination of lipids; Qualitative and quantitative determination of vitamins.	3
3.	Isolation of enzymes from various sources; Measurement of energy using bomb calorimeter; Determination of pKa of acid; Determination of pI for casein.	3
4.	Estimation of sugars by Anthrone method; Estimation of protein by Lowry method; Estimation of amino acid using Biuret reaction; Separation of amino acids using paper chromatography..	3
5.	Separation of amino acids using thin layer chromatography. Estimation of phosphorus in food sample; Estimation of iron content in foods; Determination of calcium in food samples; Estimation of β-carotene using column chromatography; Estimation of ascorbic acid using dye method; Effects of acids and alkali on pigments	3
	Total Practical's	**15**

9. Suggested Books/Readings:

S.No.	Authors/ Book Name/ Publishers
1.	Berdanier, C. D., Feldman, E. B., & Dwyer, J. (2008). *Handbook of Nutrition and Food* (2nd ed.). CRC Press.
2.	Berg, J. M., Tymoczko, J. L., Stryer, L., & Gatto Jr., G. J. (2002). *Biochemistry* (7th ed.). W. H. Freeman and Company.
3.	Buchanan, B. B., Gruissem, W., & Jones, R. L. (2002). *Biochemistry and Molecular Biology of Plants*. John Wiley & Sons, Inc.
4.	Moe, G., Kelley, D., Berning, J., & Byrd-Bredbenner, C. (2013). *Wardlaw's Perspectives in Nutrition: A Functional Approach*. McGraw-Hill.
5.	Nelson, D. L., & Cox, M. M. (2012). *Lehninger Principles of Biochemistry* (6th ed.). Macmillan Learning.

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1.	**Course Code: 0140251022**	**Subject Code: FT 312**	**Course Title: Processing Technology of Cereals**		
2.	**Semester: V**		**Credits: 3 (2+1)**		
3.	**Contact Hours:**	**L: 2**	**P: 2**		
4.	**Relative weightage:**	**MTE: 24**	**ETE: 48**	**Quiz/PA: 24**	**FPE: 24**
5.	**Objectives:**				
I.	To understand the present status, future prospects, and the morphological and physico-chemical properties of cereals and millets.				
II.	To study the processing techniques of major cereals and millets, including rice, wheat, corn, barley, oats, rye, and sorghum.				
III.	To explore milling operations, including conventional and modern milling processes, and their effect on product quality.				
IV.	To learn the processing of secondary and tertiary products from cereals and millets, with a focus on infant foods, breakfast cereals, and by-product utilization.				
6.	**Course Outcomes:**				
CO1	Explain the characteristics, composition, and nutritional value of cereals and millets.				
CO2	Analyze the various milling processes and their impact on the quality and efficiency of cereal products.				
CO3	Evaluate the different methods of rice, wheat, and corn milling and processing, including enrichment and fortification techniques.				
CO4	Understand the processing of secondary and tertiary cereal products, including infant foods, breakfast cereals, and by-product utilization.				

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	3	2	1	1	2	1	3	1	2	1	1	1
CO2	3	3	2	2	2	1	3	2	2	2	1	1
CO3	3	3	2	3	2	1	3	3	3	2	1	2
CO4	2	2	2	2	3	2	2	2	2	3	2	2
Average	2.75	2.5	1.75	2	2.25	1.25	2.75	2	2.25	2	1.25	1.5

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

7. Details of Course:

Units	**Particulars**	**No. of Lectures**
I	Present status and future prospects of cereals and millets; Morphology, physico-chemical properties of cereals, major and minor millets Chemical composition and nutritive value; Paddy processing and rice milling: Conventional milling, modern milling; Milling operations, milling machines, milling efficiency; Quality characteristics influencing final milled product	9
II	Parboiling; Rice bran stabilization and its methods; Ageing of rice; Enrichment of rice – methods of enrichment; Rice fortification; Wheat milling: Break system, purification system and reduction system; extraction rate and its effect on flour composition; Quality characteristics of flour and their suitability for baking	7

III	Corn milling: Dry and wet milling of corn, starch and gluten separation, milling fractions and modified starches; Barley: Malting and milling; Oat/Rye: Processing, milling; Sorghum: Milling, malting, pearling	7
IV	Millets (Pearl millets, finger millets): Processing of millets for food uses; Secondary and tertiary products processing of cereals and millets; By-products processing of cereals and millets; Processing of infant foods from cereals and millets; Breakfast cereal foods: Flaked, puffed, expanded, extruded and shredded	7
	Total Lectures:	**30**

8. Practical

Units	Content of Practical's	No. of Practical's
I	Morphological characteristics of cereals; Physical properties of cereals; Chemical properties of cereals	3
II	Parboiling of paddy; Cooking quality of rice; Milling of rice; Conditioning and milling of wheat	3
III	Production of sorghum flakes; Production of popcorns, flaked rice, puffed rice, noodles	3
IV	Preparation of sorghum malt; Determination of gelatinization temperature by amylograph	3
V	Processing of value-added products from millets; Visit to Cereal processing unit	3
	Total Practical's:	**15**

9. Suggested Books/Readings:

S. No.	Authors/ Name of Books/Publishers
1.	Araullo, E. V., De Padua, D. B., & Graham, M. (1976). *Rice Post Harvest Technology*. IDRC.
2.	Chakraverty, A., & Singh, R. P. (2014). *Post Harvest Technology and Food Process Engineering*. CRC Press.
3.	Chakraverty, A., Mujumdar, A. S., Vijaya Raghavan, G. S., & Ramaswamy, H. S. (2003). *Handbook of Post-Harvest Technology: Cereals, Fruits, Vegetables, Tea, and Spices*. Marcel Dekker, Inc.
4.	Champagne, E. T. (2004). *Rice: Chemistry and Technology* (3rd ed.). AACC International, Inc.
5.	David, A. V. Dendy, & Dobraszczyk, B. J. (2001). *Cereal and Cereal Products: Technology and Chemistry*. Springer-Verlag.
6.	Kent, N. L., & Evers, A. D. (1994). *Kent's Technology of Cereals: An Introduction for Students of Food Science and Agriculture* (4th ed.). Elsevier Science Ltd.
7.	Khan, K., & Shewry, P. R. (2009). *Wheat: Chemistry and Technology* (4th ed.). AACC International, Inc.
8.	Matz, S. A. (1991). *The Chemistry and Technology of Cereals as Food and Feed* (2nd ed.). Springer Science + Business Media.
9.	Wrigley, C. (2004). *Encyclopedia of Grain Science*. Academic Press.
10.	White, P. J., & Johnson, L. L. (2003). *Corn: Chemistry and Technology* (2nd ed.). AACC International, Inc.

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1.	**Course Code: 0140251032**	**Subject Code: FT 313**	**Course Title: Processing Technology of Fruits and Vegetables**		
2.	**Semester: V**		**Credits: 3 (2+1)**		
3.	**Contact Hours:**	**L: 2**	**P: 2**		
4.	**Relative weightage:**	**MTE: 20**	**ETE: 40**	**Quiz/PA: 20**	**FPE: 20**
5.	**Objectives:**				
I.	To understand various methods for preserving fruits and vegetables, including both traditional and modern techniques.				
II.	To gain knowledge of FSSAI specifications and regulations for fruit and vegetable products.				
III.	To comprehend the principles and technology behind canning for fruit and vegetable preservation.				
IV.	To explore the production processes and applications of by-products from fruits and vegetables				
6.	**Course Outcomes**:				
CO1	To understand the overall production and processing scenario of fruits and vegetables in the industry.				
CO2	To learn the different processing methods, operations, and equipment used in the fruit and vegetable industry.				
CO3	To explore commercial processing technologies for large-scale production and distribution of processed products.				
CO4	To understand various processing methods and the equipment used in fruit and vegetable processing.				

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	3	2	1	1	1	1	1	2	1	1	1	1
CO2	1	1	1	1	1	1	1	3	1	1	1	1
CO3	2	2	1	1	2	1	1	1	1	1	1	1
CO4	2	2	1	1	1	1	1	2	2	1	2	1
Average	**2.2**	**1.8**	**1**	**1.2**	**1.4**	**1.2**	**1**	**2.2**	**1.2**	**1**	**1.2**	**1**

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

7. Details of Course:

Units	**Particulars**	**No. of Lectures**
I	Production and processing scenario of fruits and vegetables in India and world; Scope of fruit and vegetable processing industry in India; Overview of principles and preservation methods of fruits and vegetables; Supply chain of fresh fruits and vegetables; Primary processing and pack house handling of fruits and vegetables; Peeling, slicing, cubing, cutting and other size reduction operations for fruits and vegetables.	8
II	Minimal processing of fruits and vegetables; Blanching- operations and equipment; Canning: - Definition, processing steps, and equipment. Cans and containers, quality assurance and defects in canned products.	7
III	FSSAI specifications and preparation and preservation of juices, squashes, syrups, sherbets, nectars, cordials, etc.; Processing and equipment for above products; FSSAI specifications of crystallized fruits and preserves, jam, jelly and marmalades, candies; Preparation, preservation and machines for manufacture of above products; Preparation, preservation and machines for manufacture of chutney, pickles, sauce, puree, paste, ketchup; toffee, cheese, leather, dehydrated, wafers and papads, soup powders.	8

IV	Production of pectin and vinegar; Commercial processing technology of selected fruits and vegetables for production of various value added processed products; By-products of fruit and vegetable processing industry.	7
	Total Lectures:	**30**

8. Practical

S. No.	Content of Practicals	No. of Practical's
1	Primary processing of selected fruits and vegetables.	2
2	Canning of Mango/Guava/ Papaya; Preparation of jam from selected fruits; Preparation of jelly from selected fruits.	2
3	Preparation of fruit marmalade; Preparation of RTS; Preparation of squash; Preparation of syrup.	3
4	Preparation of raisins, dried fig and dried banana; Preparation of anardana; Preparation of papain; Preparation of pickles;	2
5	Preparation of dried ginger; Preparation of dried onion and garlic. Preparation of banana and potato wafers; Preparation of dehydrated leafy vegetables; Visit to fruits and vegetables pack house, canning plant, vegetable dehydration plant	6
	Total Practical's	**15**

9. Suggested Readings

S.NO.	Authors/ Name of Books/Publishers
1.	Chavan, U. D., & Patil, J. V. (2013). *Industrial Processing of Fruits and Vegetables*. Astral International Pvt. Ltd.
2.	Chakraverty, A., Mujumdar, A. S., Vijaya Raghavan, G. S., & Ramaswamy, H. S. (2003). *Handbook of Post Harvest Technology: Cereals, Fruits, Vegetables, Tea, and Spices*. Marcel Dekker, Inc.
3.	Cruess, W. V. (2004). *Commercial Fruit and Vegetable Products*. Agrobios India.
4.	Raghavan, G. S. V., & Singh, R. P. (2005). *Postharvest Biotechnology of Fruits and Vegetables*. Springer.
5.	Tiwari, B. K., & Muthukumarappan, K. (Eds.). (2018). *Postharvest Processing of Fruits and Vegetables*. CRC Press.
6.	Sivakumar, D., & Ramaswamy, H. S. (2011). *Fruits and Vegetable Processing: Preservation Technologies*. Wiley-Blackwell.
7.	Verma, R. C., & Srivastava, R. P. (2010). *Food Processing and Preservation*. Prentice-Hall India.

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1.	**Course Code: 0140251042**	**Subject Code: FT 314**	**Course Title: Food Packaging Technology and Equipment**		
2.	**Semester: V**		**Credits: 2 (1+1)**		
3.	**Contact Hours:**	**L: 1**	**P: 2**		
4.	**Relative weightage:**	**MTE: 16**	**ETE: 32**	**Quiz/PA: 16**	**FPE: 16**
5	**Objectives:**				
I.	Understand the need, functions, and properties of different packaging materials.				
II.	Learn about lamination, molding techniques, and aseptic packaging systems.				
III.	Explore permeability concepts, smart packaging, and food-specific packaging requirements.				
IV.	Study packaging machines, filling systems, and automation in food packaging.				
6.	**Course Outcomes:**				
CO1	Knowledge of various packaging materials and their applications.				
CO2	Understanding of lamination, aseptic packaging, and their advantages.				
CO3	Ability to assess permeability and apply advanced packaging technologies.				
CO4	Proficiency in handling packaging machines and automated filling systems.				

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	1	2	2	1	3	2	2	2	1	1
CO2	2	3	2	2	2	1	2	2	3	2	1	1
CO3	3	3	2	2	3	1	3	2	3	3	1	1
CO4	2	2	2	3	2	2	2	3	2	2	2	2
Average	2.6	2.6	2	2.4	2.4	1.4	2.6	2.4	2.6	2.4	1.6	1.4

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

7. Details of Course:

Units	Particulars	No. of Lectures
I	Packaging situations in World and India; Need of packaging; Package requirements, package functions; Properties of different packaging materials; Package materials: Classification of packages, paper as package material, its manufacture, types, advantages of corrugated and paper board boxes, etc.; Glass as package material, manufacture, advantages, disadvantages. Metal (Aluminum/ tin/ SS) as package material-manufacture, advantages, disadvantages, Plastic as package material, classification of polymers, properties of each plastics, uses of each plastics	3
II	Lamination: Moulding Injection, blow, extrusion; Coating on paper and films; Aseptic packaging: Need, advantages, process, comparison of conventional and aseptic packaging, system of aseptic packaging and materials used in aseptic packaging	4
III	Permeability: Theoretical considerations, permeability of gases and vapours;	4

	Permeability of multilayer materials; Permeability in relation to packaging requirement of foods; Intelligent/Smart/Active packaging systems and their food applications, CAP/MAP; Retort structure and packaging; Edible packaging- Types and sources; Microwavable packaging – Types and applications. Transport properties of barriers; Simulations of product: Package environment interaction; Packaging of specific foods, mechanical and functional tests on package.	
IV	Packaging practices followed for fruits and vegetables and their products, packaging machines, Filling machines, vacuum packaging machines. Bottle fillers, fillers for dry mixers, ice-cream fillers, Form fill and seal (FFS) machines, vacuum packaging machine, shrink wrap packaging machine, Aseptic tetra pack system; Labelling requirements, methods of coding and regulation and standards of labelling of food packages.	4
	Total Lectures:	**15**

8. Practical

Units	**Content of Practical's**	**No. of Practical's**
I	Classification of various packages based on material and rigidity; Measurement of thickness of paper, paper boards; Measurement of basic weight and grammage of paper and paper boards.	3
II	Measurement of water absorption of paper, paper boards; Measurement of bursting strength of paper, paper boards; Measurement of tear resistance of papers.	2
III	Measurement of puncture resistance of paper and paperboard; Measurement of tensile strength of paper, paper boards; Measurement of grease resistance of papers.	2
IV	Determination of gas and water transmission rate of package films; Determination of laquer integrity test; Drop test, Box compression test; Identification of plastic films.	3
V	Determination of seal integrity, ink adhesion; packaging practices followed for packing fruits and vegetables.	2
VI	Shelf life calculations for food products; Head space analysis of packaged food; Study of vacuum packaging machine, bottle filling machine and form fill-seal machine. shrink wrap packaging machine, Aseptic tetra pack system.	3
	Total Practical's:	**15**

9. Suggested Books/Readings:

S. No.	**Authors/ Name of Books/Publishers**
1.	Ahvenainen, R. (2003). *Novel Food Packaging Techniques*. CRC-Woodhead Publishing.
2.	Coles, R., McDowell, D., & Kirwan, M. J. (2003). *Food Packaging Technology*. Blackwell Publishing.
3.	Han, J. H. (2005). *Innovations in Food Packaging*. Elsevier Science and Technology Books.
4.	Han, J. H. (2007). *Packaging for Nonthermal Processing of Food*. Blackwell Publishing.
5.	Lee, D. S. (2008). *Food Packaging Science and Technology*. CRC Press.
6.	Robertson, G. L. (2010). *Food Packaging and Shelf Life: A Practical Guide*. CRC Press.
7.	Robertson, G. L. (2014). *Food Packaging: Principles and Practice* (3rd ed.). CRC Press.

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1.	**Course Code: 0140251052**	**Subject Code: FT 315**	**Course Title: Processing of Spices and Plantation Crops**		
2.	**Semester: V**		**Credits: 3 (2+1)**		
3.	**Contact Hours:**	**L: 2**	**P: 2**		
4.	**Relative weightage:**	**MTE: 24**	**ETE: 48**	**Quiz/PA: 24**	**FPE: 24**
5.	**Objectives:**				
I.	Learn processing technology of different spices				
II.	Understand post-harvest technology of tea, coffee, cocoa etc.				
III.	Learn extraction technology of spices.				
IV.	Standard specification of spices				
6.	**Course Outcomes**:				
CO1	Understand Postharvest technology for Tea, coffee, cocoa, Vanilla and annatto processing.				
CO2	Learn methods for, operations and equipment				
CO3	Explore Commercial processing technology				
CO4	Explanation of, Processing and equipment				

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	1	1	1	1	3	2	2	2	1	2
CO2	3	2	2	2	2	2	3	3	2	2	2	2
CO3	3	3	2	2	2	1	3	3	2	2	1	2
CO4	2	2	2	1	3	2	2	2	3	3	2	2
Average	**2.8**	**2.4**	**2**	**1.8**	**2.2**	**1.8**	**2.8**	**2.6**	**2.2**	**2.4**	**1.8**	**2.2**

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

7. Details of Course:

Units	Particulars	No. of Lectures
I	Production and processing scenario of spice, flavour and plantation crops and its scope; Major spices: Post harvest technology, composition; Processed products of spices: Ginger, chilli, turmeric, onion and garlic, pepper, cardamom. Equipment for cryogenic grinding.	7
II	Minor spices: Herbs, leaves and spartan seasonings and their processing and utilization; All spice, Annie seed, sweet basil; Caraway seed, cassia, cinnamon Clove, coriander, cumin, dill seed; Fennel seed, nutmeg, mace, mint marjoram; Rosemary, saffron, sage; Savory, thyme, ajowan; Asafetida, curry leaves.	7
III	Postharvest technology for Tea, coffee, cocoa, Vanilla and annatto processing; Post-harvest technology and processing of areca nut, cashew nut, oil palm, coconut.	5
IV	Flavors of minor spices; Flavor of major spices. Spice oil and oleoresins: Extraction techniques; Super critical fluid extraction of spices.	5
V	Standard specification of spices; Standards like ESA, ASTA, FSSAI and maintenance of quality by fumigation, CAS and ETO sterilization. Functional packaging of spices and spice products; Byproducts of plantation crops and spices	6

	Total Lectures:	**30**

8. Practical

S. No.	Content of Practical's	No. of Practical's
1	Identification and characterization of flavoring compounds of spices.	3
2	Valuable oil determination; Extraction of oil from clove, pepper, cardamom, chilli.	3
3	Extraction of oleoresins: Turmeric, ginger, pepper, clove; Peperine estimation in pepper oleoresin. Steam distillation of spices.	3
4	Determination of curcumin content in turmeric; Chemical analysis of spices: Moisture, valuable oil, specific gravity, refractive index, acid value;	3
5	Study of standard specification of spices; Packaging study of spices; Preparation of curry powder; Visit to spice industry	3
	Total Practical's	**15**

9. Suggested Readings

S.No.	Authors/ Name of Books/Publishers
1.	Gupta, S. (n.d.). *Handbook of Spices and Packaging With Formulae*. Engineers India Research Institute.
2.	Hirasa, K., & Takemasa, M. (1998). *Spice Science and Technology*. Marcel Dekker.
3.	Panda, H. (n.d.). *Handbook on Spices and Condiments (Cultivation, Processing and Extraction)*. Asia Pacific Business Press Inc.
4.	Shanmugavelu, K. G. (n.d.). *Spices and Plantation Crops*. Oxford and IBH Publishing Co.

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Dr. Khem Singh Gill Akal College of Agriculture

1.	**Course Code: 0140251062**	**Subject Code: FT 316**	**Course Title: Food Storage Engineering**		
2.	**Semester: V**		**Credits: 3(2+1)**		
3.	**Contact Hours:**	**L: 1**	**P:2**		
4.	**Relative weightage:**	**MTE:24**	**ETE: 48**	**Quiz/PA: 24**	**FPA :24**
5.	**Objectives:**				
I.	To understand the significance of scientific storage systems for perishable and semi-perishable products, and the physiological changes during ripening, along with the causes of spoilage and methods of control in storage environments.				
II.	Understand the different types of storage structures, including traditional, improved, and modern designs, and the factors affecting the storage of grains, such as respiration, moisture, temperature, and ventilation.				
III.	To learn about various storage structures for grains, including traditional, improved, and modern designs, and to understand the principles of grain respiration, moisture control, and temperature regulation in storage environments.				
IV.	Understand the principles of designing grain storage structures, including functional and structural considerations, pressure distribution, and the specific requirements for warehouses, silos, and cold storage systems.				
6.	**Course Outcomes:**				
CO1	Students will be able to analyze the physiological processes involved in the ripening of climacteric and non-climacteric fruits, identify causes of spoilage (e.g., temperature, moisture, respiration loss), and apply strategies to mitigate damages from destructive agents like insects, rodents, and environmental factors in storage systems.				
CO2	Students will be able to evaluate and design effective storage systems (e.g., godowns, silos) for grains, considering factors like layout, rodent-proof design, and environmental conditioning to maintain optimal grain quality during storage.				
CO3	Apply psychometrics principles to analyze air properties and design appropriate storage environments for perishable and non-perishable foods.				
CO4	Design or recommend suitable storage systems for grains, fruits, vegetables, dairy, and other food commodities.				

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	1	1	1	1	3	2	2	2	1	2
CO2	2	3	2	1	1	1	2	2	2	2	1	2
CO3	2	2	3	2	2	1	2	2	3	3	2	2
CO4	2	2	2	3	2	2	2	3	2	3	1	2
Average	2.0	2.0	1.8	1.6	1.8	1.6	2.2	2.0	2.2	2.6	1.6	2.2

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

7. Details of Course:

S. No.	Particulars	No. of Lectures
1.	Introduction: Importance of scientific storage systems, post-harvest physiology of semi perishables and perishables, climacteric and non-climacteric fruits, respiration, ripening, changes during ripening, ethylene bio-synthesis. Damages: Direct damages, indirect damages, causes of spoilage in storage (moisture, temperature, humidity, respiration loss, heat of respiration, sprouting), destructive agents (rodents, birds, insects, etc.), sources of infestation and control.	8

2.	Storage structures: Traditional storage structures, improved storage structures, modern storage structures, godown layout, staking pattern and rodent proof godown design; Farm silos: Horizontal silos, tower silos, pit silos, trench silos, size and capacity of silos. Storage of grains: Respiration of grains, moisture and temperature changes in stored grains; conditioning of environment inside storage through ventilation.	8
3.	Aeration and stored grain management: Purposes of aeration, aeration theory, aeration system design, aeration system operation. Storage pests and control: Damage due to storage insects and pests, its control, seed coating, fumigations, etc.; Damage caused by rodents and its control.	6
4.	Design of storage structures: Functional and structural design of grain storage structures, pressure theories, pressure distribution in the bin, grain storage loads, pressure and capacities, warehouse and silos, BIS specifications, functional, structural and thermal design of cold stores.	8
	Total Lecture's	**30**

8. Practical's:

S. No.	Content of Practical's	No. of Practical's
1.	Visits to traditional storage structures; Layout design, sizing, capacity and drawing of traditional storage structures.	**3**
2.	Measurement of respiration of fruits/grains in the laboratory; Study on fumigation; Visits to FCI godowns.	**3**
3.	Design of grain godowns for particular capacity and commodity; Drawing and layout of grain godown for particular commodity and capacity; Visits to cold storage. Design of cold storage for particular capacity and commodity; Drawing and layout of cold storage for particular commodity and capacity.	**3**
4.	Visits to CA storage; Design of CA storage for particular capacity and commodity; Drawing and layout of CA storage for particular commodity and capacity; Visits to evaporative cooling system for storage; Storage study in the MAP.	**6**
	Total Practical's	**15**

9. Suggested Books/Readings:

S.No.	Authors/ Book Name/ Publishers
1.	Boumans, G. (1985). *Grain Handling and Storage*. Elsevier Science Publishers.
2.	Brooker, D. B., Bakker-Arkema, F. W., & Hall, C. W. (1976). *Drying Cereal Grains*. The AVI Publishing Company, Inc.
3.	Hall, C. W. (1980). *Drying and Storage of Agricultural Crops*. The AVI Publishing Company, Inc.
4.	Jayas, D. S., White, N. D. G., & Muir, W. E. (1994). *Stored Grain Ecosystems*. Marcel Dekker.
5.	Kutz, M. (2007). *Handbook of Farm, Dairy, and Food Machinery*. William Andrew, Inc.
6.	Michael, A. M., & Ojha, T. P. (2004). *Principal of Food Technology* (Vol. 1). Jain Brothers.
7.	Newbaver, L. W., & Walker, H. B. (2003). *Farm Buildings Design*. Prentice-Hall Inc.
8.	Pandey, H., Sharma, H. K., Chauhan, R. C., Sarkar, B. C., & Bera, M. B. (2010). *Experiments in Food Process Engineering*. CBS Publisher and Distributors Pvt Ltd.
9.	Pandey, P. H. (1997). *Post Harvest Technology of Fruits and Vegetables*. Saroj Prakashan.

Eternal University, Baru Sahib
Dr. Khem Singh Gill Akal College of Agriculture

1.	**Course Code: 0140251072**	**Subject Code: FT-317**	**Course Title: Project Preparation and Management**		
2.	**Semester: V**		**Credits: 2 (1+1)**		
3.	**Contact Hours:**	**L: 1**	**P: 2**		
4.	**Relative weightage:**	**MTE: 16**	**ETE: 32**	**Quiz/PA: 16**	**FPE: 16**
5.	**Objectives:**				
I.	To introduce the concepts and evolution of project management, its forms, and the environment in which it operates.				
II.	To understand the entire project life cycle, from project identification and screening to proposal development and scope definition.				
III.	To explore various planning and scheduling techniques				
IV.	To examine project implementation, monitoring, and control, focusing on leadership, team building, and behavioral issues, along with the recent trends in project management and the role of computers.				
6.	**Course Outcomes:**				
CO1	Explain project management evolution, forms, and life cycle.				
CO2	Identify and apply project identification, appraisal, selection, and scope techniques.				
CO3	Use planning, scheduling tools (WBS, CPM, PERT) and manage resources effectively.				
CO4	Evaluate project implementation, monitoring, control, and apply modern trends and tools.				

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	3	2	1	1	1	1	1	1	1	1	2	1
CO2	2	3	2	1	1	1	1	1	2	1	3	1
CO3	1	2	3	3	1	2	1	3	2	1	2	1
CO4	1	2	3	3	2	2	1	3	2	2	2	1
Average	**1.75**	**2.25**	**2.25**	**2**	**1.25**	**1.5**	**1**	**2**	**1.75**	**1.25**	**2.25**	**1**

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

7. Details of Course:

Units	**Particulars**	**No. of Lectures**
I	Project and project Management, Evolution of project management, Forms and environment of project management; Project life cycle; Project Identification, Screening, Project Appraisal, Project Selection, Project Proposal and Project Scope	4
II	Project Planning; Work break down structure and Network Scheduling; Critical Path Method; Program Evaluation and Review Technique; Time-cost relationship in project; Resource Considerations in Projects, Resource Profiles and levelling, limited Resource Allocation	4
III	Project Implementation, Monitoring and Control: Project management Process and role of project manager, team building, Leadership in Projects, Organizational and behavioural issues in Project Management	4
IV	Project Monitoring and Control; Project Completion and Review; Project	3

	Management - Recent trends and Future Directions. Computers in Project Management.	
	Total Lectures:	**15**

8. Practical

Units	Content of Practical's	No. of Practical's
I	Brainstorming exercise to identify a set of projects and their evaluation; work break down structure for different projects	3
II	Network Scheduling and Drawing network charts for different projects	3
III	Formulation of CPM scheduling for a specific project; Formulation of PERT scheduling for a specific project	3
IV	Reduction of Project Duration: Time/cost trade off; Resource Profiles and levelling	3
V	PERT/Cost Method, Earned value analysis	3
	Total Practical's:	**15**

9. Suggested Books/Readings:

S. No.	Authors/ Name of Books/Publishers
1.	Chandra, P. (1980). *Projects: Preparation, Appraisal, Budgeting, and Implementation*. Tata McGraw-Hill.
2.	Chandra, P. (2014). *Projects: Planning, Analysis, Selection, Financing, Implementation, and Review*. Tata McGraw-Hill Publishing Company Ltd.
3.	Gopalakrishnan, P., & Rama Moorthy, V. E. (2014). *Textbook of Project Management*. Laxmi Publications Pvt. Ltd.
4.	Kerzner, H. (2006). *Project Management: A System Approach to Planning, Scheduling, and Controlling*. CBS Publishers and Distributors.
5.	Nicholas, J. M. (2005). *Project Management for Business and Technology: Principles and Practices*. Pearson Prentice Hall.
6.	Panneerselvam, R. (2004). *Operations Research* (2nd ed.). International Book House.

Eternal University, Baru Sahib
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1.	**Course Code: 0190052032**	**Subject Code: ECON- 311**	**Course Title: Agricultural Marketing and Trade**		
2.	**Semester: V**		**Credits: 3(2+1)**		
3.	**Contact Hours:**	**L: 2**	**P: 2**		
4.	**Relative weightage:**	**MTE: 24**	**ETE: 48**	**Quiz/PA: 24**	**FPE: 24**
5.	**Objective:**				
I.	To understand the fundamentals of agricultural marketing and trade				
II.	To analyze the factors influencing supply and demand in agricultural markets				
III.	To explore different marketing channels and strategies in agriculture				
IV.	To examine the role of government policies and regulations in agricultural markets.				
6.	**Course Outcomes:**				
CO1	Students will understand the fundamentals of agricultural marketing, including market structures, demand and supply dynamics, producer's surplus, and pricing and promotion strategies.				
CO2	Students will understand the agricultural marketing process and its core functions, including exchange, physical, and facilitating functions, as well as the role of market functionaries and marketing channels for different farm products.				
CO3	Students will understand market integration, marketing efficiency, price spread, and the role of public and cooperative institutions in agricultural marketing.				
CO4	Students will gain knowledge about marketing risks, agricultural price policy, international trade concepts, WTO agreements, and the role of government institutions and reforms such as APMC and GST in agricultural marketing.				

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	3	2	2	1	1	2	2	1	1	1	2	1
CO2	2	3	2	2	1	2	2	2	2	1	2	1
CO3	2	3	2	2	1	2	2	2	3	2	2	1
CO4	2	3	2	2	2	3	2	2	3	2	3	1
Average	**2.25**	**2.75**	**2**	**1.75**	**1.25**	**2.25**	**2**	**1.75**	**2.25**	**1.5**	**2.25**	**1**

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

7.	**Details of Course:**	
Units	**Particulars**	**No. of Lectures**
I	Agricultural Marketing: Concepts and definitions of market, marketing, agricultural marketing, market structure, marketing mix and market segmentation, classification and characteristics of agricultural markets; Demand, supply and producer's surplus of agri commodities: nature and determinants of demand and supply of farm products, producer's surplus – meaning and its types, marketable and marketed surplus, factors affecting marketable surplus of agri-commodities; Pricing and promotion strategies: pricing considerations and approaches – cost based and competition based	7

	pricing; market promotion – advertising, personal selling, sales promotion and publicity – meaning, merits and demerits.	
II	Marketing process and functions: Marketing process concentration, dispersion and equalization; exchange functions – buying and selling; physical functions – storage, transport and processing; facilitating functions – packaging, branding, grading, quality control and labelling (Agmark); Market functionaries and marketing channels: Types and importance of agencies involved in agricultural marketing; meaning and definition of marketing channel; number of channel levels; marketing channels for different farm products.	8
III	Integration, efficiency, costs and price spread: Meaning, definition and types of market integration; marketing efficiency; marketing costs, margins and price spread; factors affecting cost of marketing; reasons for higher marketing costs of farm commodities; ways of reducing marketing costs; Role of Govt. in agricultural marketing: Public sector institutions- CWC, SWC, FCI, CACP and DMI – their objectives and functions; cooperative marketing in India.	7
IV	Risk in marketing: Types of risk in marketing; speculation and hedging; an overview of futures trading; Agricultural prices and policy: Meaning and functions of price; administered prices; need for innovations in agricultural price policy; Trade: Concept of International Trade and its need, theories of absolute and comparative advantage, balance of payments (BoPs). Present status and prospects of international trade in agri-commodities; WTO; Agreement on Agriculture (AoA) and its implications on Indian agriculture; IPR; Role of government in agricultural marketing; Role of APMC and its relevance in the present-day context. Forms of business organizations, GST and its implication on Indian economy.	8
	Total Lectures:	**30**

8. Practical

Units	**Particulars**	**No. of Practical's**
I	Plotting and study of demand and supply curves and calculation of elasticity. Computation of marketable and marketed surplus of important commodities.	3
II	Study of relationship between market arrivals and prices of three selected commodities.	3
III	Study of price behaviour over time for three selected commodities.	3
IV	Construction of index numbers for two to three commodities. Application of principles of comparative advantage of international trade.	3
V	Visit to a local market to study various marketing functions performed by different agencies, identification of marketing channels for selected commodity, collection of data regarding marketing costs, margins and price spread and presentation of report in the class. Visit to market institutions – NAFED, SWC, CWC, cooperative marketing society, etc. to study their organization and functioning	3
	Total Practical's:	**15**

9. Suggested Books/Readings:

S. No.	**Authors/ Name of Books/Publishers**
1.	Acharya, S. S., & Agarwal, N. L. (2006). *Agricultural Marketing in India*. Oxford and IBH Publishing Co. Pvt. Ltd.
2.	Chinna, S. S. (2005). *Agricultural Economics and Indian Agriculture*. Kalyani Publishers.

3.	Dominic Salvatore. (n.d.). *Microeconomic Theory (Schaum's Outline Series)*. McGraw-Hill International Book Company.
4.	Kohls, R. L., & Uhl, J. N. (2002). *Marketing of Agricultural Products*. Prentice-Hall of India Private Ltd.
5.	Kotler, P., & Armstrong, G. (2005). *Principles of Marketing*. Pearson Prentice-Hall.
6.	Lekhi, R. K., & Singh, J. (2006). *Agricultural Economics*. Kalyani Publishers.
7.	Memoria, C. B., Joshi, R. L., & Mulla, N. I. (2003). *Principles and Practice of Marketing in India*. Kitab Mahal.
8.	Pandey, M., & Tewari, D. (2004). *Rural and Agricultural Marketing*. International Book Distributing Co. Ltd.
9.	Sharma, R. (2005). *Export Management*. Laxmi Narain Agarwal.

SEMESTER-VI					
S. No.	**Course Code**	**Subject Code**	**Course Title**	**Credit hours**	**Total Credit hours**
1.	0140261012	FT 321	Food Additives and Preservatives	2 (1+1)	**21 (13+8)**
2.	0140261022	FT 322	Sensory Evaluation of Food Products	2 (1+1)	
3.	0140261032	FT 323	Processing Technology of Legumes and Oilseed	3 (2+1)	
4.	0140261042	FT 324	Food Refrigeration and Cold Chain	3 (2+1)	
5.	0140261052	FT 325	Processing of Meat, Fish and Poultry Products	3 (2+1)	
6.	0140261062	FT 326	Processing Technology of Beverages	3 (2+1)	
7.	0140261072	FT 327	Bakery, Confectionary and Snack Products	3 (2+ 1)	
8.	0140261082	FT 328	Processing Technology of Liquid Milk	2 (1+1)	

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1.	**Course Code: 0140261012**	**Subject Code: FT 321**	**Course Title: Food Additives and Preservatives**		
2.	**Semester: VI**		**Credits: 2 (1+1)**		
3.	**Contact Hours:**	**L: 1**	**P: 2**		
4.	**Relative weightage:**	**MTE: 16**	**ETE: 32**	**Quiz/PA: 16**	**FPE: 16**
5.	**Objectives:**				
I.	To understand various types of food additives, their technological roles, and the principles of their safety evaluation in food systems.				
II.	To gain insight into the sources, types, and processing of food colors, dyes, and natural pigments used in food.				
III.	To explore different food preservatives and functional ingredients used to enhance shelf life and nutritional value.				
IV.	To study the chemistry, functions, and applications of antioxidants, artificial and natural sweeteners, and acidity regulators in food processing				
6.	**Course Outcomes:**				
CO1	Explain the classification, technological functions, and safety evaluation protocols for food additives in accordance with regulatory standards.				
CO2	Describe the role, processing techniques, and regulatory aspects of synthetic and natural food colorants and dyes.				
CO3	Identify the mechanisms by which preservatives and functional ingredients act in food systems, and assess their applications.				
CO4	Apply the knowledge of antioxidants, sweeteners, and acidity regulators in developing safe and high-quality food products.				

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	3	2	2	2	1	1	3	2	3	1	1	2
CO2	3	2	2	2	1	1	3	2	3	1	1	2
CO3	3	3	2	2	1	2	3	2	2	2	1	2
CO4	3	3	3	2	2	2	3	2	3	2	1	2
Avg	3	2.5	2.25	2	1.25	1.5	3	2	2.75	1.5	1	2

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

7. Details of Course:

Units	**Particulars**	**No. of Lectures**
I	Introduction to Food additives; Intentional and unintentional food additives, their toxicology and safety evaluation; Naturally occurring food additives	3
II	Food colors and dyes: Regulatory aspects of dyes, food color (natural and artificial), pigments and their importance and utilization as food color; Processing of natural and artificial food colorants; flavours, emulsifiers, sweeteners	3
III	Food preservatives and their chemical action; Role and mode of action of Class I and Class II preservatives; chelating agents, stabilizers and thickeners; humectants/polyhydric alcohol, anti-caking agent, firming agent, flour bleaching and maturing agents	4

IV	Antioxidants, nutritional and non-nutritional sweeteners; food processing; Acidity regulators	5
	Total Lectures:	**15**

8 Practical

Units	Content of Practicals	No. of Practical
I	Evaluation of GRAS aspect of food additives; Estimation of chemical preservatives by TLC (organic and inorganic)	3
II	Identification of food colour by TLC (organic and inorganic); Quantitative estimation of added dyes; Isolation and identification of naturally occurring food pigments by paper and TLC	3
III	Role and mode of action of chelating agent in fruit juice; Role and mode of action of stabilizer and thickener in frozen dairy products (ice-cream);	3
IV	Role and mode of clarifying agent in fruit juices; Role and mode of antioxidant in frozen fish	3
V	Role of leaving agent in baked food product; Preservation of coconut shreds using humectants	3
	Total Practical:	**15**

9. Suggested Books/Readings:

S. No.	Authors/ Name of Books/Publishers
1.	Belitz, H.-D., Grosch, W., & Schieberle, P. (2009). *Food Chemistry* (4th ed.). Springer-Verlag Berlin Heidelberg.
2.	Deshpande, S. S. (2002). *Handbook of Food Toxicology*. Marcel and Dekker AG.
3.	Mahindru, S. N. (2008). *Food Additives: Characteristics, Detection and Estimation*. Aph Publishing Corporation.

Eternal University, Baru Sahib
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1.	**Course Code: 0140261022**	**Subject Code: FT 322**	**Course Title: Sensory Evaluation of Food Products**		
2.	**Semester: VI**		**Credits: 2 (1+1)**		
3.	**Contact Hours:**	**L: 1**	**P: 2**		
4.	**Relative weightage:**	**MTE: 16**	**ETE: 32**	**Quiz/PA: 16**	**FPE: 16**

5.	**Objectives:**
I.	Understand the basic principles and methodologies used in sensory evaluation of food products.
II.	Acquire knowledge about consumer preferences and behavior through consumer studies.
III.	Study the concept, components, and perception of flavor in food.
IV.	Learn the industrial and research-based applications of flavor in enhancing food quality.
6.	**Course Outcomes**:
CO1	Analyze various factors such as appearance, aroma, and texture that affect consumer acceptance of food
CO2	Define flavor scientifically and discuss its critical role in determining the overall quality of food products.
CO3	Explore the classification of sensory attributes and the physiological basis of basic taste perceptions.
CO4	Demonstrate the use of sensory testing techniques in evaluating and improving food quality and product development

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	3	2	2	1	2	1	3	2	2	2	1	2
CO2	3	2	2	1	1	1	2	2	2	1	1	1
CO3	2	2	2	1	1	1	2	2	2	1	1	1
CO4	3	3	3	2	2	1	3	3	2	2	2	2
Avg	2.75	2.25	2.25	1.25	1.5	1	2.5	2.25	2	1.5	1.25	1.5

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

7. Details of Course:

Units	**Particulars**	**No. of Lectures**
I	Definition and importance of sensory evaluation in relation to consumer acceptability and economic aspects; Factors affecting food acceptance; Terminology related to sensory evaluation. Principles of good practice: the sensory testing environment, test protocol considerations, Basic principles: Senses and sensory perception, physiology of sensory organs, classification of tastes and odours, threshold value factors affecting senses, visual, auditory, tactile and other responses.	3
II	Flavour: Definition and its role in food quality; Taste: Classification, taste qualities, relative intensity, reaction time, effect of disease, temperature, and taste medium on taste, basic tastes, interaction of tastes. Odour: Definition, classification, neutral-mechanisms, olfactory abnormalities, odour testing, techniques, thresholds, odour intensities, olfaction; Visual, auditory, tactile and other senses, vision, audition, oral perception other than taste.	3

III	Factors influencing sensory measurements: Attitudinal factors, motivation psychological errors in judgment, relation between stimulus and perception adaptation; Correlation of sensory and instrumental analysis; Requirements of sensory evaluation, sampling procedures; Factors influencing sensory measurements; Interrelationship between sensory properties of food products and various instrumental and physico-chemical tests.	3
IV	Quality Evaluations Application of sensory testing: sensory evaluation in food product development, sensory evaluation in quality control. Laboratory quality measurement: Types of tests, panel selection and testing environment, serving procedures, instruction to judges, difference tests, directional difference tests, classification of difference tests, two-sample tests, threesample tests, multisampling tests, comparison of procedures, ranking, scoring, hedonic scaling; dilution procedures, descriptive sensory analysis, contour method, other procedures.	3
V	Consumer measurement: Factors influencing acceptance and preference, Objectivess of consumer preference studies, information obtained from consumer study, factors influencing results from consumer surveys, methods of approach, development of the questionnaire, types of questionnaires, serving procedures; Comparison of laboratory panels with consumer panels; Limitations of consumer survey.	3
	Total Lectures:	**15**

8. Practical

S. No.	Content of Practicals	No. of practical's
1	Determination of threshold value for basic tastes; Odour recognition, difference (PC, Duo- trio, triangle).	3
2	Determination of threshold value for various odours; Selection of judging panel.	3
3	Training of judges, for recognition of certain common flavour and texture defects using different types of sensory tests.	3
4	Descriptive analysis methodology; Sensory evaluation of various food products using different scales, score cards and tests; Texture profile methodology; Estimation of color.	3
5	Estimation of color; Relationship between Objectives and subjective methods; Designing a sensory laboratory.	3
	Total Practical's	**15**

9. Suggested Readings

S.NO.	Authors/ Name of Books/Publishers
1.	Amerine, M. A., Pangborn, R. M., & Rossler, E. B. (1965). *Principles of Sensory Evaluation of Food*. Academic Press.
2.	Early, R. (1995). *Guide to Quality Management Systems for Food Industries*. Blackie Academic.
3.	Jellinek, G. (1985). *Sensory Evaluation of Food: Theory and Practice*. Ellis Horwood.
4.	Lawless, H. T., & Klein, B. P. (1991). *Sensory Science: Theory and Applications in Foods*. Marcel Dekker.

Eternal University, Baru Sahib
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1.	**Course Code: 0140261032**	**Subject Code: FT 323**	**Course Title: Processing Technology of Legumes and Oilseeds**		
2.	**Semester: VI**		**Credits: 3 (2+1)**		
3.	**Contact Hours:**	**L: 2**	**P: 2**		
4.	**Relative weightage:**	**MTE: 24**	**ETE: 48**	**Quiz/PA: 24**	**FPE: 24**
5.	**Objectives:**				
I.	To understand the present status, morphology, classification, and nutritional aspects of legumes and oilseeds.				
II.	To study various traditional and modern pulse milling methods, processing techniques, and value addition strategies.				
III.	To gain knowledge of oilseed milling technologies, extraction methods, and associated processing factors.				
IV.	To learn the refining processes of oils, their principles, and explore utilization and value addition of by-products.				
6.	**Course Outcomes:**				
CO1	Students will be able to explain the importance, structure, classification, and nutritional profile of legumes and oilseeds.				
CO2	Students will demonstrate knowledge of pulse milling operations, processing conditions, and their effect on product quality.				
CO3	Students will understand oilseed milling processes and identify the factors affecting milling efficiency and product quality.				
CO4	Students will be able to evaluate oil refining methods and utilize by-products of milling for development of value-added products.				

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	3	2	1	1	2	1	3	1	1	1	1	1
CO2	3	2	2	2	2	1	2	3	3	2	1	2
CO3	3	3	2	2	2	1	3	3	2	2	1	2
CO4	3	2	3	2	3	2	2	2	3	3	2	2
Average	**3.0**	**2.25**	**2.0**	**1.75**	**2.25**	**1.25**	**2.5**	**2.25**	**2.25**	**2.0**	**1.25**	**1.75**

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

7. Details of Course:

Units	**Particulars**	**No. of Lectures**
I	Present status and future prospects of legumes and oilseeds; Morphology of legumes and oilseeds; Classification and types of legumes and oilseeds; Chemical composition, nutritional value and anti-nutritional compounds in legumes and oilseeds; Methods of removal of anti- nutritional compounds.	6
II	Pulse milling: Home scale, cottage scale and modern milling methods, machines, milling quality, milling efficiency; Factors affecting milling quality and quantity; Problems in dhal milling industry; Nutritional changes during soaking and sprouting of pulses; Cooking quality of dhal, methods, factors	10

	affecting cooking of dhal; Quick cooking dhal, instant dhal; Soybean milk processing and value addition; Fermented products of legumes	
III	Oil seed milling: Ghanis, hydraulic presses, expellers, solvent extraction methods, machines. Milling quality, milling efficiency, factors affecting milling quality and quantity; Problems in oil milling industry; Desolventization	6
IV	Refining of oils: Degumming, neutralization, bleaching, filtration, deodorization, winterization and their principles and process controls; Hydrogenation of oils; New technologies in oilseed processing; Utilization of oil seed meals for different food uses: High protein products like protein concentrates and isolates; By-products of pulse and oil milling and their value addition.	8
	Total Lectures:	**30**

8 Practical

Units	**Content of Practical's**	**No. of Practical's**
I	Determination of physical properties of legumes and oil seeds. Determination of proximate composition of selected pulses and oilseeds. Determination of nutritional quality of selected pulses and oilseeds	**3**
II	Preservation of food by heat treatment- pasteurization; Preservation of food by high concentration of sugar: Jam; Preservation of food by using salt: Pickle.	**3**
III	Preservation of food by using acidulants i.e. pickling by acid, vinegar or acetic acid; Preservation of food by using chemical preservatives.	**3**
IV	Study of mini dhal mill; Study of mini oil mill*;* Preconditioning of pulses before of mini oil mill; Preconditioning of pulses before milling; Preconditioning of oilseeds before milling.	**3**
V	Removal of anti-nutritional compounds from selected pulses and oilseeds; Laboratory milling of selected pulses and its quality evaluation*;* Laboratory milling of selected oilseeds and its quality evaluation.	**3**
	Total Practicals:	**15**

9. Suggested Books/Readings:

S. No.	**Authors/ Name of Books/Publishers**
1.	Chakraverty, A. (2008). *Post Harvest Technology of Cereals, Pulses and Oilseeds* (3rd ed.). Oxford and IBH Publishing Co. Pvt. Ltd.
2.	Chakraverty, A., Mujumdar, A. S., Vijaya Raghavan, G. S., & Ramaswamy, H. S. (2003). *Handbook of Post-Harvest Technology: Cereals, Fruits, Vegetables, Tea, and Spices*. Marcel Dekker, Inc.
3.	Gunstone, F. D. (2008). *Oils and Fats in the Food Industry*. John Wiley & Sons, Ltd.
4.	Sahay, K. M., & Singh, K. K. (2001). *Unit Operations of Agricultural Processing*. Vikas Publishing House Pvt. Ltd.
5.	Shahidi, F. (Ed.). (2005). *Bailey's Industrial Oil and Fat Products* (6th ed., Vols. 1–6). John Wiley & Sons, Inc.

Eternal University, Baru Sahib
Dr. Khem Singh Gill Akal College of Agriculture

1.	**Course Code: 0140261042**	**Subject Code: FT 324**	**Course Title: Food Refrigeration and Cold Chain**		
2.	**Semester: VI**		**Credits: 3(2+1)**		
3.	**Contact Hours:**	**L: 2**	**P:2**		
4.	**Relative weightage:**	**MTE:24**	**ETE: 48**	**Quiz/PA: 24**	**FPE:24**
5.	**Objectives:**				
I.	To understand the fundamental principles of refrigeration, including the second law of thermodynamics, coefficient of performance, and refrigerating capacity.				
II.	To understand the working principle of air refrigerators operating on the reversed Carnot cycle and the selection of operating temperatures.				
III.	To study the working principle of air refrigerators operating on the Bell Coleman cycle (reversed Brayton cycle), including the analysis of gas cycles and multistage compression.				
IV.	To study the process of vapor-absorption refrigeration, including calculations and the maximum coefficient of performance of heat-operated refrigerating machines.				
6.	**Course Outcomes:**				
CO1	Students will be able to explain the basic principles of refrigeration and determine the refrigerating capacity and coefficient of performance for refrigeration systems.				
CO2	Learn about the thermodynamic properties of refrigerants and how these properties affect refrigeration system performance.				
CO3	Develop an understanding of refrigeration load calculations and how to select appropriate refrigeration capacity for different food products.				
CO4	Students will be able to explain the operation of vapor-absorption refrigeration systems and perform calculations to determine their performance.				

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	1	2	1	1	3	2	1	1	1	1
CO2	3	2	1	2	1	1	3	2	1	1	1	1
CO3	3	3	2	2	2	1	3	2	2	2	1	2
CO4	3	2	2	2	1	1	3	2	2	2	1	2
Average	**3**	**2.25**	**1.5**	**2**	**1.25**	**1**	**3**	**2**	**1.5**	**1.5**	**1**	**1.5**

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

7. Details of Course:

S. No.	Particulars	No. of Lectures
1.	Principles of refrigeration: Definition, background with second law of thermodynamics, unit of refrigerating capacity, coefficient of performance; Production of low temperatures: Expansion of a liquid with flashing, reversible/ irreversible adiabatic expansion of a gas/ real gas, thermoelectric cooling, adiabatic demagnetization.	3
2.	Air refrigerators working on reverse Carnot cycle: Carnot cycle, reversed Carnot cycle, selection of operating temperatures; Air refrigerators working on Bell Coleman cycle: Reversed Brayton or Joule or Bell Coleman cycle, analysis of gas cycle, polytropic and multistage compression; plug and chill type refrigeration based on chemicals. Vapour refrigeration: Vapor as a refrigerant in reversed Carnot cycle with p-V and T-s diagrams, limitations of reversed Carnot cycle; Vapour compression system: Modifications in reverse Carnot cycle with vapour as a refrigerant (dry Vs wet compression, throttling Vs isentropic expansion), representation of vapor compression	8

	cycle on pressure- enthalpy diagram, super heating, sub cooling; effect of suction vapour, super heat and liquid sub cooling on actual vapour compression cycle;	
3.	Vapour-absorption refrigeration system: Process, calculations, maximum coefficient of performance of a heat operated refrigerating machine; water/lithium bromide and ammonia/water absorption cooling. Common refrigerants and their properties: classification, nomenclature, desirable properties of refrigerants- physical, chemical, safety, thermodynamic and economical; azeotrope refrigerants. Components of vapour compression refrigeration system, evaporator, compressor, condenser and expansion valve; Ice manufacture: principles and systems of ice production, basic types of ice, ice makers, Treatment of water for making ice, brines, freezing tanks, ice cans, air agitation, quality of ice;	7
4.	Cold storage: Cold store, design of cold storage for different categories of food resources, size and shape, construction and material, insulation, vapour barriers, floors, frost-heave, interior finish and fitting, evaporators, automated cold stores, security of operations. Refrigerated transport: Handling and distribution, cold chain, refrigerated product handling, order picking, refrigerated vans, refrigerated display. Low temperature Refrigeration: cryogenic fluid and fluid properties; liquefaction; application in food. Air-conditioning: Meaning, factors affecting comfort air-conditioning, classification, sensible heat factor, industrial air-conditioning, problems on sensible heat factor; Winter/summer/year round air-conditioning, unitary air-conditioning systems, central air-conditioning, physiological principles in air-conditioning, air distribution and duct design methods; design of complete air-conditioning systems; humidifiers and dehumidifiers; Cooling/Refrigeration load calculations:	12
	Total Lectures	**30**

8.	**Practical**	
S. No.	**Contents of Practical's**	**No. of Practical's**
1.	Study of vapour compression refrigeration system; Determination of COP of vapour compression refrigeration system; Study of various types of compressors, condensers, expansion valves and evaporative coils used in refrigeration systems.	3
2.	Study of refrigerants, their properties and charts; Study of direct and indirect contact freezing equipment for foods; Study of spray freezing process for foods.	3
3.	Study of food cold storage; Estimation of refrigeration load for cold storage; Estimation of refrigeration load for meat and poultry products; Study of refrigeration system of dairy plant.	3
4.	Estimation of refrigeration load for ice-cream; Study of cooling system for bakery and estimation of refrigeration loads; Estimation of refrigeration load during chocolate enrobing process.	3
5.	Study of refrigerated van; Study of deep freezing and thawing of foods; Study of refrigerated display of foods and estimation of cooling load.	3
	Total Practical's	**15**

9. Suggested Books/Readings:

S.No.	Authors/ Book Name/ Publishers
1.	ASHRAE. (2006). *ASHRAE Handbook: Refrigeration*. American Society of Heating, Refrigerating and Air-Conditioning Engineers.
2.	Arora, C. P. (2000). *Refrigeration and Air Conditioning* (2nd ed.). Tata McGraw-Hill Publishing Co. Ltd.
3.	Pandey, H., Sharma, H. K., Chauhan, R. C., Sarkar, B. C., & Bera, M. B. (2010). *Experiments in Food Process Engineering*. CBS Publisher and Distributors Pvt Ltd.
4.	Stoecker, W. F., & Jones, J. W. (1982). *Refrigeration and Air Conditioning* (2nd ed.). McGraw Hill Book Co.
5.	Whitman, W. C., Johnson, W. M., Tomczyk, J. A., & Silberstein, E. (2009). *Refrigeration and Air Conditioning Technology* (6th ed.). Delmar, Cengage Learning.

Eternal University, Baru Sahib
Dr. Khem Singh Gill Akal College of Agriculture

1.	**Course Code: 0140261052**	**Subject Code: FT 325**	**Course Title: Processing of Meat, Fish and Poultry Products**		
2.	**Semester: VI**		**Credits: 3 (2+1)**		
3.	**Contact Hours:**	**L: 2**	**P: 2**		
4.	**Relative weightage:**	**MTE: 24**	**ETE: 48**	**Quiz/PA: 24**	**FPE: 24**
5.	**Objectives:**				
I.	To understand the structure, composition, and importance of meat, poultry, and fish in the context of food science and industry.				
II.	To study the various processing methods, preservation techniques, and post-mortem changes that affect the quality and shelf life of meat, poultry, and fish.				
III.	To learn about the preparation, preservation, and quality evaluation of meat, poultry, eggs, and fish products, including value-added products and the use of novel preservation methods.				
IV.	To gain knowledge about safety standards and regulations in the meat and fish industry, focusing on quality control measures such as HACCP, ISO, and other international standards.				
6.	**Course Outcomes:**				
CO1	Explain the processes in meat, poultry, and fish industries, including pre-slaughter and slaughtering techniques.				
CO2	Understand preservation techniques and factors affecting the quality and shelf life of meat and fish.				
CO3	Evaluate the quality of meat, poultry, eggs, and fish, and prepare value-added products.				
CO4	Assess and apply safety standards and regulations in the meat and fish industries.				

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	2	2	1	1	1	1	3	2	2	1	1
CO2	3	3	2	1	2	1	1	2	2	2	2	1
CO3	2	2	3	2	2	1	1	3	3	3	2	1
CO4	2	3	3	2	2	1	2	3	2	3	2	2
Average	**2.5**	**2.5**	**2.5**	**1.5**	**1.8**	**1**	**1.25**	**2.75**	**2.25**	**2.5**	**1.75**	**1.25**

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

7. Details of Course:

Units	**Particulars**	**No. of Lectures**
I.	Status of meat poultry and fish industry in India; Sources and importance of meat, poultry and fish. Structure and composition of muscle, types, classification and composition of fish, Pre- slaughter operations and slaughtering operations for animals and poultry. Dressing and evaluation of animal carcasses; Factors affecting post-mortem changes, properties and shelf life of meat; Mechanical deboning, grading and aging; Eating and cooking quality of meat	7

II.	Preservation of meat, poultry and fish by chilling, freezing, pickling, curing, cooking and smoking, canning, dehydration, radiation, chemical and biological preservatives. Novel methods: Low dose irradiation; High pressure treatment, hurdle barrier concept for- meat, poultry and fish. Characteristic of fresh fish and spoilage indices of fish and factors affecting the spoilage of fish	5
III.	Meat tenderization, Meat emulsions, Fish protein concentrates (FPC), fish protein extracts (FPE), fish protein hydrolysates (FPH), Meat quality parameters – color water holding capacity, palatability, marbling quantum of connective tissue, firmness and storage conditions; Meat cutting and handling; Preparation, preservation and equipment for manufacture of smoked meat and its quality evaluation; Preparation, packaging and equipment for manufacture of dehydrated meat products and their quality evaluation; Preparation, preservation and equipment for manufacture of meat sausages and their quality evaluation; Surimi process, traditional and modern surimi production lines, quality of surimi products, comparison of surimi and fish mince products; Abattoir design and layout	12
IV.	Eggs: Structure, composition, quality characteristics, defects and grading of egg processing, preservation of eggs; Processing and preservation of poultry meat and chicken patties, Fermented and value-added products of fish, Preparation protocols of indigenous products: Fish sauce and paste; By-products of meat, poultry, fish and eggs and their utilization; Safety standards in meat/ fish industry: HACCP/ISO/MFPO/ FSSAI/ Kosher/Halal, EU hygienic regulations and ISO 9000 standards.	6
	Total Lectures:	**30**

8 Practical

Units	**Content of Practicals**	**No. of Practical**
I.	Pre-slaughter operations of meat animals and poultry birds; Slaughtering and dressing of meat animals*;* Study of post-mortem changes; Meat cutting and handling; Preservation of meat by freezing, curing, pickling and dehydration.	3
II.	Evaluation of quality and grading of eggs*;* Preservation of shell eggs; Preparation of value-added poultry meat products; Value added egg products; Visit to abattoir.	3
III.	Study of anatomy and dressing of fish; Study of anatomy and dressing of prawn and other marine products*;* Identification of different types of fish - Selection and grading; Identification of different types of prawn and other marine products; Quality evaluation of fish.	3
IV.	Preparation of sun dried and salt cured fish, fish sauce; Chilling and freezing of fish; Preparations of fish protein concentrate; Preparation of fish meal; Preparation of marine fish oils and various fish products*;* Preparation of value-added sea products: Cutlets, bullets, wafers; Processing of fish oils; Canning methods for marine fishery products	2
V.	Preservation of fish: Drying, pickling; Preservation of marine products using fermentation process; Estimation of TVB and TMA; Determination of iodine value; Visit to fish and prawn processing industry.	4
	Total Practicals:	**15**

9. Suggested Books/Readings:

S. No.	**Authors/ Name of Books/Publishers**
1.	Berkel, B. M.-V., Boogaard, B. V.-D., & Heijnen, C. (2004). *Preservation of Fish and*

	Meat. Agromisa Foundation.
2.	Borström, G. (1961). *Fish as Food* (Vols. 1–4). Academic Press.
3.	FAO. (2003). *Code of Practices of Canned Fishery Products*. Food and Agriculture Organization of the United Nations.
4.	Hall, G. M. (1997). *Fish Processing Technology* (2nd ed.). Chapman & Hall.
5.	Kerry, J., Kerry, J., & Ledward, D. (2005). *Meat Processing: Improving Quality*. Woodhead Publishing Ltd.
6.	Lawrie, R. A. (1985). *Meat Science* (4th ed.). Pergamon Press.
7.	Nanda, V. (2014). *Meat, Egg and Poultry Science and Technology*. I.K. International Publishing House Pvt. Ltd.
8.	Rautenstrauss, B. W., & Liehr, T. (2002). *FISH Technology*. Springer

Eternal University, Baru Sahib
Dr. Khem Singh Gill Akal College of Agriculture

1.	**Course Code: 0140261062**	**Subject Code: FT 326**	**Course Title: Processing Technology of Beverages**		
2.	**Semester: VI**		**Credits: 3 (2+1)**		
3.	**Contact Hours:**	**L: 2**	**P: 2**		
4.	**Relative weightage:**	**MTE: 24**	**ETE: 48**	**Quiz/PA: 24**	**FPE: 24**
5.	**Objectives:**				
I.	To learn about the different types of beverages and their distinguishing characteristics.				
II.	To understand the various technologies involved in beverage processing along with their historical development and importance.				
III.	To gain knowledge about the different quality tests applied to beverages.				
IV.	To understand the ingredients, manufacturing processes, and packaging techniques used in the beverage industry.				
6.	**Course Outcomes**:				
CO1	Students will understand the historical background and significance of beverages in the food industry.				
CO2	Students will become familiar with FSSAI standards and regulatory specifications for various types of beverages.				
CO3	Students will be able to classify beverages and identify their sensory and taste qualities.				
CO4	Students will acquire knowledge about quality testing procedures and quality control methods in beverage production.				

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	3	1	1	1	1	1	3	1	1	1	1	1
CO2	2	2	2	2	1	1	2	2	3	2	2	1
CO3	2	2	2	1	1	1	2	1	2	1	1	1
CO4	2	2	3	3	2	2	2	3	3	2	2	2
Average	**2.25**	**1.75**	**2.0**	**1.75**	**1.25**	**1.25**	**2.25**	**1.75**	**2.25**	**1.5**	**1.5**	**1.25**

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

7. Details of Course:

Units	**Particulars**	**No. of Lectures**
I	History and importance of beverages and status of beverage industry; Processing of beverages: Packaged drinking water, juice-based beverages, synthetic beverages, still, carbonated; Low-calorie and dry beverages, isotonic and sports drinks.	8
II	Dairy based beverages, Alcoholic beverages, fruit beverages, specialty beverages, Tea, coffee, cocoa, spices, plant extracts, etc. FSSAI specifications for beverages.	7
III	Ingredients, manufacturing and packaging processes and equipment for different beverages; Water treatment and quality of process water; Sweeteners, colorants, acidulants, Clouding and clarifying and flavouring agents for beverages, Carbon dioxide and carbonation.	8
IV	Quality tests and control in beverages, Miscellaneous beverages: Coconut water, sweet toddy, Sugar cane juice, coconut milk, flavoured syrups.	7

Total Lectures:	**30**

8. Practical

S. No.	Content of Practical's	No. of practical's
1	Quality analysis of raw water; Determination of density and viscosity of caramel.	3
2	Determination of colours in soft drinks by wool technique; Preparation of iced and flavoured tea.	3
3	Preparation of carbonated and non-carbonated beverages; Determination of caffeine in beverages.	3
4	Determination of brix value, gas content, pH and acidity of beverages; Quality analysis of tea and coffee; Preparation of miscellaneous beverages.	3
5	Visit to carbonation unit; Visit to mineral water plant.	3
	Total Practical's	**15**

9. Suggested Readings

S.NO.	Authors/ Name of Books/Publishers
1.	Ashurst, P. R. (2005). *Chemistry and Technology of Soft Drinks and Fruit Juices* (2nd ed.). Blackwell Publishing Ltd.
2.	Chakraverty, A., Mujumdar, A. S., Vijaya Raghavan, G. S., & Ramaswamy, H. S. (2003). *Handbook of Post-Harvest Technology: Cereals, Fruits, Vegetables, Tea, and Spices*. Marcel Dekker, Inc.
3.	Eblinger, H. M. (2009). *Handbook of Brewing: Processes, Technology, Markets*. Wiley-VCH Verlag GmbH & Co. KGaA.
4.	Hui, Y. H. (2007). *Handbook of Food Products Manufacturing: Principles, Bakery, Beverages, Cereals, Cheese, Confectionary, Fats, Fruits, and Functional Foods*. John Wiley & Sons, Inc.

Eternal University, Baru Sahib
Dr. Khem Singh Gill Akal College of Agriculture

1.	**Course Code: 0140261072**	**Subject Code: FT 327**	**Course Title: Bakery, Confectionery and Snack Products**		
2.	**Semester: VI**		**Credits: 3(2+1)**		
3.	**Contact Hours:**	**L: 2**	**P: 2**		
4.	**Relative weightage:**	**MTE: 24**	**ETE: 48**	**Quiz/PA: 24**	**FPE: 24**
5.	**Objectives:**				
I.	Apply principles of food science, chemistry, and engineering to understand the formulation, processing, packaging, and quality testing of bakery, confectionery, and snack products.				
II.	Identify defects in bakery, confectionery, and snack products and propose appropriate scientific corrective measures.				
III.	Design new or improved formulations and processes for bakery and snack items with desirable sensory, nutritional, and shelf-life properties.				
IV.	Understand extrusion technology and its application in the production of breakfast cereals and snacks				
6.	**Course Outcome:**				
CO1	Describe the types, specifications, formulations, and role of ingredients in bakery and confectionery product preparation and processing.				
CO2	Demonstrate the knowledge of equipment, processing steps, packaging, and storage techniques for bakery, confectionery, and snack food products, including traditional and modern methods.				
CO3	Evaluate the quality of bakery, confectionery, and snack products, and analyze defects along with their causes and corrective measures.				
CO4	Perform practical operations related to mixing, fermentation, baking, extrusion, and packaging while evaluating finished product quality in a laboratory or industrial setting.				

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	3	3	3	2	2	2	3	3	2	2	1	1
CO2	3	3	3	2	2	2	3	3	2	2	1	1
CO3	3	3	3	2	2	2	3	3	2	2	1	1
CO4	3	3	3	2	2	2	3	3	2	2	1	1
Average	**3**	**3**	**3**	**2**	**2**	**2**	**3**	**3**	**2**	**2**	**1**	**1**

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

7. Details of Course:

Units	**Particulars**	**No. of Lectures**
I	Bakery products- Types (leavened and unleavened), specifications, compositions and ingredients (flour, sugar, fat, shortening, leavening agent etc.); Formulations, processing (mixing, fermentation, rounding, proofing, sheeting, moulding, baking, depanning etc.), equipment, packaging, storage and quality testing of bakery products. Processing technology of bread, biscuits and cakes. Classification of biscuits and the manufacturing process of crackers	**10**
II	Confectionery and chocolate products: Types, specifications, compositions,	**5**

	ingredients, formulations; Hard-boiled candies, pan coating, toffees and caramels, chewing gum and sugar-free confections; Processing of chocolate – types of cocoa beans and processing, other ingredients, mixing, refining, conching, storage, and packaging.	
III	Processing, equipment, packaging, storage and quality testing of confectionery and chocolate products. Product quality characteristics: Defects, causes, and corrective measures. Extrusion technology and applications in food processing; Snack foods: Types, specifications, compositions, ingredients	**5**
IV	Formulations, processing, equipment, packaging, storage and quality testing; Snack food seasonings. Breakfast cereals, macaroni products and malts: Specifications, compositions, ingredients; Formulations, processing, equipment for breakfast cereals, macaroni, and malts; Packaging, storage and quality testing for breakfast cereals, macaroni and malts. Cooked corn products – tortilla chips; Modified starches for snack foods; Oils and industrial frying. Preservatives used in Bakery, Confectionery, and snack products preservation, Quality testing of Bakery, Confectionery, and snack products.	**10**
	Total Lecture:	**30**

8. Practical

Units	**Content of Practical's**	**No. of Practical**
I	Identification and composition of various ingredients for snacks, bakery and confectionery products; Flours, their classifications and characterization.	**3**
II	Preparation, packaging and quality evaluation of selected snack items; Preparation, packaging and quality evaluation of selected bakery items.	**3**
III	Preparation, packaging, and quality evaluation of selected confectionery items; preparation, packaging, and quality evaluation of chosen chocolates.	**3**
IV	Preparation of traditional Indian confection;	**3**
V	Visit to bakery, confectionery and snack units (industry).	**3**
	Total Practical:	**15**

9. Suggested Books/Readings:

S. No.	**Authors/ Name of Books/Publishers**
5.	Amendola, J., & Rees, N. (2003). *Understanding baking: The art and science of baking* (3rd ed.). John Wiley and Sons, Inc.
6.	Corke, H., Leyn, I. D., Cross, N. A., Nip, W. K., & Hui, Y. H. (2006). *Bakery products: Science and technology*. Blackwell Publishing Ltd.
7.	Manley, D. (2000). *Technology of biscuits, crackers and cookies* (3rd ed.). Woodhead Publishing Limited.
8.	Kent, N. L., & Evers, A. D. (1994). *Kent's technology of cereals: An introduction for students of food science and agriculture* (4th ed.). Elsevier Science Ltd.

Eternal University, Baru Sahib
Dr. Khem Singh Gill Akal College of Agriculture

1.	**Course Code: 0140261082**	**Subject Code: FT 328**	**Course Title: Processing Technology of Liquid Milk**		
2.	**Semester: VI**		**Credits: 2 (1+1)**		
3.	**Contact Hours:**	**L: 1**	**P: 2**		
4.	**Relative weightage:**	**MTE: 16**	**ETE: 32**	**Quiz/PA: 16**	**FPE: 16**
5.	**Objectives:**				
I.	To provide an understanding of the historical development, production, and utilization of milk in India.				
II.	To explore the composition, properties, and various types of processed and fermented milk products.				
III.	To study the effects of thermal treatment on milk and biochemical changes during fermentation.				
IV.	To identify milk adulterants, quality defects, and their prevention methods.				
6.	**Course Outcomes:**				
CO1	Students will gain knowledge of milk production, collection, preservation, and processing.				
CO2	Students will understand the impact of thermal treatments and fermentation on milk quality.				
CO3	Students will be able to detect and prevent milk adulteration and quality defects.				
CO4	Students will learn about dairy equipment, including pasteurizers, homogenizers, and sterilizers				

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	3	2	2	2	2	1	3	2	2	2	2	2
CO2	3	3	2	2	3	1	3	2	2	2	1	2
CO3	3	3	3	2	2	1	3	3	3	2	1	2
CO4	2	2	3	3	2	1	2	3	2	2	2	2
Average	2.75	2.5	2.5	2.25	2.25	1	2.75	2.5	2.25	2	1.5	2

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

7. Details of Course:

Units	**Particulars**	**No. of Lectures**
I	Historical development of dairy in India; Production and utilization of milk; Composition and properties of milk; Liquid milk collection, preservation, processing, packaging and storage - standardized milk, skim milk, sterilized milk, reconstituted/rehydrated milk, recombined milk, flavoured milk, fermented milk, acidophilous milk, etc.	4
II	Effect of thermal treatment on milk constituents; Fermented milk products: Processing, manufacture, storage and packaging of acidophilus milk, cultured buttermilk and other fermented milk; Bio-chemical changes occurring during manufacture of fermented milks; Factors affecting these changes and effects of these changes on the quality of finished products. Cream: definition, classification, manufacture of different types of cream, processing of cream	4
III	Adulterations in milk and its detection; Quality defects in milk-causes and prevention, liquid milk collection, processing, packaging and storage systems	4

	and equipment - bulk milk coolers, milk chilling units.	
IV	Milk reception equipment, milk tanks/silos, pasteurizers, sterilizers, centrifuges, clarifiers, filtration units, homogenizers, packaging and filling machines, CIP units, etc.; Hygienic design concepts, sanitary pipes and fittings, corrosion process and their control.	3
	Total Lectures:	**15**

8 Practical

Units	Content of Practical's	No. of Practical's
I	Platform tests of raw milk (clot on boiling (COB) test, alcohol test).	3
II	Determination of physical properties of milk; Determination of proximate composition and biochemical properties of milk; Determination of microbiological properties of milk.	3
III	Detection of adulterants in milk; Identification and demonstration of liquid milk processing equipment, pipes and fittings.	3
IV	Preparing standardized milk as per requirement; Separation of fat from milk; Pasteurization and homogenization of milk.	3
V	Packaging of liquid milk; Preparation of curd and yogurt, Visit to chilling centre and dairy plant.	3
	Total Practical's:	**15**

9. Suggested Books/Readings:

S. No.	Authors/ Name of Books/Publishers
1.	De, S. (2005). *Outlines of Dairy Technology*. Oxford University Press.
2.	Hui, Y. H. (1993). *Dairy Science and Technology Handbook* (Vols. 1–3). Wiley-VCH.
3.	Kanekanian, A. (2014). *Milk and Dairy Products as Functional Foods*. John Wiley & Sons.
4.	Kessler, H. G. (1981). *Food Engineering and Dairy Technology*. Verlag A. Kessler.
5.	Tamime, A. Y. (2009). *Milk Processing and Quality Management*. Blackwell Publishing.
6.	Walstra, P., Wouters, J. T. M., & Geurts, T. J. (2006). *Dairy Science and Technology* (2nd ed.). CRC Press.

Fourth Year
SEMESTER-VII

S. No.	Course Code	Subject Code	Course Title	Credit hours	Total Credit hours
1.	0140271012	FT 411	Food Process Equipment Design	3 (2+1)	**20(5++15)**
2.	0140271022	FT 412	Processing Technology of Dairy Products	3 (2+1)	
3.	0140271032	FT 413	ICT Applications in Food Industry	3 (1+2)	
4.	0140271042	FT 414	Seminar	1 (0+1)	
5.		ELECT**	Elective Courses	10 (0+10)	

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1.	**Course Code: 0140271012**	**Subject Code: FT 411**	**Course Title: Food Process Equipment Design**		
2.	**Semester: VII**		**Credits: 3(2+1)**		
3.	**Contact Hours:**	**L: 2**	**P:2**		
4.	**Relative weightage:**	**MTE:24**	**ETE: 48**	**Quiz/PA: 24**	**FPE:24**
5.	**Objectives :**				
I.	To understand the selection of materials based on their mechanical properties, corrosion resistance, and fabrication considerations, along with the principles of designing for static and dynamic loads, stresses, and safety factors.				
II.	To understand the principles and methods involved in the design of pressure and storage vessels, including their operating conditions, stresses, and the design of heat exchangers such as shell and tube, plate, and scraped surface exchangers.				
III.	To understand the principles and methods involved in the design of evaporators, crystallizers, agitators, separators, and freezing equipment, considering the mechanical components, operational requirements, and system efficiencies for food processing.				
IV.	To learn the design principles of various drying equipment, extruders, and fermenters, while understanding the importance of safety considerations and hazard analysis in process industries.				
6.	**Outcomes:**				
CO1	Students will be able to select appropriate materials for various applications, considering factors such as mechanical properties, corrosion prevention, and economic considerations, while applying design principles to ensure structural integrity and safety under different loading conditions.				
CO2	Students will be able to design pressure vessels, including the shell, components, and accessories, considering factors like stress and thermal gradients, and will also be capable of designing various types of heat exchangers (shell and tube, plate, and scraped surface) for specific applications like sterilization and retorting.				
CO3	Students will be able to design various types of evaporators (single and multiple effect, rising and falling film), crystallizers, agitators, centrifuge separators, and freezing equipment, while ensuring proper selection of components such as shafts, pulleys, and drive systems, optimizing performance for food and refrigeration applications.				
CO4	Students will be able to design different types of dryers (tray, tunnel, fluidized, spray, vacuum, freeze, microwave), extruders (cold, hot, twin-screw), and fermenters, while integrating safety measures and pressure relief devices into equipment design to ensure safe and efficient operations in food processing systems.				

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	3	2	2	2	2	1	3	2	2	2	2	2
CO2	3	3	2	2	3	1	3	2	2	2	1	2
CO3	3	3	3	2	2	1	3	3	3	2	1	2
CO4	2	2	3	3	2	1	2	3	2	2	2	2
Average	**2.75**	**2.5**	**2.5**	**2.25**	**2.25**	**1**	**2.75**	**2.5**	**2.25**	**2**	**1.5**	**2**

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

7. Details of Course:

S. No.	**Particulars**	**No. of Lectures**
1.	Materials and properties: Materials for fabrication, mechanical properties, ductility, hardness, corrosion, protective coatings, corrosion prevention	6

	linings equipment, choice of materials, material codes. Design considerations: Stresses created due to static and dynamic loads, combined stresses, design stresses and theories of failure, safety factor, temperature effects, radiation effects, effects of fabrication method, economic considerations.	
2.	Design of pressure and storage vessels: Operating conditions, design conditions and stress; Design of shell and its component, stresses from local load and thermal gradient, mountings and accessories. Design of heat exchangers: Design of shell and tube heat exchanger, plate heat exchanger, scraped surface heat exchanger, sterilizer and retort.	6
3.	Design of evaporators and crystallizers: Design of single effect and multiple effect evaporators and its components; Design of rising film and falling film evaporators and feeding arrangements for evaporators; Design of crystallizer and entrainment separator. Design of agitators and separators: Design of agitators and baffles; Design of agitation system components and drive for agitation. Design of centrifuge separator; Design of equipment components, design of shafts, pulleys, bearings, belts, springs, drives, speed reduction systems. Design of freezing equipment: Design of ice-ream freezers and refrigerated display system.	9
4.	Design of dryers: Design of tray dryer, tunnel dryer, fluidized dryer, spray dryer, vacuum dryer, freeze dryer and microwave dryer. Design of extruders: Cold and hot extruder design, design of screw and barrel, design of twin screw extruder. Design of fermenters: Design of fermenter vessel, design problems. Hazards and safety considerations: Hazards in process industries, analysis of hazards, safety measures, safety measures in equipment design, pressure relief devices	9
	Total	**30**

8. Practical

S. No.	Content of Practicals	No. of Practical
1.	Design of pressure vessel; Design of shell and tube heat exchangers and plate heat exchanger.	**3**
2.	Design of sterilizers and retort; Design of single and multiple effect evaporators; Design of rising film and falling film evaporator.	**3**
3.	Design of crystallizer; Design of tray dryer; Design of fluidized bed dryer; Design of spray dryer; Design of vacuum dryer; Design of microwave dryer.	**3**
4.	Design of belt and chain conveyor; Design of screw conveyor; Design of bucket elevator and pneumatic conveyor.Design of twin screw extruder.	**4**
5.	Design of fermenter.	**2**
	Total	**15**

9. Suggested Books/Readings:

S.No.	Authors/ Book Name/ Publishers
1.	Bhattacharyya, B. C. (2008). *Introduction to Chemical Equipment Design: Mechanical Aspect*. CBS Publishers and Distributors.
2.	Couper, J. R., Penney, W. R., Fair, J. R., & Walas, S. M. (2012). *Chemical Process Equipment: Selection and Design*. Elsevier.
3.	Geankoplis, C. J. (2003). *Transport Processes and Separation Process Principles (Includes Unit Operations)* (4th ed.). Prentice-Hall.
4.	Ibarz, A., & Barbosa-Cánovas, G. V. (2003). *Unit Operations in Food Engineering*. CRC Press.

5.	Pandey, H., Sharma, H. K., Chauhan, R. C., Sarkar, B. C., & Bera, M. B. (2010). *Experiments in Food Process Engineering*. CBS Publishers and Distributors Pvt. Ltd.
6.	Richardson, J. F., & Peacock, D. G. (1994). *Coulson and Richardson's Chemical Engineering (Vol. 3): Chemical and Biochemical Reactors and Process Control* (3rd ed.). Elsevier Butterworth-Heinemann.
7.	Saravacos, G. D., & Kostaropoulos, A. E. (2002). *Handbook of Food Processing Equipment*. Springer Science and Business Media.
8.	Singh, R. P., & Heldman, D. R. (2014). *Introduction to Food Engineering* (5th ed.). Elsevier.
9.	Sinnott, R. K. (1999). *Chemical Engineering Design (Vol. 6)* (3rd ed.). Butterworth-Heinemann.
10.	Stanbury, P. F., Whitaker, A., & Hall, S. J. (1995). *Principles of Fermentation Technology* (2nd ed.). Elsevier Science Ltd.
11.	Valentas, K. J., Rotstein, E., & Singh, R. P. (1997). *Handbook of Food Engineering Practice*. CRC Press.

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1.	**Course Code: 0140271022**	**Subject Code: FT 412**	**Course Title: Processing Technology of Dairy Products**		
2.	**Semester: VII**		**Credits: 3 (2+1)**		
3.	**Contact Hours:**	**L: 2**	**P: 2**		
4.	**Relative weightage:**	**MTE:24**	**ETE: 48**	**Quiz/PA: 24**	**FPE:24**
5.	**Objectives:**				
I.	To understand classification, composition, and processing of dairy products.				
II.	To learn manufacturing, equipment, and quality control of butter, ghee, and paneer.				
III.	To explore processing, quality, and defect prevention in frozen desserts.				
IV.	To gain knowledge of drying techniques and quality of condensed and dried milk.				
6.	**Course Outcomes:**				
CO1	Students will be able to classify and process dairy products.				
CO2	Students will be able operate equipment and ensure quality control.				
CO3	Students will be able to identify and prevent product defects.				
CO4	Students will be able to apply modern drying techniques.				

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	3	1	1	1	1	1	3	1	1	1	1	1
CO2	2	2	2	2	1	1	2	2	3	2	2	1
CO3	2	2	2	1	1	1	2	1	2	1	1	1
CO4	2	2	3	3	2	2	2	3	3	2	2	2
Average	2.25	1.75	2.0	1.75	1.25	1.25	2.25	1.75	2.25	1.5	1.5	1.25

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

7. Details of Course:

Units	**Particulars**	**No. of Lectures**
I	Cream: Basic aspect, Classification, manufacture of different types of cream, processing of cream; Classification of dairy products; Butter: Definition, composition; processing and production steps, overrun, butter making machines, quality testing of table butter, butter- defects, causes and their prevention, packaging and storage	**8**
II	Butter oil and ghee: Definition, composition, processing, equipment, quality tests; Paneer and Cheese: Definition, composition, types, processing steps, process flow diagram, equipment, quality defects, causes and prevention, packaging and storage.	**8**
III	Ice cream and frozen desserts: Definition, composition, types, Processing steps and flow diagram, equipment, quality testing, defects causes and prevention, packaging and storage.	**6**

IV	Condensed and Dried milk: Definition, composition, role of milk constituents in condensed milk, manufacture of condensed milk, types of standards for dried milk. Manufacture of SMP and WMP using roller and spray drying, instantization, recent developments in drying, quality testing, defects, causes and prevention, packaging and storage	8
	Total Lectures:	**30**

8 Practical

Units	**Content of Practical's**	**No. of Practical's**
I	Preparation of butter/ table butter, Preparation of ghee, Preparation of paneer	**3**
II	Preparation of selected type of cheese; Preparation of ice-cream and selected frozen desserts	**3**
III	Preparation of condensed milk; Preparation of spray dried milk powder	**3**
IV	Preparation of selected Indian dairy products Shrikhand mawa/khoa based products halwa/ kheer etc.,	**3**
V	Determination of selected quality parameters of selected dairy products; Visit to dairy plant.	**3**
	Total Practical's:	**15**

9. Suggested Books/Readings:

S. No.	**Authors/ Name of Books/Publishers**
6.	Aneja, R. P., Mathur, B. N., Chandan, R. C., & Banerjee, A. K. (2002). *Technology of Indian Milk Products: Handbook of Process Technology Modernization for Professionals, Entrepreneurs and Scientists*. Dairy India Yearbook.
7.	De, S. (2005). *Outlines of Dairy Technology*. Oxford University Press.
8.	Hui, Y. H. (1993). *Dairy Science and Technology Handbook* (Vols. 1–3). Wiley-VCH.
9.	Kanekanian, A. (2014). *Milk and Dairy Products as Functional Foods*. John Wiley & Sons.
10.	Kessler, H. G. (1981). *Food Engineering and Dairy Technology*. Verlag A. Kessler.
11.	Tamime, A. Y. (2009). *Milk Processing and Quality Management*. Blackwell Publishing.
12.	Walstra, P., Wouters, J. T. M., & Geurts, T. J. (2006). *Dairy Science and Technology* (2nd ed.). CRC Press.

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1.	**Course Code: 0140271032**	**Subject Code: FT 413**	**Course Title: ICT Applications in Food Industry**		
2.	**Semester: VII**		**Credits: 3 (1+2)**		
3.	**Contact Hours:**	**L: 1**	**P: 4**		
4.	**Relative weightage:**	**MTE:24**	**ETE: 48**	**Quiz/PA: 24**	**FPE:24**
5.	**Objectives:**				
I.	To introduce the importance of computerization and automation in the food industry.				
II.	To familiarize students with SCADA systems, including hardware, software, and protocols.				
III.	To develop problem-solving skills using MATLAB for food industry applications.				
IV.	To provide knowledge of computational fluid dynamics (CFD) and its role in food processing.				
6.	**Course Outcomes:**				
CO1	Students will understand the role of computerization in food industry operations.				
CO2	Students will be able to implement SCADA systems for process automation.				
CO3	Students will develop MATLAB programming skills for data analysis and modeling.				
CO4	Students will apply CFD concepts to optimize food processing systems.				

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO4**	**PSO5**	**PSO6**
CO1	2	2	1	1	2	2	2	2	1	1	1	2
CO2	3	3	3	3	2	2	3	3	3	2	2	3
CO3	3	2	2	3	2	2	2	3	2	2	2	3
CO4	2	2	2	2	2	2	2	2	2	2	2	2
CO5	3	2	3	3	2	2	3	3	2	2	2	3
Avg.	**2.6**	**2.2**	**2.2**	**2.4**	**2**	**2**	**2.4**	**2.6**	**2**	**1.8**	**1.8**	**2.6**

1= Weak Correlation 2 = Moderate Correlation 3 = Strong Correlation

7. Details of Course:

Units	**Particulars**	**No. of Lectures**
I	Importance of computerization in food industry, operating environments and information systems for various types of food industries. Introduction to Supervisory control and data acquisition (SCADA): SCADA systems hardware, firmware, software and protocols, landlines, local area network systems, modems. Spreadsheet applications: Data interpretation and solving problems, preparation of charts, use of macros to solve engineering problems. Use of add-ins, use of solver.	4
II	Web hosting and webpage design; file transfer protocol (FTP), Online food process control from centralized server system in processing plant. Use of MATLAB in food industry; computing with MATLAB, script files and editor/debugger, MATLAB help system. Problem solving methodologies, numeric, cell, arrays, matrix operations; User	4

	defined functions, programming using MATLAB; debugging MATLAB programs, Applications to simulations; Plotting and model building in MATLAB, X-Y plotting functions, subplots and overlay plots, special plot types, interactive plotting in MATLAB;	
III	Function discovery, regression, the basic fitting interface, three dimensional plots; Introduction to Toolboxes useful to Food Industry, Curve fitting toolbox, Fuzzy logic toolbox, Neural Network toolbox, Image processing toolbox, statistical toolbox. Introduction to computational fluid dynamics (CFD), governing equations of fluid dynamics; Models of flow, substantial derivative, divergence of velocity, continuity, momentum and energy equations; Physical boundary conditions, discretization; Applications of CFD in food and beverage industry; Introduction to CFD softwares, GAMBIT and Fluent software, LabVIEW – LabVIEW environment: Getting data into computer, data acquisition devices, NI-DAQ, simulated data acquisition, sound card, front panel/block diagram, toolbar/tools palette;	4
IV	Components of a LabVIEW application: Creating a VI, data Flow execution, debugging techniques, additional help, context help, tips for working in LabVIEW; LabVIEW typical programs: Loops, while loop, for loop, functions and sub Vis, types of functions, searching the functions palette, creating custom sub Vis, decision making and file I/O, case structure, select (if statement), file I/O; LabVIEW results: Displaying data on front panel, controls and indicators, graphs and charts, arrays, loop timing, signal processing, textual math, math script.	3
	Total Lectures:	**15**

8 Practical

Units	Content of Practical's	No. of Practical's
I	Introduction to various features in spreadsheet; Solving problems using functions in spreadsheets; Use of Add-Ins in spread sheet and statistical data analysis using Analysis Tool pack.	6
II	Solution of problems on regression analysis using Analysis Tool pack in spreadsheet; Solution of problems on optimization using solver package in spreadsheet.	4
III	Introduction to MATLAB; Writing code using MATLAB programming; Solution of problems using Curve Fitting Toolbox in MATLAB; Solution of problems using Fuzzy Logic Toolbox in MATLAB.	6
IV	Solution of problems using Neural Network Toolbox in MATLAB; Solution of problems using Image Processing Toolbox in MATLAB; Introduction to GAMBIT software.	6
V	Creation of geometry for laminar flow through pipe using GAMBIT.	4
VI	Introduction to FLUENT software; Import of geometry and application of boundary conditions; Solution of problems on laminar flow using FLUENT; Introduction to LabVIEW and NI-DAQ.	4
	Total Practical's:	**30**

9. Suggested Books/Readings:

S. No.	Authors/ Name of Books/Publishers
1.	Bailey, D., & Wright, E. (2003). *Practical SCADA for Industry*. Elsevier.
2.	Chapman, N., & Chapman, J. (2006). *Web Design: A Complete Introduction*. John Wiley & Sons.
3.	Palm, W. J., III. (2011). *Introduction to MATLAB for Engineers* (3rd ed.). McGraw-Hill.
4.	Singh, R. P. (2014). *Computer Applications in Food Technology: Use of Spreadsheets in*

	Graphical, Statistical and Process Analysis. Academic Press.
5.	Sun, D. W. (2007). *Computational Fluid Dynamics in Food Processing*. CRC Press.

ELECTIVE COURSES

Sr. No.	Course Code	Code	Course Title	Credit hours
Food Technology				
1	0140277012	FTE 411	Introduction to Food Biotechnology	3 (2+1)
2	0140277022	FTE 412	Design and Formulation of Foods	3 (2+1)
3	0140277032	FTE 413	Traditional Indian Dairy Products	2 (1+1)
4	0140277042	FTE 414	Ice-cream and Frozen Desserts	3 (2+1)
5	0140277052	FTE 415	Instrumental Techniques in Food Analysis	2 (1+1)
6	0140277062	FTE 416	Food Plant Design and Layout	3 (2+1)
7	0140277072	FTE 417	Waste and By-Products Utilization	3 (2+1)
Food Quality Assurance				
1	0140277082	FQE 411	Industrial Microbiology	3 (2+1)
Food Engineering and Renewable				
1	0140277092	FEE 411	Instrumentation and Process Control in Food Industry	3 (1+2)
2	0140277102	FEE 412	Energy Conservation and Management	2 (1+1)
3	0140277112	FEE 413	Applications of Renewable Energy in Food Processing	2 (1+1)
Food Business Management				
1	0140277122	FBE 411	Business Management and Economics	2 (2+0)
2	0140277132	FBE 412	Statistical Methods and Numerical Analysis	2 (1+1)

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1.	**Course Code: 0140277022**	**Subject Code: FTE 412**	**Course Title: Design and Formulation of Foods**		
2.	**Semester: VII**		**Credits: 3 (2+1)**		
3.	**Contact Hours:**	**L: 2**	**P: 2**		
4.	**Relative weightage:**	**MTE: 24**	**ETE: 48**	**Quiz/PA: 24**	**FPE: 24**
5.	**Objectives:**				
I.	To introduce the fundamentals of nutrients, food classification, and anti-nutritional factors.				
II.	To provide knowledge of different food groups and recommended dietary allowances (RDA) for various age groups.				
III.	To develop an understanding of therapeutic diets and diet planning for specific health conditions.				
IV.	To explore the concepts of functional foods and nutraceuticals in health and wellness.				
6.	**Course Outcomes:**				
CO1	Students will understand the role of nutrients and their impact on health.				
CO2	Students will be able to plan balanced diets for different population groups.				
CO3	Students will learn to formulate therapeutic diets for managing various diseases.				
CO4	Students will gain knowledge of functional foods, nutraceuticals, and their applications.				

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	2	2	1	1	2	3	3	2	2	2	1	3
CO2	2	2	3	1	3	2	3	2	2	2	1	2
CO3	2	3	3	1	3	2	3	2	3	2	2	2
CO4	3	2	2	2	3	3	3	3	3	3	2	3
Avg.	**2.25**	**2.25**	**2.25**	**1.25**	**2.75**	**2.5**	**3**	**2.25**	**2.5**	**2.25**	**1.5**	**2.5**

1= Weak Correlation 2 = Moderate Correlation 3 = Strong Correlation

7. Details of Course:

Units	**Particulars**	**No. of Lectures**
I	Nutrients and their function, food classification and their nutritive value, anti-nutritional factors present in food;	8
II	Concept of different food groups, recommended dietary allowances (RDA) for Indians; nutrition for infant, pre-school and school children, adult, pregnant and lactating women, old age people. Production and formulation of Indian traditional sweet and snack food products, steps for quality improvement and value addition	8
III	Therapeutic diets – Principles and Objectives of diet therapy, diet for patient suffering from Diabetes mellitus, osteoporosis, cardiac problem, gastrointestinal disorder, Diet planning and use of exchange list in nutrient calculation	6
IV	Functional foods - definition and concepts; design of functional foods; Nutraceuticals food - definition and concepts, design of nutraceutical foods. Recent trends in food formulation; antioxidant rich food products; concepts for formulation of foods for drought and disaster afflicted; defense services, sportsmen, space food	8
	Total Lectures:	**30**

8 Practical

Units	Content of Practical's	No. of Practical's
I	To study the principles and planning menu; Develop diet plan using food exchange list and nutrient calculation for school children, adult, pregnant	**3**
II	Preparation and formulation of Indian Traditional Snack, Traditional Sweet	**3**
III	Preparation and development of food for pregnant and lactating women, foods for infants;	**3**
IV	Preparation and formulation of food and energy drinks for diabetic person (sugar free food products); sports person and osteoporosis;	**3**
V	Preparation of prebiotic and pro biotic food product; Preparation of functional food using millets; whey beverage probiotic beverage; Production of functional beverage and antioxidant determination; Visit to Food Processing Industries/ Expos	**3**
	Total Practical's:	**15**

9. Suggested Books/Readings:

S. No.	Authors/ Name of Books/Publishers
4.	Antia, F. P. (1974). *Clinical Dietetics and Nutrition*. Oxford Medicine Publications.
5.	Davidson, S., Passmore, R., & Eastwood, M. A. (1986). *Davidson and Passmore Human Nutrition and Dietetics*. Churchill Livingstone.
6.	Gopalan, C., Ramashastri, B. V., & Balasubramaniam, S. C. (1989). *Nutritive Value of Indian Foods*. National Institute of Nutrition.
7.	Mazza, G. (1998). *Functional Foods: Biochemical and Processing Aspects*. Technomic Publishing Co.
8.	Pokorny, J., Yanishlieva, N., & Gordon, M. (2001). *Antioxidants in Food*. Woodhead Publishing.
9.	Potter, N. N., & Hotchkiss, J. H. (1995). *Food Science* (5th ed.). Chapman & Hall.
10.	Robinson, C. (1975). *Basic Nutrition and Diet Therapy*. Macmillan.
11.	Steinkrauss, K. H. (1995). *Handbook of Indigenous Fermented Foods*. Marcel Dekker.
12.	Swaminathan, M. (1974). *Essentials of Nutrition*. Ganesh Co.

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1.	**Course Code: 0140277082**	**Subject Code: FQE 411**	**Course Title: Industrial Microbiology**		
2.	**Semester: VII**		**Credits: 3 (2+1)**		
3.	**Contact Hours:**	**L: 2**	**P: 2**		
4.	**Relative weightage:**	**MTE: 24**	**ETE: 48**	**Quiz/PA: 24**	**FPE: 24**
5.	**Objectives:**				
I.	To understand the basics of industrial microbiology and fermentation processes.				
II.	To study the selection, strain improvement, and preservation of industrially important microorganisms.				
III.	To explore the different types of fermentation media, microbial growth, and fermentation processes.				
IV.	To learn about bioreactor design, upstream and downstream processes, and methods for enzyme/product purification.				
6.	**Course Outcomes:**				
CO1	Explain the principles of industrial microbiology and fermentation processes.				
CO2	Identify criteria for selecting and preserving industrial microorganisms.				
CO3	Demonstrate understanding of fermentation media, microbial growth, and various fermentation techniques.				
CO4	Apply knowledge of bioreactor design and upstream/downstream processes in industrial settings.				

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	3	2	2	1	2	2	3	2	2	2	1	2
CO2	2	2	2	1	2	2	2	2	2	2	1	2
CO3	3	3	3	2	2	2	3	3	3	3	2	3
CO4	3	3	3	3	2	2	3	3	3	3	2	3
Avg.	**2.75**	**2.5**	**2.5**	**1.75**	**2**	**2**	**2.75**	**2.5**	**2.5**	**2.5**	**1.5**	**2.5**

1= Weak Correlation 2 = Moderate Correlation 3 = Strong Correlation

7. Details of Course:

Units	**Particulars**	**No. of Lectures**
I	Overview of Industrial Microbiology; Introduction to industrial fermentations, Range of fermentation processes, Chronological development, Compartmental part of fermentation processes; Industrially Important Microorganisms.	7
II	Criteria for Selection of Industrially Important Microorganisms, Overview of strain improvement of Industrially Important Microorganisms. Preservation of industrially important microorganisms.	7
III	Fermentation Media; Media selection, Medium Formulation, Medium for industrial fermentation; Microbial Growth; Typical Growth Curve, Synchronous growth, Batch Fermentations, Continuous Fermentation; Fed Batch Fermentation. Bioreactor Design: Basic functions, Parts of stirred tank fermenter: Aeration and agitation; agitator,	9

	Impeller, sparger systems, baffles and other accessories, Types of reactor; Problems related to scale up of Process.	
IV	Upstream and Down Stream Processes: Upstream processes, Overview of Downstream Processing, Methods of cell destruction, Methods of purification of enzyme/product, Concentration and Packaging.	7
	Total Lectures:	**30**

8. Practical

Units	Content of Practical's	No. of Practical's
I	Isolation and screening of citric acid/ amylase/ protease /antibiotic producing microbes,	3
II	Production of citric acid/Lactic acid/ Acetic acid, Purification of citric acid/Lactic acid/ Acetic acid and Estimation of citric acid/Lactic acid/ Acetic acid	3
III	Standardization of physical factors for higher yields of citric acid; Isolation, identification of cultures producing bio-colours; Production, purification and estimation of beer/ ethanol	3
IV	Production, purification and assay of fungal amylases/ proteases/Lipase; Production and assay of nisin from lactic acid bacteria;	3
V	Single cell protein production; Starter activity of Baker's yeast Mushroom production.	3
	Total Practical's:	**15**

9. Suggested Books/Readings:

S. No.	Authors/ Name of Books/Publishers
4.	Briggs, D. E., Boulton, C. A., Brookes, P. A., & Stevens, R. (2004). *Brewing Science and Practice*. Woodhead Publishing Ltd.
5.	Casida Jr., L. E. (1968). *Industrial Microbiology*. New Age International Publishers.
6.	Okafor, N. (2007). *Modern Industrial Microbiology and Biotechnology*. Science Publishers.
7.	Reed, G. (2004). *Prescott and Dunn's Industrial Microbiology* (4th ed.). AVI Publishers.
8.	Stanbury, P. F., Whitaker, A., & Hall, S. J. (1995). *Principles of Fermentation Technology* (2nd ed.). Elsevier Science Ltd.

Eternal University, Baru Sahib
Dr. Khem Singh Gill Akal College of Agriculture

1.	**Course Code: 0140277012**	**Subject Code: FTE 411**	**Course Title: Introduction to Food Biotechnology**		
2.	**Semester: VII**		**Credits: 3 (2+1)**		
3.	**Contact Hours:**	**L: 2**	**P: 2**		
4.	**Relative weightage:**	**MTE: 24**	**ETE: 48**	**Quiz/PA: 24**	**FPE: 24**
5.	**Objectives:**				
I.	To understand the fundamentals of biotechnology, including DNA replication, transcription, and translation.				
II.	To study DNA transfer mechanisms, vectors, and cloning techniques.				
III.	To gain proficiency in molecular biology techniques like PCR, DNA sequencing, and immunoblotting.				
IV.	To explore the applications and ethical issues in biotechnology, including genetic engineering and bioremediation.				
6.	**Course Outcomes:**				
CO1	Explain key processes in biotechnology, including DNA replication, transcription, and translation.				
CO2	Utilize various vectors and cloning techniques in recombinant DNA technology.				
CO3	Perform molecular biology techniques such as PCR, sequencing, and immunoblotting.				
CO4	Assess the applications and ethical concerns in biotechnology.				

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	3	2	1	1	1	2	3	2	2	1	1	2
CO2	3	3	3	2	2	2	3	3	2	2	1	2
CO3	3	3	3	3	2	3	3	3	3	2	2	3
CO4	2	2	2	2	3	3	2	2	3	3	3	3
Avg.	**2.75**	**2.5**	**2.25**	**2**	**2**	**2.5**	**2.75**	**2.5**	**2.5**	**2**	**1.75**	**2.5**

1= Weak Correlation 2 = Moderate Correlation 3 = Strong Correlation

7. Details of Course:

Units	**Particulars**	**No. of Lectures**
I	Introduction, History and scope of biotechnology, Review of DNA replication, transcription, and translation, Natural and artificial mechanisms of DNA transfer, Introduction to vectors, Selectable markers, Cloning vectors, Expression vectors, Shuttle vectors	9
II	Creation of recombinant DNA molecules, Creation of genomic and cDNA libraries; Library screening, Ligation, Restriction endonuclease digestion and mapping, Gel electrophoresis, Northern blotting, Southern blotting	7
III	Polymerase Chain Reaction (PCR), DNA sequencing and sequence analysis, Reverse transcriptase PCR, Real time PCR, Production of monoclonal antibodies, Immunoblotting. DNA microarrays, Protein microarrays	7
IV	Introduction to bioinformatics. Applications of biotechnology: Genetically engineered foods, Bioremediation, DNA fingerprinting, Molecular diagnostics, Molecular forensics	7

	Transgenic organisms, Ethical issues in biotechnology, The future of biotechnology	
	Total Lectures:	**30**

8 Practical

Units	Content of Practical's	No. of Practical's
I	Study of auxotroph; Micro-propagation through tissue culture; Strain improvement through U.V. mutation for lactose utilization	3
II	Chemical mutagenesis using chemical mutagens (Ethidium bromide); Determination of survival curves using physical and chemical mutagens;	3
III	Isolation and analysis of chromosomal/genomic DNA from *E. coli* and *Bacillus cereus*	3
IV	Separation of protoplast using cellulytic enzymes; Production of biomass from fruit and vegetable waste	3
V	Introduction of ELISA/Southern blot/DNA finger printing, etc.; Agarose gel electrophoresis of plasmid DNA; Pesticide degradation by *Pseudomonas* spp.	3
	Total Practical's:	**15**

9. Suggested Books/Readings:

S. No.	Authors/ Name of Books/Publishers
1.	Brandenberg, O., Dhlamini, Z., Sensi, A., Ghosh, K., & Sonnino, A. (2011). *Introduction to Molecular Biology and Genetic Engineering*. FAO.
2.	Paul, M. (2007). *Biotechnology and Food Processing Mechanics*. Gene-Tech Books.
3.	Primrose, S. B., & Twyman, R. M. (2006). *Principles of Gene Manipulation and Genomics* (7th ed.). Blackwell Publishing.
4.	Renneberg, R., & Lorch, V. (2017). *Biotechnology for Beginners*. Academic Press.
5.	Singh, B. D. (2014). *Biotechnology: Expanding Horizons*. Kalyani Publishers.
6.	Smith, J. E. (2009). *Biotechnology* (5th ed.). Cambridge University Press.
7.	Stahl, U., Donalies, U. E. B., & Nevoigt, E. (2009). *Food Biotechnology*. Springer.
8.	Watson, J. D. (2013). *Molecular Biology of the Gene* (7th ed.). Benjamin Cummings.

Eternal University, Baru Sahib
Dr. Khem Singh Gill Akal College of Agriculture

1.	**Course Code: 0140277122**	**Subject Code: FBE 411**	**Course Title: Business Management and Economics**	
2.	**Semester: VII**		**Credits: 2 (2+0)**	
3.	**Contact Hours:**	**L: 2**		
4.	**Relative weightage:**	**MTE: 24**	**ETE: 40**	**Quiz/PA: 16**
5.	**Objectives:**			
I.	To understand definitions and core principles of management, including planning, organizing, staffing, directing, and controlling.			
II.	To gain knowledge of organizational structures, types of organizations, and economic fundamentals like demand, supply, and elasticity.			
III.	To study market types, national income indicators, production theory, cost analysis, and break-even analysis.			
IV.	To explore financial management, accounting systems, human resource management, and corporate social responsibility.			
6.	**Course Outcomes:**			
CO1	Explain management principles, functions, and organizational structures.			
CO2	Differentiate micro and macroeconomics, and interpret demand, supply, and market behavior.			
CO3	Analyze national income, production functions, cost concepts, and break-even points.			
CO4	Apply basic concepts of financial and human resource management, and understand business ethics and CSR.			

Mapping of Course Outcomess (COs) to Program Outcomes (POs) & Program Specific Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	2	2	2	1	2	2	2	2	2	1	2	2
CO2	2	3	2	1	2	2	2	2	2	2	2	2
CO3	3	3	3	2	2	2	3	2	2	2	2	2
CO4	2	2	2	2	3	3	2	2	3	2	3	3
Avg.	**2.25**	**2.5**	**2.25**	**1.5**	**2.25**	**2.25**	**2.25**	**2**	**2.25**	**1.75**	**2.25**	**2.25**

1= Weak Correlation 2 = Moderate Correlation 3 = Strong Correlation

7. Details of Course:

Units	**Particulars**	**No. of Lectures**
I	Definitions, management principles, scientific principles, administrative principles; Maslow's Hierarchy of needs theory. Functions of management: Planning, organizing, staffing, directing, controlling	6
II	Organizational structures, principles of organization; Types of organization: Formal and informal, line, line and staff, matrix, hybrid. Introduction to economics: Definitions, nature, scope, difference between microeconomics and macroeconomics; Theory of demand and supply, elasticity of demand, price and income elasticity	8
III	Markets: Types of markets and their characteristics. National income: GDP, GNP, NNP, disposable personal income, per capita income, inflation; Theory of production: Production function, factors of production; Law of variable proportions and law of returns to scale; Cost: Short run and long run cost, fixed cost, variable cost, total cost,	8

	average cost, marginal cost, opportunity cost; Break even analysis	
IV	Finance management: Definition, scope, Objectives; Different systems of accounting: Financial accounting, cost accounting, management accounting; Human resource management: Definitions, Objectivess of manpower planning, process, sources of recruitment, process of selection; Corporate social responsibility: Importance, business ethics	8
	Total Lectures:	**30**

8. **Suggested Books/Readings:**

S. No.	Authors/ Name of Books/Publishers
1.	Dewett, K. K., & Navalur, M. H. (n.d.). *Modern Economic Theory*. S. Chand and Sons.
2.	Harold, K. (n.d.). *Principles of Management*. Tata McGraw-Hill Education Private Limited.
3.	Jain, S. P. (n.d.). *Financial Accounting*. Kalyani Publications.
4.	Prasad, L. M. (2001). *Principles and Practices of Management* (9th ed.). S. Chand and Sons.
5.	Rao, P. S. (n.d.). *Human Resource Management*. Himalaya Publications.
6.	Thomas, P. C. (n.d.). *Managerial Economics* (9th ed.). Kalyani Publishers.

Eternal University, Baru Sahib
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1.	**Course Code: 0140277092**	**Subject Code: FEE 411**	**Course Title: Instrumentation and Process Control in Food Industry**		
2.	**Semester: VII**		**Credits: 3 (1+2)**		
3.	**Contact Hours:**	**L: 1**	**P: 4**		
4.	**Relative weightage:**	**MTE: 24**	**ETE: 48**	**Quiz/PA: 24**	**FPE: 24**
5.	**Objectives:**				
I.	Learn different measurement and control parameters and instruments for their measurement				
II.	Understand process control in food processing				
III.	Gain and understanding Instrumentation				
IV.	Gain the knowledge about food processing				
V.	Study effects of thermal processing on food processing				
6.	**Course Outcomes**:				
CO1	Understand food processing.				
CO2	Learn methods for, Instrumentation and Process Control in Food Industry				
CO3	Explore important force and pressure using potentiometer, resistance thermometer, thermocouples.				
CO4	Technology Transmission				
CO5	Role of Computer-based monitoring and control				

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	2	1	1	2	2	2	2	1	1	1	2
CO2	3	3	3	3	2	2	3	3	3	2	2	3
CO3	3	2	2	3	2	2	2	3	2	2	2	3
CO4	2	2	2	2	2	2	2	2	2	2	2	2
CO5	3	2	3	3	2	2	3	3	2	2	2	3
Avg.	**2.6**	**2.2**	**2.2**	**2.4**	**2**	**2**	**2.4**	**2.6**	**2**	**1.8**	**1.8**	**2.6**

1= Weak Correlation 2 = Moderate Correlation 3 = Strong Correlation

7. Details of Course:

Units	Particulars	No. of Lectures
I	Introduction, definitions, characteristics of instruments, static and dynamic characteristics, Temperature and temperature scales; Various types of thermometers; thermocouples, resistance thermometers and pyrometers; Pressure and pressure scales, manometers, pressure elements differential pressure.	3
II	Liquid level measurement, different methods of liquid level measurement, flow measurement, differential pressure meters, variable area meters; Weight measurement: Mechanical scale, electronic tank scale, conveyor scale, Measurement of displacement, temperature, velocity, force and pressure using potentiometer, resistance thermometer, thermocouples.	3
III	Transmission: Pneumatic and electrical, Control elements: control actions, pneumatic and electrical control systems; Process control: Definition, simple system analysis,	3

	dynamic behavior of simple process, Laplace transform, process control hardware.	
IV	Frequency response analysis, characteristics, Bode diagram and Nyquist plots and stability analysis; Controllers and indicators: Temperature control, electronic controllers, timers and indicators, discrete controllers, adaptive and intelligent controllers.	3
V	Computer-based monitoring and control: Importance, hardware features of data acquisition and control computer signal interfacing, examples in food processing; Introduction of 8051/8085 based system and applications in processing.	3
	Total Lectures:	**15**

8. Practical

S. No.	Content of Practical's	No. of Practical's
1	Study on instrumentation symbols; Determination of relative humidity by wet and dry bulb thermometer;	6
2	Study of characteristics of pressure transducers, real-time study of pressure transducers characteristics with PC, characteristics of IC temperature sensor.	7
3	Study of characteristics of capacitive transducer; 8051 based programming examples; Programmable Logic Controllers (PLC) Hardware; PLC Ladder programming; control of Multiprocessing system.	7
4	Measurement of wind velocity by anemometer; Measurement of intensity of sunshine by sunshine recorders.	5
5	Characteristics of platinum RTD, temperature-controlled alarm system; Study of water level to current conversion.	5
	Total Practical's	**30**

9. Suggested Readings

S. No.	Authors/ Name of Books/Publishers
1.	Green, D. W., & Perry, R. H. (2008). *Perry's Chemical Engineers' Handbook* (8th ed.). McGraw-Hill.
2.	Johnson, C. D. (2003). *Process Control Instrumentation Technology* (7th ed.). Prentice Hall of India Pvt. Ltd.
3.	Lipták, B. G. (2003). *Instrument Engineer's Handbook* (Vols. I & II, 4th ed.). CRC Press.
4.	Murty, D. V. S. (2004). *Transducers and Instrumentation*. Prentice Hall of India Pvt. Ltd.

Eternal University, Baru Sahib
Dr. Khem Singh Gill Akal College of Agriculture

1.	**Course Code: 0140277052**	**Subject Code: FTE 415**	**Course Title: Instrumental Techniques in Food Analysis**		
2.	**Semester: VII**		**Credits: 3 (1+2)**		
3.	**Contact Hours:**	**L: 1**	**P: 4**		
4.	**Relative weightage:**	**MTE: 24**	**ETE: 48**	**Quiz/PA: 24**	**FPE: 24**
5.	**Objectives:**				
I.	To introduce the fundamental concepts, rules, and regulations of food analysis.				
II.	To familiarize students with the principles and methodologies of proximate analysis and instrumental techniques.				
III.	To explore various chromatographic methods used in food compositional analysis.				
IV.	To understand separation techniques such as dialysis, electrophoresis, and ultrafiltration.				
6.	**Course Outcomes:**				
CO1	Students will understand the principles and regulatory aspects of food analysis.				
CO2	Students will develop skills in proximate and instrumental food analysis techniques.				
CO3	Students will be able to apply chromatography for food composition and quality assessment.				
CO4	Students will gain knowledge of advanced separation techniques for food analysis.				

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	3	2	2	2	2	3	3	2	3	2	2	3
CO2	3	3	3	3	2	2	3	3	3	2	2	3
CO3	3	3	3	3	2	2	3	3	3	2	2	3
CO4	3	2	2	3	2	3	3	3	3	3	2	3
Avg.	**3**	**2.5**	**2.5**	**2.75**	**2**	**2.5**	**3**	**2.75**	**3**	**2.25**	**2**	**3**

1= Weak Correlation 2 = Moderate Correlation 3 = Strong Correlation

7. Details of Course:

Units	**Particulars**	**No. of Lectures**
I	Concepts of food analysis; Rules and regulations of food analysis Principles and methodology involved in analysis of foods: Rheological analysis, textural profile analysis of foods, Methods of analysis: Proximate constituents: Total fat, crude fiber, protein, moisture, minerals analysis; adulterations. Principles and methodology involved in analytical techniques: spectroscopy, ultraviolet visible, infrared spectroscopy, atomic absorption and emission, florescence mass spectroscopy. Food compositional analysis and applications in the food industry	5
II	Chromatography: Principle of chromatography, classifications, (Adsorption, column, partition, gel-filtration, affinity, ion-exchange, size-exclusion method) gas-liquid, high performance liquid chromatography; Ion chromatography and others.	4
III	Separation techniques: Dialysis, electrophoresis, sedimentation, ultra-filtration, ultra	2

	centrifugation, iso-electric focusing,	
IV	Chemically sensitive semiconductor devices: Solid-state sensors for pH, acidity, amperometric, potentiometric and; Acoustic sensors, Rapid microbiological methods: Overview, Conductance/impedance techniques for microbial assay; chemosensors, biosensors, immunosensors.	4
	Total Lectures:	**15**

8 Practical

Units	**Content of Practical's**	**No. of Practical's**
I	Sampling plan; Sample collection and preparation for analysis; Sensory evaluation of products.	4
II	Quality evaluation of raw materials: Fruits, vegetables, cereals, dairy products, meat, poultry products; Quality evaluation of food products for color and taste of marketed products.	4
III	Analysis of heavy metals using atomic absorption spectrophotometer; Estimation of physic acid using spectrophotometer.	4
IV	Separation of amino acids by two-dimensional paper chromatography; Identification of sugars in fruit juice using TLC; Separation of pralines by ion exchange chromatography; Molecular weight determination using sephadox-gel.	6
V	Identification of organic acids by paper electrophoresis; Gel-electrophoresis for analytic techniques; Quantitative determination of sugars and fatty acid profile by GLE; GCMS; Quantitative make-up of water and fat-soluble vitamins using HPLC. Fatty acid profiling using gas chromatograph	6
VI	Separation of sugars by paper chromatography; Analysis of wheat flour; Analysis of foods for pesticide and drug residues; Study of colorimetry and spectrophotometry; Spectrophotometric method of total chlorophyll (A & B).	6
	Total Practical's:	**30**

9. Suggested Books/Readings:

S. No.	**Authors/ Name of Books/Publishers**
1	Nielsen, S. S. (2010). *Food Analysis Laboratory Manual* (2nd ed.). Springer.
2	Nielsen, S. S. (2003). *Food Analysis* (3rd ed.). Kluwer Academic.
3	Ötles, S. (2009). *Handbook of Food Analysis Instruments*. CRC Press.
4	Sun, D. W. (2008). *Modern Techniques for Food Authentication*. Elsevier.

Eternal University, Baru Sahib
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1.	**Course Code: 0140277032**	**Subject Code: FTE 413**	**Course Title: Traditional Indian Dairy Products**		
2.	**Semester: VII**		**Credits: 2 (1+1)**		
3.	**Contact Hours:**	**L: 1**	**P: 2**		
4.	**Relative weightage:**	**MTE: 16**	**ETE: 32**	**Quiz/PA: 16**	**FPE: 16**
5.	**Objectives:**				
I.	To provide knowledge about traditional Indian milk products, their manufacturing processes, mechanization, preservation, and packaging advancements.				
II.	Acquire knowledge about packaging options available for traditional dairy products and methods for their shelf life				
III.	To provide knowledge about traditional Indian milk products, their manufacturing processes, mechanization, preservation, and packaging advancements.				
IV.	Acquire knowledge about the preparation and preservation of misti dahi, kheer, and payasam, along with innovative packaging solutions.				
6.	**Course Outcomes:**				
CO1	Students will understand the classification, composition, and production techniques of khoa and khoa-based sweets.				
CO2	Students will learn the manufacturing processes of chhana and chhana-based sweets, along with mechanization and preservation techniques.				
CO3	Students will gain knowledge about paneer, chakka, shrikhand, and their industrial-scale production and packaging.				
CO4	Students will explore the preparation and preservation of misti dahi, kheer, and payasam, along with innovative packaging solutions.				

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	3	2	2	1	2	2	3	2	2	2	1	2
CO2	3	3	3	2	3	2	3	3	3	3	2	3
CO3	3	3	3	3	2	2	3	3	3	3	2	3
CO4	2	2	2	2	3	3	2	3	3	3	3	3
Avg.	**2.75**	**2.5**	**2.5**	**2**	**2.5**	**2.25**	**2.75**	**2.75**	**2.75**	**2.75**	**2**	**2.75**

1= Weak Correlation 2 = Moderate Correlation 3 = Strong Correlation

7. Details of Course:

Units	**Particulars**	**No. of Lectures**
I	Status and significance of traditional Indian milk products in India. Khoa: Classification of types, standards methods of manufacture and preservation, factors affecting yield of khoa. Mechanization in manufacture of khoa. Khoa based sweets: Burfi, Peda, Milkcake, Kalakhand, Gulabjaman and their compositional profile and manufacture practices	4
II	Rabri and Basundi: Product identification, process description, factors affecting yield, physico-chemical changes during manufacture. Channa: Product description, standards method of manufacture, packaging and preservation. Chhana-based sweets: Rasogolla, Sandesh, Rasomalai. Mechanization of manufacturing process, advances in	4

	preservation and packaging.	
III	Paneer: Product description, standards, method of manufacture, packaging and preservation. Mechanization of Paneer manufacturing/packaging process. Chakka/Maska and Shrikhand: Product description, standards, method of manufacture, small scale and industrial process of production, packaging and preservation aspects.	3
IV	Misti Dahi: Product description method of manufacture and packaging process. Kheer and Payasam: Product description methods of manufacture, innovations in manufacturing and packaging processes. Biopreservative principles in enhancing the self-life of indigenous milk products including active packaging.	4
	Total Lectures:	**15**

8. Practical

Units	**Content of Practical's**	**No. of Practical's**
I	Preparation of Khoa from cow, buffalo and concentrated milk; Preparation of Burfi, Peda, Kalakand, Milkcake and Gulabjamun;	6
II	Preparation of Paneer from cow, buffalo and mixed milk; Preparation of Chhana from cow and buffalo milk and mixed milk	4
III	Preparation of Sandesh and Rasogolla; Preparation of kheer; Preparation of Rabri, Misti Dahi, Chhana and Shrikhand; Visit to industry	5
	Total Practical's:	**15**

9. Suggested Books/Readings:

S. No.	**Authors/ Name of Books/Publishers**
1	Agarwala, S. P. (2006). Equipment for paneer making. In *Lecture Compendium on Developments in Traditional Dairy Products* (pp. 132–137). Short course organized by CAS, December 10–30, 2006.
2	Aneja, R. P., Mathur, B. N., Chandan, R. C., & Banerjee, A. K. (2002). *Technology of Indian Milk Products*. Dairy India Publications.
3	Dharam Pal, & Narender Raju, P. (Eds.). (2006). *Developments in Traditional Dairy Products* (Lecture Compendium of the 21st Short Course). CAS in Dairy Technology, NDRI, Karnal.
4	Pal, D. (1997). Technology of the manufacture of rabri and basundi. In *Advances in Traditional Dairy Products* (Short course, CAS in Dairy Technology). NDRI Deemed University, Karn

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1.	**Course Code: 0140277042**	**Subject Code: FTE 414**	**Course Title: Ice-cream and Frozen Desserts**		
2.	**Semester: VII**		**Credits: 3 (2+1)**		
3.	**Contact Hours:**	**L: 2**	**P: 2**		
4.	**Relative weightage:**	**MTE: 24**	**ETE: 48**	**Quiz/PA: 24**	**FPE: 24**
5.	**Objectives:**				
I.	To provide an in-depth understanding of the ice cream industry, including its composition,				
II.	Aquire knowledge about the physic-chemical properties of ice cream mix and effect of process				
III.	To provide an in-depth understanding of the ice cream industry, including its composition,				
IV.	Aquire knowledge about the packaging, hardening, storage, and defect prevention in ice cream production.				
6.	**Course Outcomes:**				
CO1	Students will understand the history, classification, composition, and role of stabilizers/emulsifiers in ice cream.				
CO2	Students will learn about the technological aspects of ice cream manufacturing, including freezing, refrigeration, and plant hygiene.				
CO3	Students will analyze the effects of processing on the physico-chemical properties of ice cream and methods to control overrun.				
CO4	Students will gain knowledge of packaging, hardening, storage, and defect prevention in ice cream production.				

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	2	2	2	1	1	2	2	2	2	1	1	2
CO2	3	3	3	3	2	2	3	3	3	3	2	3
CO3	3	3	3	3	2	2	3	3	3	2	2	3
CO4	2	2	2	2	3	2	2	2	3	2	2	2
Avg.	**2.5**	**2.5**	**2.5**	**2.25**	**2**	**2**	**2.5**	**2.5**	**2.75**	**2**	**1.75**	**2.5**

1 = Weak Correlation 2 = Moderate Correlation 3 = Strong Correlation

7.	**Details of Course:**	
Units	**Particulars**	**No. of Lectures**
I	History, development and status of ice cream industry, Definition, classification and composition and standards of ice cream and other frozen desserts. Stabilizers and emulsifiers-their classification, properties and role in quality of ice cream,	8
II	Technological aspects of ice cream manufacture, Thermodynamics of freezing and calculation of refrigeration loads, Types of freezers, refrigeration control / instrumentation, Hygiene, cleaning and sanitation of ice cream plant	8
III	Effect of process treatments on the physico-chemical properties of ice-cream mixes and ice cream, Processing and freezing of ice-cream mix and control of over run, Packaging, hardening, storage and shipping of ice-cream, Defects in ice cream, their causes and prevention.	6

IV	Recent advances in ice-cream industry (flavourings, colourings, fat replacers, bulking agents) and plant management, Nutritive value of ice-cream.	8
	Total Lecture:	**30**

8 Practical

Units	Content of Practical's	No. of Practical's
I	Calculation of standardization of ice-cream mixes; Manufacture of plain and fruit flavoured icecream; Manufacture of chocolate, fruit and nut ice cream;	5
II	Preparation of sherbets/ices; Preparation of soft served and filled ice-cream	3
III	Manufacture of kulfi. Study of continuous and batch type freezers; Manufacture of ice-cream by continuous process; Determination of overrun in ice cream	4
IV	Visit to an Ice Cream Plant.	3
	Total Practical's:	**15**

9. Suggested Books/Readings:

S. No.	Authors/ Name of Books/Publishers
1	Arbuckle, W. S. (1991). *Ice Cream*. AVI Publishing Co. Inc.
2	Hall, C. W., & Hedric, T. T. (1975). *Drying of Milk and Milk Products* (p. 338). AVI Publishing Co. Inc.
3	Hui, Y. H. (1993). *Dairy Science and Technology Handbook: Vol. 2. Product Manufacturing*. Wiley-VCH.
4	Ice Cream Alliance & Ice Cream Federation. (1992). *Code of Practice for the Hygienic Manufacture of Ice Cream*.
5	NDRI. (1998). *Advances in Ice Cream and Frozen Desserts* (Lecture compendium, Sixth Short Course, December 15, 1998 – January 4, 1999). NDRI, Karnal.
6	Robinson, R. K. (1986). *Modern Dairy Technology* (Vol. 2). Elsevier Scientific Publishing Co.
7	Robinson, R. K. (2002). *Dairy Microbiology Handbook* (3rd ed.). John Wiley & Sons.
8	Sommer, H. H. (1951). *The Theory and Practice of Ice Cream Making* (6th ed., pp. 5–10). Madison, Wisconsin.

Eternal University, Baru Sahib
Dr. Khem Singh Gill Akal College of Agriculture

1.	**Course Code: 0140277122**	**Subject Code: FEE 412**	**Course Title: Energy Conservation and Management**		
2.	**Semester: VII**		**Credits: 2 (1+1)**		
3.	**Contact Hours:**	**L: 1**	**P: 2**		
4.	**Relative weightage:**	**MTE: 16**	**ETE: 32**	**Quiz/PA: 16**	**FPE: 16**
5.	**Objectives:**				
I.	To equip students with the knowledge and skills required to effectively manage and conserve energy resources within the context of dairy and food processing industries				
II.	To train students or professionals to plan, implement, and monitor energy management programs and audits in accordance with national and international standards				
III.	To encourage the adoption of energy-efficient technologies, practices, and systems to reduce overall energy consumption and operational costs.				
IV.					
6.	**Course Outcomes**:				
CO1	Explain the principles of energy conservation and the importance of energy management in various sectors.				
CO2	Analyse energy consumption patterns and identify opportunities for energy savings in industrial, commercial, and residential applications.				
CO3	Conduct energy audits and apply appropriate tools and techniques for measuring and improving energy efficiency.				
CO4	Evaluate the performance of energy-efficient equipment and systems, and recommend suitable energy conservation measures				

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	2	2	1	3	2	2	2	2	3	2	2
CO2	2	3	2	2	3	2	2	2	2	3	2	2
CO3	3	3	3	2	3	2	3	3	3	3	2	3
CO4	3	2	3	2	3	2	3	2	3	3	2	3
Avg.	**2.5**	**2.5**	**2.5**	**1.75**	**3**	**2**	**2.5**	**2.25**	**2.5**	**3**	**2**	**2.5**

1 = Weak Correlation 2 = Moderate Correlation 3 = Strong Correlation

7. Details of Course:

Units	Particulars	No. of Lectures
I	Introduction: Potential and Importance of industrial energy conservation in dairy and food processing; Energy conservation Act 2001 and its important features, Schemes of Bureau of Energy Efficiency (BEE); Electricity Act 2003, Integrated energy policy; Energy management and audit: Definition, energy audit, need, types of energy audit; Energy audit approach understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel and energy substitution.	4
II	Electrical load management: Demand management, energy management information systems, Energy saving controllers and cost saving techniques; Quality of power, Power	3

	factor and its improvement; Transformers, losses in transformers; Energy savings in transformers; Electric motor-selection and application, Energy efficient motors; Variable Speed Drives and Variable Frequency Drives (VFD) and their role in saving electric energy; Bureau of Energy Efficiency (BEE): Power saving guide with Star Ratings of electrical appliances: Induction Motors, Air conditioners, Refrigerators and Water Heaters.	
III	Industrial Lighting: Quality of light, types of light sources, energy efficiency, Light controls. Energy efficiency and conservation in utilities: High efficiency boilers, improved combustion techniques for energy conservation, Fluidized Bed Combustion and multi fuel capabilities; Energy conservation in steam distribution systems, efficient piping layouts, protective and insulation coverings in utility pipes; Steam conservation opportunities; Upkeep and maintenance of steam auxiliaries and fittings. Energy conservation in Refrigeration and AC systems (HVAC), Cooling towers, Pumps and pumping systems, Fans, Blowers, Air compressors; Maintenance and upkeep of Vacuum lines and Compressed air pipe lines.	4
IV	Energy Savings methods in hot air generator, Thermic fluid heater, Steam radiator. Energy conservation in buildings: Concepts of Green Buildings; Waste-heat recovery and thermal energy storage in food processing facilities; Condensate recovery and reuse; Application of recuperator to recover energy from flue gases from boiler, DG exhaust, hot air from spray dryer, FBD etc; Diesel generating sets (stand by AC Gen sets): Energy saving opportunities in DG sets.	4
	Total Lectures:	**15**

9. Practical

S. No.	Content of Practical's	No. of Practical's
1	Study of Energy Conservation Act 2001; Study of schemes of BEE.	3
2	Study of concepts of Energy Balance in Unit Operations and System. boundaries; Solving examples on energy balances.	4
3	Solving problems on electrical energy use and management: Connected load, Maximum demand, Demand factor and Load curve.	4
4	Drawing Energy Balance on a boiler: Collection of data, Analysis of results and determination of efficiency; Exercise on energy audit of a Dairy plant.	4
	Total Practical's	**15**

10 Suggested Readings

S. No.	Authors/ Name of Books/Publishers
1	Ahmad, T. (2012). *Dairy Plant Engineering and Management*. Kitab Mahal.
2	Klemeš, J., Smith, R., & Kim, J.-K. (2008). *Handbook of Water and Energy Management in Food Processing*. Woodhead Publishing.
3	Wang, L. (2008). *Energy Efficiency and Management in Food Processing Facilities* (1st ed.). CRC Press.
4	O'Callaghan, P. (1993). *Energy Management*. McGraw-Hill Book Company Europe.

Eternal University, Baru Sahib
Dr. Khem Singh Gill Akal College of Agriculture

1.	**Course Code: 0140277112**	**Subject Code: FEE 413**	**Course Title: Applications of Renewable Energy in Food Processing**		
2.	**Semester: VII**		**Credits: 2 (1+1)**		
3.	**Contact Hours:**	**L: 1**	**P: 2**		
4.	**Relative weightage:**	**MTE: 16**	**ETE: 32**	**Quiz/PA: 16**	**FPE: 16**
5.	**Objectives:**				
I.	To introduce various renewable energy sources and their applications in the food industry.				
II.	To familiarize students with solar energy technologies and their role in food processing.				
III.	To explore biomass energy, including briquetting, combustion, and gasification processes.				
IV.	To study biogas production, its applications, and the utilization of food waste for biogas generation.				
6.	**Course Outcomes:**				
CO1	Students will understand different renewable energy sources and their significance in food processing.				
CO2	Students will gain knowledge of solar energy systems, including photovoltaic and thermal applications.				
CO3	Students will learn biomass conversion techniques and their applications in food industries.				
CO4	Students will be able to design and implement biogas systems for sustainable energy production				

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	2	2	1	3	2	2	2	2	3	1	2
CO2	3	2	2	2	3	2	2	2	2	3	2	2
CO3	3	2	3	2	3	2	3	2	3	3	2	3
CO4	3	2	3	2	3	2	3	3	3	3	2	3
Avg.	**2.75**	**2**	**2.5**	**1.75**	**3**	**2**	**2.5**	**2.25**	**2.5**	**3**	**1.75**	**2.5**

1 = Weak Correlation 2 = Moderate Correlation 3 = Strong Correlation

7. Details of Course:

Units	Particulars	No. of Lectures
I	Introduction to energy sources; classification of renewable energy sources, utilization of these sources in food processing sector; Solar radiation, measurement of solar radiation, types of solar collectors and their uses; familiarization with solar energy gadgets: solar cooker, solar concentrator, solar dryer, solar steam generator; utilization of solar thermal energy in food processing;	4
II	Solar photovoltaic cells, modules, arrays, conversion process of solar energy into electricity, applications in food industry; Biomass and its characterization; briquetting of biomass.	4
III	Biomass combustion, pyrolysis, gasification and uses of gasifiers in food industry and biodiesel preparation; Importance of biogas technology, production mechanism, types of biogas plants, uses of biogas, handling and utilization of digested slurry. Use of food	4

	waste for biogas generation and its applications;	
IV	Brief introduction to wind energy, hydroelectric energy, ocean energy.	3
	Total Lectures:	**15**

8 Practical

Units	Content of Practical's	No. of Practical's
I	Study of solar radiation measuring instruments; Study of solar cooker; Study of solar water heater; Study of solar dryer; Study of solar PV system;	**3**
II	Estimation of calorific value of biomass. Estimation of moisture content of biomass; Estimation of ash content of biomass; Estimation of fixed carbon and volatile matter of biomass;	**6**
III	Study of briquetting machine; Demonstration of up draft gasifier; Demonstration of down draft gasifier; Demonstration of working of a fixed dome type biogas plants;	**3**
IV	Demonstration of a floating drum type biogas plants; Demonstration of biodiesel preparation; Demonstration of wind measuring instruments	**3**
	Total Practical's:	**15**

9. Suggested Books/Readings:

S. No.	Authors/ Name of Books/Publishers
I.	Khandelwal, K. C., & Mahdi, S. S. (1990). *Biogas Technology: A Practical Handbook*.
II.	Rai, G. D. (2013). *Non-Conventional Energy Sources*. Khanna Publishers.
III.	Rai, G. D. (n.d.). *Solar Energy Utilization*. Khanna Publishers.
IV.	Rathore, N. S., Kurchania, A. K., & Panwar, N. L. (2007). *Non-Conventional Energy Sources*. Himanshu Publications.
V.	Rathore, N. S., Kurchania, A. K., & Panwar, N. L. (2007). *Renewable Energy: Theory and Practice*. Himanshu Publications.
VI.	Tiwari, G. N., & Ghoshal, M. K. (2005). *Renewable Energy Resources: Basic Principles and Applications*. Narosa Publishing House.

Eternal University, Baru Sahib
Dr. Khem Singh Gill Akal College of Agriculture

1.	**Course Code: 0140277062**	**Subject Code: FTE 416**	**Course Title: Food Plant Design and Layout**		
2.	**Semester: VII**		**Credits: 3(2+1)**		
3.	**Contact Hours:**	**L: 1**	**P:2**		
4.	**Relative weightage:**	**MTE:24**	**ETE: 48**	**Quiz/PA:24**	**FPE: 24**
5.	**Objectives:**				
I.	To understand the principles of food plant design, including the classification of food processing plants and the various considerations (technical, economic, legal, safety, and hygiene) involved in plant design, along with the steps and methodologies involved in conducting a feasibility study.				
II.	To understand the factors influencing plant location and size, as well as the principles of product and process design, including economic considerations, process planning, and the use of flow sheeting and process flow charts for effective plant design.				
III.	To understand the types, planning, and development of efficient plant layouts, including the use of symbols, space standards, and computer-aided tools for layout design and evaluation.				
IV.	To understand the planning and design requirements of service facilities, plant surroundings, and worker safety, including utilities, hygiene, safety standards, and the selection of appropriate building materials and construction practices.				
6.	**Course Outcomes:**				
CO1	Students will be able to classify food processing plants, identify design challenges, and apply the principles of plant design to address technical, economic, legal, and safety considerations. They will also be able to conduct a feasibility study by gathering and analyzing market and technical data, and prepare a comprehensive feasibility report.				
CO2	Students will be able to evaluate plant location options using location theory models, determine optimal plant size through economic analysis and breakeven calculations, and design products and processes by selecting raw materials and processes that align with technical, economic, and social factors.				
CO3	Students will be able to plan and develop effective plant layouts by evaluating alternatives, applying layout standards and symbols, and using computer-aided methods to optimize space, workflow, and distances between critical plant areas and facilities.				
CO4	Students will be able to plan and design service facilities (like steam, refrigeration, drainage, and CIP systems), support infrastructure (offices, canteens, maintenance areas), and ensure compliance with safety and hygiene standards, while selecting suitable building materials and designing for health, safety, and efficient operation in food processing environments.				

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	3	3	3	2	3	3	3	2	3	3	2	3
CO2	3	3	3	2	3	3	3	3	3	3	2	3
CO3	3	2	3	3	2	2	2	3	3	3	2	3
CO4	3	2	3	2	3	2	2	2	3	3	2	3
Avg.	**3**	**2.5**	**3**	**2.25**	**2.75**	**2.5**	**2.5**	**2.5**	**3**	**3**	**2**	**3**

1 = Weak Correlation 2 = Moderate Correlation 3 = Strong Correlation

7. Details of Course:

S. No.	**Particulars**	**No. of Lectures**
1.	Introduction Classification of food processing plants, food plant design concepts, situations giving rise to plant design problems and general design considerations (technical, economic, legal, safety and hygiene). Feasibility	5

	Study Steps involved in feasibility study, collection of the information, information flow diagrams, market analysis, technical analysis and preparation of feasibility report.	
2.	Plant Location Factors affecting plant location, their interaction with plant location, location theory models for evaluation of alternate locations. Plant Size Economic plant size, factors affecting the plant size (technical and economical), raw material availability, market demand, and competition in the market, return on investment etc. Procedures for estimation of economic plant size (breakeven analysis and optimization), estimation of volume of production for each product. Product and Process Design; Design of product, product specifications, least cost mix of raw materials, process design, process selection considering technical, economic and social aspects. Process planning and scheduling, flow sheeting, flow diagrams and process flow charts including their design and computer aided development of flow charts.	8
3.	Plant Layout Types of layouts, considerations involved in planning an efficient layout, preparation and development of layout, evaluation of alternate layouts, use of computers in development and evaluation of layouts, equipment symbols, flow sheet symbols, electric symbols, graphic symbols for piping systems, standards for space requirement and dimensions, distances between critical plant areas and for different plant facilities.	8
4.	Planning and Design of Service Facilities and Plant Surroundings Requirements of the steam, refrigeration, water, electricity, waste disposal, lighting, ventilation, drainage, CIP system, dust removal, fire protection etc. Design and installation of piping system, codes for building, electricity, boiler room, plumbing and pipe colouring. Planning of offices, laboratories, lockers and toilet facilities, canteen, parking lots and roads, loading docks, garage, repair and maintenance shop, ware houses etc. Workers Safety and Health Aspects Falling hazards and safeguards, electric hazards, heat exposure, dust protection, noise control, protection against chemicals, fire safety, fumes, moist conditions, personnel hygiene, sanitary requirements and standards, insect, rodent and bird control. Building and Building Materials Requirements in respect of building type, wall, ceiling andfloor construction, building height and building materials.	9
	Total Lectures	**30**

8. Practical

S. No.	Contents of Practical's	No. of Practical's
1.	Prepare a feasibility report; prepare a plant location report, study design and layout of milk processing plant. To study design and layout of fruit processing plant.	**3**
2.	To study design and layout of beverage plant. To study design and layout of bakery and confectionery plant.	**3**
3.	To study design and layout of grain processing plant.	**3**
4.	To study design and layout of cold storage and warehouse.	**3**
5.	To study design and layout of meat and meat products plant.	**3**
	Total Practical's	**15**

10. Suggested Books/Readings:

S.No.	Authors/ Book Name/ Publishers
1.	Backhurst, J. R., & Barker, J. H. (1968). *Process Plant Design*. Heimann Educational Books, London.
2.	Clifton, D. S., & Fyffe, D. E. (1977). *Project Feasibility Analysis*. John Wiley and Sons, New

	York.
	Leesley, M. E. (1982). *Computer Aided Process Plant Design*. Gulf Publishing Company, Houston.
4.	Maroulis, Z. B., & Saravacos, G. D. (2003). *Food Plant Economics*. CRC Press.
5.	Moore, J. M. (1962). *Plant Layout and Design*. The Macmillan Company.
6.	Morris, W. T. (1978). *Engineering Economic Analysis*. Reston Publishing Company, Inc., New York.
7.	Perry, R. H., & Green, D. W. (2008). *Perry's Chemical Engineers' Handbook* (8th ed.). McGraw-Hill.
8.	Peters, M. S., & Timmerhaus, K. D. (1991). *Plant Design and Economics for Chemical Engineers* (4th ed.). McGraw-Hill.
9.	Rosenau, M. D. (1981). *Project Management for Engineers*. Van Nostrand Reinhold Co., New York.
10.	Villbrandt, F. C., & Dryden, C. E. (1959). *Chemical Engineering Plant Design*. McGraw-Hill.

Eternal University, Baru Sahib
Dr. Khem Singh Gill Akal College of Agriculture

1.	**Course Code: 0140277072**	**Subject Code: FTE 417**	**Course Title: Waste and By-Products Utilization**		
2.	**Semester: VII**		**Credits: 3 (2+1)**		
3.	**Contact Hours:**	**L: 1**	**P: 2**		
4.	**Relative weightage:**	**MTE: 24**	**ETE: 48**	**Quiz/PA: 24**	**FPE: 24**
5.	**Objectives:**				
I.	Understand the nature of agricultural wastes and their impact on the environment				
II.	Conceptualize physical, chemical and biological basis of agricultural waste treatment				
III.	Analyze and design systems for the collection, handling, treatment and utilization of wastes				
IV.	Understand the waste treatment processes				
6.	**Course Outcomes**:				
CO1	Understand the types, sources, and characteristics of waste and by-products generated in various industries, especially in the food and agricultural sectors.				
CO2	Analyze the environmental and economic impacts of waste disposal and the importance of sustainable waste management.				
CO3	Identify and evaluate appropriate technologies and methods for the conversion of waste and by-products into value-added products.				
CO4	Apply principles of waste minimization, recycling, and resource recovery in real-world industrial processes.				

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	2	2	2	1	3	2	2	2	2	3	1	2
CO2	2	3	2	1	3	3	2	2	2	3	2	2
CO3	3	2	3	2	3	2	3	3	3	3	2	3
CO4	3	2	3	2	3	3	3	3	3	3	2	3
Avg.	**2.5**	**2.25**	**2.5**	**1.5**	**3**	**2.5**	**2.5**	**2.5**	**2.5**	**3**	**1.75**	**2.5**

1 = Weak Correlation 2 = Moderate Correlation 3 = Strong Correlation

7. Details of Course:

Units	**Particulars**	**No. of Lectures**
I	Types and formation of by-products and waste; Magnitude of waste generation in different food processing industries; Uses of different agricultural by-products from food industry, rice mill, sugarcane industry, oil mill etc.	5
II	Concept, scope and maintenance of waste management and effluent treatment; Waste parameters and their importance in waste management- temperature, pH, Oxygen demands (BOD, COD), fat, oil and grease content, metal content, forms of phosphorous and sulphur in waste waters, microbiology of waste, other ingredients like insecticide, pesticides and fungicides residues.	7
III	Waste utilization in various industries, furnaces and boilers run on agricultural wastes and by products, briquetting of biomass as fuel, production of charcoal briquette, generation of electricity using surplus biomass, producer gas generation and utilization; biofuels and ethanol, packaging material through recycling.	6

IV	Waste treatment and disposal: Design, construction, operation and management of institutional community and family size biogas plants, vermi-composting. Pre-treatment of waste: sedimentation, coagulation, flocculation and floatation; Secondary treatments: biological and chemical oxygen demand for different food plant waste– trickling filters, oxidation ditches, activated sludge process, rotating biological contractors,	6
V	Lagoons; Tertiary treatments: advanced waste water treatment process- sand, coal and activated carbon filters, phosphorous, sulphur, nitrogen and heavy metals removal. Assessment, treatment and disposal of solid waste; Effluent treatment plants; Environmental performance of food industry to comply with ISO-14001 standards.	6
	Total Lectures:	**30**

8. Practical

S. No.	**Practical**	**No. of Practicals**
1	Determination of temperature, pH, turbidity solids content, BOD and COD of waste water.	**3**
2	Determination of ash content of agricultural wastes and determination of un-burnt carbon in ash.	**4**
3	Study about briquetting of agricultural residues. Estimation of excess air for better combustion of briquettes.	**4**
4	Study of extraction of oil from rice bran. Study on bioconversion of agricultural wastes.	**4**
	Total	**15**

9. Suggested Readings

S.No.	**Authors/ Book Name/ Publishers**
1.	Bhatia, S. C. (2001). *Environmental Pollution and Control in Chemical Process Industries*. Khanna Publishers.
2.	Garg, S. K. (1998). *Environmental Engineering (Vol. II): Sewage Disposal and Air Pollution Engineering*. Khanna Publishers.
	Joshi, V. K., & Sharma, S. K. (2011). *Food Processing Waste Management: Treatment and Utilization Technology*. New India Publishing Agency.
4.	Markel, I. A. (1981). *Managing Livestock Waste*. AVI Publishing Co.

Skill Enhancement Courses (SECs): Detailed Syllabi

Discipline/ Department	Course Code	Subject Code	Course Title	Credit hours
Food Technology	0140215011	SEC 111	Introduction to Drying Technology and Dryers	2 (0+2)
	0140215021	SEC 112	Introduction to Processing of Extruded Foods	2 (0+2)
	0140215031	SEC 113	Introduction to Milling (Rice, Dal, Spices, etc.)	2 (0+2)
Food Quality	0140215041	SEC 114	Introduction to Food Safety and Sanitation	2 (0+2)
	0140215051	SEC 115	Introduction to Good Laboratory Practices	2 (0+2)
	0140215061	SEC 116	Basic Food Analysis Laboratory Techniques	2 (0+2)
Food Engineering	0140215071	SEC 117	Introduction to Electrical and Control Systems in Food Industry	2 (0+2)
	0140215081	SEC 118	Introduction to Mechanical Systems in Food Industry	2 (0+2)
	0140215091	SEC 119	Introduction to AutoCAD	2 (0+2)
Food Plant Operations	0140225011	SEC 121	Maintenance of Food Processing Equipment	2 (0+2)
	0140225021	SEC 122	Introduction to Bottling and Canning Line	2 (0+2)
	0140225031	SEC 123	Introduction to Manufacturing of Bakery Products	2 (0+2)

Eternal University, Baru Sahib
Dr. Khem Singh Gill Akal College of Agriculture

1.	**Course Code: 0140215011**	**Subject Code: SEC 111**	**Course Title: Introduction to Drying Technology and Dryers**	
2.	**Semester: I**		**Credits: 2(0+2)**	
3.	**Contact Hours:**	**P: 4**		
4.	**Relative weightage:**	**MTE: 24**	**Quiz/PA: 16**	**FPE: 40**
5.	**Objectives:**			
I.	To understand the fundamentals of the drying process, mechanisms, moisture estimation techniques, and drying kinetics.			
II.	To study the principles and operational mechanisms of various drying methods, including cabinet, tunnel, spray, drum, fluidized bed, foam-mat, microwave, vacuum, solar, and refractance window drying.			
III.	To develop practical skills in food drying techniques and evaluate the rehydration and quality characteristics of dried products.			
IV.	To gain awareness of packaging, labeling, and FSSAI regulations, and apply knowledge through industrial visits and case studies on fruits and vegetable drying.			
6.	**Course Outcomes:**			
CO1	Students will understand the principles and mechanisms of various drying methods and technologies used in food dehydration.			
CO2	Students will demonstrate practical skills in operating drying equipment such as cabinet dryers, spray dryers, roller dryers, and freeze dryers.			
CO3	Analyze the drying characteristics, moisture kinetics, sorption isotherms, and rehydration properties of dehydrated foods			
CO4	Apply knowledge of product development, packaging, labelling, and regulatory standards (FSSAI) for dehydrated food products.			

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	3	2	2	1	1	1	1	3	2	2	1	1
CO2	3	3	2	1	2	1	1	2	2	2	2	1
CO3	2	2	3	2	2	1	1	3	3	3	2	1
CO4	2	3	3	2	2	1	2	3	2	3	2	2
Average	2.5	2.5	2.5	1.5	1.8	1	1.25	2.75	2.25	2.5	1.75	1.25

7.	**Practical**	
Units	**Particulars**	**No. of Practical's**
I	Introduction to drying process and its mechanism. Understanding different methods for moisture estimation. Determination of moisture content with oven method. Determination of drying characteristics and study of kinetics. Prediction of moisture sorption isotherms. Determination of equilibrium moisture content of grain	**6**
II	Introduction to different dryings theories and its importance. Introduction to different methods of drying (Contact, Convective and Radiation). Principle and Operational mechanism involved in Cabinet and Tunnel Drying.	**6**

	Principle and Operational mechanism involved in Spray Drying. Principle and Operational mechanism involved in Roller/ Drum Drying	
III	Principle and Operational mechanism involved in solar drying. Principle and Operational mechanism involved in fluidized bed drying. Principle and Operational mechanism involved in foam-mat drying. Principle and Operational mechanism involved in microwave drying. Principle and Operational mechanism involved in vacuum oven drying. Principle and Operational mechanism involved in refractance window drying of foods. Principle and Operational mechanism involved in spray drying.	**6**
IV	Study of pretreatment methods for drying and dehydration. Study of operational principle and working of freeze dryer. Study of Rehydration/ Reconstitution properties of dehydrated foods. Drying of fruit slices in cabinet drier. Drying of green leafy vegetables. Drying of mango/ other pulp by foam-mat drying. Drying of foods using roller dryer and Spray dryer	**6**
V	Drying of foods using freeze drying process. Study of-pre and post drying treatment. Case hardening and product and dryers' characteristics affecting drying. Study of packaging, labelling and FSSAI Regulations of Dehydrated products. Industrial Visit(s) to different dehydration Units Case study on fruits and vegetable drying.	**6**
	Total Practical's:	**30**

8 Suggested Books/Readings:

S. No.	Authors/ Name of Books/Publishers
1.	Bhandari, B. (2015). *Handbook of Industrial Drying* (4th ed., Edited by A. S. Mujumdar). CRC Press.
2.	Brennan, J. G., & Grandison, A. S. (Eds.). (2012). *Food Processing Handbook* (2nd ed.). Wiley-VCH.
3.	Heldman, D. R., Lund, D. B., & Sabliov, C. (Eds.). (2018). *Handbook of Food Engineering* (3rd ed.). CRC Press.
4.	Soltanbehnam, S., & Jayas, D. S. (2020). Drying of Foodstuffs. In A. S. Mujumdar (Ed.), *Handbook of Industrial Drying* (4th ed., pp. 589–625). CRC Press.
5.	Van't Land, C. M. (2011). *Drying in the Process Industry*. John Wiley & Sons.

Eternal University, Baru Sahib
Dr. Khem Singh Gill Akal College of Agriculture

1.	**Course Code: 0140215021**	**Subject Code: SEC 112**	**Course Title: Introduction to Processing of Extruded Foods**	
2.	**Semester: I**		**Credits: 2(0+2)**	
3.	**Contact Hours:**	**P: 4**		
4.	**Relative weightage:**	**MTE: 24**	**Quiz/PA: 16**	**FPE: 40**
5.	**Objectives:**			
I.	To understand the principles, components, and operational mechanisms of food extruders including single and twin-screw systems.			
II.	To develop hands-on skills in the preparation and quality evaluation of various extruded products such as pasta, snacks, cereals, and plant-based meat analogues			
III.	To assess the functional, physical, textural, and sensory properties of extruded food products, and study the influence of feed variables like moisture content			
IV.	To gain knowledge on packaging, labelling, FSSAI regulations, and techno-economic feasibility of commercial extruded food products.			
6.	**Course Outcomes:**			
CO1	Students will understand the working principles and components of different types of food extruders and their role in food processing.			
CO2	Students will demonstrate practical skills in preparing a variety of extruded products such as pasta, snacks, and plant-based analogues.			
CO3	Evaluate the physical, functional, and sensory properties of extruded food products and analyze their quality			
CO4	Understand the basic knowledge of packaging, labelling, FSSAI regulations, and assess the techno-economic feasibility of extruded food products.			

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	3	1	1	1	1	1	3	1	1	1	1	1
CO2	2	2	2	2	1	1	2	2	3	2	2	1
CO3	2	2	2	1	1	1	2	1	2	1	1	1
CO4	2	2	3	3	2	2	2	3	3	2	2	2
Average	2.25	1.75	2.0	1.75	1.25	1.25	2.25	1.75	2.25	1.5	1.5	1.25

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

7. Practical

Units	**Particulars**	**No. of Practical's**
I	Introduction and market survey of extruded products. Introduction of food extruders components and their functions. Principle and operational mechanism involved in cold and hot extruder (Single and Twin-Screw Extruder). Preparation of spaghetti pasta. Preparation of penne pasta. Preparation of noodles. Preparation of vermicelli. Preparation of instant noodles.	**6**
II	Quality evaluation of pasta products. Demonstration of extrusion products (extruded snacks/ breakfast cereal/ texturized vegetable protein).Preparation of traditional extruded products (sev/ chakli).Evaluation of physical	**6**

	properties of expanded snacks. Evaluation of water and milk hydration properties of breakfast cereals.	
III	Evaluation of functional properties of expanded snacks. Evaluation of functional properties of texturized vegetable protein. Preparation of plant-based meat analogue by using extruder. Preparation of cereal, pulses based ready-to-eat snack food by extrusion cooking. Preparation of extruded confectionary products.	**6**
IV	Effect of feed moisture content on extrudate food product characteristic. Studies on development of weaning food by extrusion technology. Texture profile analysis of extruded product. Preparation of dietary fiber rich extruded product. Quality evaluation of commercially available extruded food products. Packaging of Extruded products. .	**6**
V	Quality evaluation of different extruded products. Determination of techno-economic feasibility of prepared extruded product. Sensory evaluation of prepared extruded products. Labelling and FSSAI. Regulations of different extruded products. Visit to Commercial Extrusion Unit	**6**
	Total Practical's:	**30**

8 Suggested Books/Readings:

S. No.	Authors/ Name of Books/Publishers
1.	Bouvier, J. M., & Campanella, O. H. (2014). *Extrusion Processing Technology: Food and Non-Food Biomaterials*. John Wiley & Sons.
2.	Clark, S., Jung, S., & Lamsal, B. (Eds.). (2014). *Food Processing: Principles and Applications* (2nd ed.). John Wiley & Sons.
3.	Ek, P., & Ganjyal, G. M. (2020). Basics of Extrusion Processing. In G. M. Ganjyal (Ed.), *Extrusion Cooking* (pp. 1–28). Woodhead Publishing.
4.	Maskan, M., & Altan, A. (Eds.). (2012). *Advances in Food Extrusion Technology*. CRC Press.
5.	Moscicki, L. (Ed.). (2011). *Extrusion-Cooking Techniques: Applications, Theory and Sustainability*. John Wiley & Sons.

Eternal University, Baru Sahib
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1.	**Course Code: 0140215031**	**Subject Code: SEC 113**	**Course Title: Introduction to Milling (Rice, Dal, Spices, etc.)**		
2.	**Semester: I**		**Credits: 2(0+2)**		
3.	**Contact Hours:**	**P: 4**			
4.	**Relative weightage:**	**MTE: 24**	**Quiz/PA: 16**	**FPE: 40**	
5.	**Objectives:**				
I.	To introduce students to the principles and methods of milling rice, dal, and spices, including cleaning, dehusking, and polishing technique.				
II.	To familiarize students with the physical and quality characteristics of milled products and the operation of associated milling equipment				
III.	To develop practical skills in spice powder preparation, formulation, and packaging, with an emphasis on yield and quality analysis.				
IV.	To provide insights into industrial practices, by-product utilization, and regulatory requirements through case studies and industrial visits.				
6.	**Course Outcomes:**				
CO1	Students will understand the traditional and modern milling techniques used for rice, dal, and spices, including the principles and operational mechanisms of related equipment.				
CO2	Students will analyse the physical and quality parameters of milled products such as moisture content, yield, defects, and particle size distribution				
CO3	Demonstrate skills in processing, cleaning, grading, and packaging of rice, pulses, and spices, and apply techniques for spice mix formulation				
CO4	Evaluate the techno-economic feasibility, by-product utilization, and regulatory compliance (labelling and FSSAI standards) of milled and spice products through practical exposure and case studies				

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	3	2	2	1	2	2	3	2	2	2	1	2
CO2	3	3	3	2	3	2	3	3	3	3	2	3
CO3	3	3	3	3	2	2	3	3	3	3	2	3
CO4	2	2	2	2	3	3	2	3	3	3	3	3
Avg.	**2.75**	**2.5**	**2.5**	**2**	**2.5**	**2.25**	**2.75**	**2.75**	**2.75**	**2.75**	**2**	**2.75**

1= Weak Correlation 2 = Moderate Correlation 3 = Strong Correlation

7. Practical

Units	**Particulars**	**No. of Practical**
I	Introduction and market survey of milled rice, dal and spices. Determination of Physical Properties of rice grain, dal and spices. To study the defects in grains and milled rice, dal and spices by physical observation. Determination of moisture content in different milled product. Studies on traditional methods of milling of dal and rice grains.	**6**
II	Cleaning of rice, dal and spices for milling. Studies on different dehusking and deshelling equipment's involved in the milling of paddy grains. Principles and Operational mechanism of rice mills. Determination of Head Rice Yield (HRY),	**6**

	Milled Rice Yield (MRY) and % Brokens. Determination of polishing quality of paddy.	
III	Production process of rice from paddy. Studies on different by-products of paddy milling. Studies on different methods and pretreatments involved in pulse milling. Studies on Dry milling and Wet milling of pulses for production of dal. Principles and Operational mechanism of Dal Mills. Cleaning and inspection for effective grading and sieving of grains based on size and grade.	**6**
IV	Manufacture of Dalia from cereals and legumes. Study on Mini Dal Mill. Studies on utilization of by-products from dal milling industry. Demonstration of the procedure of cleaning of unprocessed whole spices. Principles and Operational mechanism of Spice Mills. Preparation of turmeric powder. Preparation of curry powder. Recipe formulation and preparation of different spice mix powders (Turmeric, Chilli, Onion, Ginger, etc.).	**6**
V	Milling yield calculation for different grains. Packaging and storage techniques for milled products. Techno-economic feasibility of prepared spice powder and milled dal. Case study on spice powder processing industries. To study milling quality of rice, dal and spices. Study of packaging, labelling and FSSAI Regulations of Dehydrated products. Visit to Commercial Rice mill, Dal mill and Spice industry.	**6**
	Total Practical's:	**30**

8 Suggested Books/Readings:

S. No.	Authors/ Name of Books/Publishers
1.	Bhattacharya, K. R. (2011). *Rice Quality: A Guide to Rice Properties and Analysis*. Woodhead Publishing.
2.	Chakraverty, A., Singh, R. P., & Mujumdar, A. S. (2003). *Handbook of Postharvest Technology: Cereals, Fruits, Vegetables, Tea, and Spices*. Marcel Dekker.
3.	National Bank for Agriculture and Rural Development (NABARD). (2020). *Techno-Economic Feasibility of Mini Rice and Dal Mills*. NABARD.
4.	NIIR Board of Consultants & Engineers. (2005). *Handbook on Drying, Milling & Production of Cereal Foods: Wheat, Rice, Corn, Oat, Barley, Sorghum*. National Institute of Industrial Research.
5.	Srivastava, M. M. (2015). *Handbook of Pulse Processing Technologies*. NIPA.

Eternal University, Baru Sahib
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1.	**Course Code: 0140215041**	**Subject Code: SEC 114**	**Course Title: Introduction to Food Safety and Sanitation**	
2.	**Semester: I**		**Credits: 2(0+2)**	
3.	**Contact Hours:**	**P: 4**		
4.	**Relative weightage:**	**MTE: 24**	**Quiz/PA: 16**	**FPE: 40**
5.	**Objectives:**			
I.	To impart foundational knowledge of food safety, sanitation concepts, and hazard identification in food establishments.			
II.	To enable students to develop process flow diagrams and perform hazard analysis using techniques like FMEA (Failure Modes and Effects Analysis)			
III.	To familiarize students with Good Hygiene Practices (GHP), Good Manufacturing Practices (GMP), and HACCP implementation.			
IV.	To develop practical skills in sanitation procedures, allergen identification, pest control, and waste management in food environments			
6.	**Course Outcomes:**			
CO1	Students will understand and apply key concepts of food safety, sanitation, and hazard identification in food establishments.			
CO2	Develop and implement HACCP plans, including monitoring, corrective actions, and operational prerequisite programs.			
CO3	Demonstrate proper hygiene practices, use of sanitizers, temperature control, and allergen management.			
CO4	Assess and apply appropriate methods for waste disposal, pest control, and compliance with food safety regulations.			

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	2	2	2	1	1	2	2	2	2	1	1	2
CO2	3	3	3	3	2	2	3	3	3	3	2	3
CO3	3	3	3	3	2	2	3	3	3	2	2	3
CO4	2	2	2	2	3	2	2	2	3	2	2	2
Avg.	**2.5**	**2.5**	**2.5**	**2.25**	**2**	**2**	**2.5**	**2.5**	**2.75**	**2**	**1.75**	**2.5**

1 = Weak Correlation 2 = Moderate Correlation 3 = Strong Correlation

7. Practical

Units	**Particulars**	**No. of Practical's**
I	Understanding Food Safety and Sanitation: Concept, Terms and Importance. Developing the process flow for the food establishment including all the inputs, outputs and interim loops. Data collection for identification of biological, chemical and physical hazards. Hazard Analysis using FMEA Technique for Risk Assessment. Demonstration of Correct method of washing hands. Assessment of personal hygiene.	**6**
II	Identifying the Key Focus Areas for GHP and GMP. Identifying Gaps in its Implementation; Closure Plans for Identified Gaps. Importance of temperature control and demonstrating proper cooking, cooling and reheating temperatures	**6**

	using thermometers.	
III	Introduction to HACCP. Development of OPRP (Operational Pre-requisite Programme) and Development of HACCP Plan (Critical Limits including Rationale for Limits). Monitoring Procedure, Correction and Corrective Measures.	**6**
IV	Introduction to Cleaning agents and Techniques for Sanitizing surfaces. Hands-on Demonstration of using Chemical Sanitizers correctly. To recognize signs of pest infestations and methods of control.	**6**
V	Demonstration of segregation of waste. To study proper disposal methods for different types of waste. Practice identifying common food allergens and labelling. Pest control management. ISO Certification.	**6**
	Total Practicals:	**30**

8 Suggested Books/Readings:

S. No.	Authors/ Name of Books/Publishers
1.	Gregoire, M. B. (2016). *Food Safety and Sanitation for Foodservice*. Pearson.
2.	Marriott, N. G., Schilling, M. W., & Gravani, R. B. (2018). *Principles of Food Sanitation* (6th ed.). Springer.
3.	Mcswane, D., Linton, R., & Rue, N. R. (2014). *Food Safety Fundamentals: Essentials of Food Safety and Sanitation*. Pearson.
4.	Mortimore, S., & Wallace, C. (2013). *HACCP: A Practical Approach* (3rd ed.). Springer.
5.	Motarjemi, Y., & Lelieveld, H. (Eds.). (2014). *Food Safety Management: A Practical Guide for the Food Industry*. Academic Press.

Eternal University, Baru Sahib
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1.	**Course Code: 0140215051**	**Subject Code: SEC 115**	**Course Title: Introduction to Good Laboratory Practice**	
2.	**Semester: I**		**Credits: 2(0+2)**	
3.	**Contact Hours:**	**P: 4**		
4.	**Relative weightage:**	**MTE: 24**	**Quiz/PA: 16**	**FPE: 40**
5.	**Objectives:**			
I.	To understand the principles and importance of Good Laboratory Practices (GLP) in ensuring safety, accuracy, and reliability in scientific work.			
II.	To gain hands-on experience with laboratory instruments and equipment, including their proper use, calibration, and maintenance.			
III.	To develop skills in aseptic techniques, sample handling, and documentation, ensuring the integrity and traceability of experimental data.			
IV.	To learn and apply proper waste disposal, sterilization, and chemical safety practices to maintain a clean and contamination-free laboratory environment.			
6.	**Course Outcomes:**			
CO1	Students will demonstrate knowledge of Good Laboratory Practices (GLP) and effectively apply safety measures, including use of personal protective equipment and hazard identification.			
CO2	Operate, calibrate, and maintain common laboratory instruments such as pH meters, balances, spectrophotometers, and autoclaves with accuracy and precision.			
CO3	Follow aseptic techniques and standard operating procedures (SOPs) for microbial handling, sample collection, and basic laboratory experiments.			
CO4	Apply proper waste management, labelling, and documentation protocols to ensure safe, ethical, and traceable laboratory practices.			

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	3	2	2	2	2	1	3	2	2	2	2	2
CO2	3	3	2	2	3	1	3	2	2	2	1	2
CO3	3	3	3	2	2	1	3	3	3	2	1	2
CO4	2	2	3	3	2	1	2	3	2	2	2	2
Average	2.75	2.5	2.5	2.25	2.25	1	2.75	2.5	2.25	2	1.5	2

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

7. Practical

Units	**Particulars**	**No. of Lectures**
I	Introduction and Importance of Good Laboratory Practices. Practical session on identifying hazards and using appropriate Personal Protective Equipment. Hands-on practice with common lab equipment (e.g., microscopes, pipettes, balances, centrifuges etc.).	**6**
II	Equipment calibration techniques and How to properly maintain instruments. Techniques for cleaning, drying and sterilizing lab glassware to prevent contamination. Autoclave operation for Sterilization, Calibration of balances, pH meters and Spectrophotometers.	**6**

III	Sample collection techniques for biological, chemical, or environmental samples. Correct labelling and storage procedures to maintain integrity. Proper segregation and disposal of hazardous and non-hazardous lab waste. Understanding chemical compatibility and safe disposal practices.	**6**
IV	Performing basic quality control tests like titration, pH measurement and UV-Vis Spectrophotometry to assess the purity and quality of samples. Aseptic techniques for handling microbial cultures, preparing agar plates and transferring cultures.	**6**
V	Detecting, recording and reporting errors or deviations in experimental work. Writing and following SOPs for basic lab techniques like, solution preparation or instrument usage.	**6**
	Total Practicals:	**30**

8 Suggested Books/Readings:

S. No.	Authors/ Name of Books/Publishers
1.	Bohinski, R. C., & Hennen, T. J. (2015). *Laboratory Techniques in Microbiology and Biotechnology*. Pearson.
2.	Hill, R. H., Jr., & Finster, D. C. (2016). *Laboratory Safety for Chemistry Students* (2nd ed.). Wiley.
3.	Ninfa, A. J., Ballou, D. P., & Benore, M. (2009). *Fundamental Laboratory Approaches for Biochemistry and Biotechnology* (2nd ed.). Wiley.
4.	Prichard, E., & Barwick, V. (2007). *Quality Assurance in Analytical Chemistry*. Wiley.
5.	Seiler, J. P. (2005). *Good Laboratory Practice: The Why and the How* (2nd ed.). Springer.

Eternal University, Baru Sahib
Dr. Khem Singh Gill Akal College of Agriculture

1.	**Course Code: 0140215061**	**Subject Code: SEC 116**	**Course Title: Basic Food Analysis Laboratory Techniques**	
2.	**Semester: I**		**Credits: 2(0+2)**	
3.	**Contact Hours:**	**P: 4**		
4.	**Relative weightage:**	**MTE: 24**	**Quiz/PA: 16**	**FPE: 40**
5.	**Objectives:**			
I.	To understand the importance and methodology of sampling and sample preparation for accurate food quality analysis.			
II.	To develop practical skills in sensory and physicochemical evaluation of food products, including color, taste, moisture, ash, protein, fat, fiber, and sugar content.			
III.	To perform chemical and instrumental methods of food analysis, including pH, acidity, vitamin C, TSS, and mineral content.			
IV.	To familiarize students with standard analytical techniques and laboratory practices, including visits to NABL-accredited labs for real-world exposure			
6.	**Course Outcomes:**			
CO1	Students will apply appropriate sampling techniques and prepare food samples for various analytical procedures.			
CO2	Conduct sensory and physicochemical analysis of food products to assess their quality parameters.			
CO3	Perform qualitative and quantitative estimations of key nutrients and constituents such as moisture, protein, fat, sugar, fiber, acidity, and minerals.			
CO4	Interpret analytical data and ensure compliance with food quality standards through hands-on laboratory experience.			

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	3	2	2	2	2	1	3	2	2	2	2	2
CO2	3	3	2	2	3	1	3	2	2	2	1	2
CO3	3	3	3	2	2	1	3	3	3	2	1	2
CO4	2	2	3	3	2	1	2	3	2	2	2	2
Average	2.75	2.5	2.5	2.25	2.25	1	2.75	2.5	2.25	2	1.5	2

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

7. Practical

Units	**Particulars**	**No. of Practical's**
I	Sampling plan; Sample collection and preparation for analysis. Sensory evaluation techniques of food products. Quality evaluation of food products for color and taste of marketed products. Determination of moisture content in food samples.	**6**
II	Water analysis. Determination of ash content in food samples. Determination of crude fat in food samples. Determination of crude protein in food samples by Kjeldahl method. Determination of crude fibre in food samples.	**6**
III	Qualitative tests for sugars. Qualitative tests for proteins, Colorimetric estimation of protein concentration. Estimation of total and reducing sugars.	**6**

	Measuring the pH of various food samples like fruits, dairy, and beverages.	
IV	Determining the acidity in food samples by titrating with a base. Determination of Total Soluble Solids and Vitamin C in food samples. Determination of Salt Content in food samples. Determination of colour and firmness of samples.	**6**
V	Estimation of chlorophyll and carotenoids in food samples. Estimation of Macro and Micro Minerals. Visit to NABL-Accredited Food Laboratory.	**6**
	Total Practical's:	**30**

8 Suggested Books/Readings:

S. No.	Authors/ Name of Books/Publishers
1.	AOAC International. (2023). *Official Methods of Analysis* (22nd ed.).
2.	Food Safety and Standards Authority of India. (2023). *Manual of Methods of Analysis of Foods*.
3.	Lawless, H. T., & Heymann, H. (2010). *Sensory Evaluation of Food: Principles and Practices* (2nd ed.). Springer.
4.	Nielsen, S. S. (2023). *Food Analysis Laboratory Manual* (4th ed.). Springer.
5.	Ranganna, S. (2014). *Handbook of Analysis and Quality Control for Fruit and Vegetable Products* (3rd ed.). Tata McGraw-Hill.

Eternal University, Baru Sahib
Dr. Khem Singh Gill Akal College of Agriculture

1.	**Course Code: 0140225011**	**Subject Code: SEC 121**	**Course Title: Maintenance of Food Processing Equipment**	
2.	**Semester: I**		**Credits: 2(0+2)**	
3.	**Contact Hours:**	**P: 4**		
4.	**Relative weightage:**	**MTE: 24**	**Quiz/PA: 16**	**FPE: 40**
5.	**Objectives:**			
I.	To provide fundamental knowledge on the types, functions, and components of food processing equipment.			
II.	To develop skills in performing preventive maintenance, troubleshooting, and minor repairs of food machinery.			
III.	To understand the proper use of cleaning agents, lubricants, and tools for maintenance activities.			
IV.	To familiarize students with the documentation procedures and safety protocols related to equipment maintenance.			
6.	**Course Outcomes:**			
CO1	Identify and understand the working principles of various food processing equipment used in industry.			
CO2	Develop and implement preventive maintenance schedules and logs for key food processing machinery.			
CO3	Demonstrate hands-on skills in basic troubleshooting, lubrication, and cleaning of processing equipment following safety protocols.			
CO4	Evaluate and perform maintenance procedures for specific equipment including sorting, milling, drying, packaging, and storage units.			

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	2	1	2	1	3	2	2	2	1	2
CO2	3	2	2	1	1	1	2	2	2	1	1	1
CO3	2	2	2	1	1	1	2	2	2	1	1	1
CO4	3	3	3	2	2	1	3	3	2	2	2	2
Avg	**2.75**	**2.25**	**2.25**	**1.25**	**1.5**	**1**	**2.5**	**2.25**	**2**	**1.5**	**1.25**	**1.5**

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

7. Practical

Units	Particulars	No. of Practical's
I	Hands-on identification of various types of food processing equipment. Creation of customized preventive maintenance checklists for different equipment. Simulated execution of a preventive maintenance routine. Understanding the types of lubricants used in food processing. Practicing proper lubrication techniques on machinery.	**6**
II	Cleaning of biofilm and scalding from surfaces of membranes and heaters. Learning about different cleaning agents and their appropriate use. Conducting cleaning protocols on equipment in compliance with food safety standards. Practical exercises in electrical troubleshooting, including circuit testing and voltage measurement.	**6**

III	Dismantling and reassembling parts of common food processing equipment. Simulated troubleshooting of common equipment malfunctions. Simulating the documentation of maintenance activities and creating maintenance logs. Study of maintenance of cleaning equipment.	**6**
IV	Study of care and maintenance of Sorting/Grading equipment. Study of care and maintenance of Milling equipment. Study of and care and maintenance of Drying equipment.	**6**
V	Study of care and maintenance of Material Handling equipment. Study of care and maintenance of Packaging equipment. Study of care and maintenance of Storage units.	**6**
	Total Practical's:	**30**

8 Suggested Books/Readings:

S. No.	Authors/ Name of Books/Publishers
1.	Cramer, M. M. (2013). *Food Plant Sanitation: Design, Maintenance, and Good Manufacturing Practices* (2nd ed.). CRC Press.
2.	Fellows, P. J. (2016). *Food Processing Technology: Principles and Practice* (4th ed.). Woodhead Publishing.
3.	Gresham, R. M., & Totten, G. E. (Eds.). (2008). *Lubrication and Maintenance of Industrial Machinery: Best Practices and Reliability*. CRC Press.
4.	Mobley, K., Higgins, L. R., & Wikoff, D. (Eds.). (2014). *Maintenance Engineering Handbook* (8th ed.). McGraw-Hill Education.
5.	Saravacos, G. D., & Kostaropoulos, A. E. (2016). *Handbook of Food Processing Equipment* (2nd ed.). Springer.

Eternal University, Baru Sahib
Dr. Khem Singh Gill Akal College of Agriculture

1.	**Course Code: 0140225021**	**Subject Code: SEC 122**	**Course Title: Introduction to Bottling and Canning Line**	
2.	**Semester: I**		**Credits: 2(0+2)**	
3.	**Contact Hours:**	**P: 4**		
4.	**Relative weightage:**	**MTE: 24**	**Quiz/PA: 16**	**FPE: 40**
5.	**Objectives:**			
I.	To understand the fundamental principles and operations involved in bottling and canning processes for food and beverages.			
II.	To familiarize students with equipment used in sorting, grading, washing, peeling, filling, sealing, and labelling.			
III.	To develop practical skills in quality control techniques including seal integrity checks, cutout analysis, and sterilization practices.			
IV.	To impart knowledge on cleaning, maintenance, and FSSAI regulatory compliance for bottled and canned food products.			
6.	**Course Outcomes:**			
CO1	Demonstrate hands-on proficiency in bottling and canning operations including blanching, filling, sealing, and sterilization of food products.			
CO2	Identify and operate various equipment used in sorting, grading, washing, cutting, and labelling.			
CO3	Evaluate the quality and safety of canned and bottled products through practical testing and cutout analysis.			
CO4	Apply knowledge of FSSAI regulations, packaging standards, and sanitation protocols in real-time processing and storage scenarios.			

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	3	2	2	1	2	1	3	2	2	2	1	2
CO2	3	2	2	1	1	1	2	2	2	1	1	1
CO3	2	2	2	1	1	1	2	2	2	1	1	1
CO4	3	3	3	2	2	1	3	3	2	2	2	2
Average	**2.75**	**2.25**	**2.25**	**1.25**	**1.5**	**1**	**2.5**	**2.25**	**2**	**1.5**	**1.25**	**1.5**

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

7. Practical

Units	**Particulars**	**No. of Practical's**
I	Introduction to bottling and canning process. Study of sorting and grading equipment's. Study of washing equipment's. Study of peeling methods and equipment's. Study of cutting equipment. To perform the blanching of fruits and vegetables. To check the adequacy of blanching process.	**6**
II	Study of different types of bottles and cans, including materials and sizes. Study of flattened can body reforming, flanging, ribbing, lidding and seaming. Lacquering of cans. Study of different filling techniques (gravity, pressure, vacuum). Practical session on filling bottles/cans accurately. Cutout analysis of cans. Hands-on practice on in-bottle sterilization.	**6**

III	Hands-on practice with various sealing methods (screw caps, corks, can lids).Testing seal integrity using various methods. Practical session on labeling machinery operation. Coding and printing best practices for product information. Conduct quality checks on filled and sealed products.	**6**
IV	Discuss common quality issues and troubleshooting techniques. Study of domestic carbonator and carbonation process. Learn proper cleaning and sanitation protocols for equipment. Hands-on cleaning sessions for different parts of the line. Basic maintenance tasks for key equipment's.	**6**
V	Troubleshooting common problems in bottling and canning lines. Workshop on regulations affecting bottling and canning. Product Handling and Storage. Practical session on proper storage techniques. Study of packaging, labelling and FSSAI Regulations of beverages and canned products. Visit to Beverage and Canning Industry.	**6**
	Total Practical's:	**30**

8 Suggested Books/Readings:

S. No.	Authors/ Name of Books/Publishers
1.	Board, N. P. C. S. (2012). *Handbook on Fruits, Vegetables & Food Processing With Canning & Preservation*. Asia Pacific Press Inc.
2.	Downing, D. L. (2013). *A Complete Course in Canning and Related Processes: Microbiology, Packaging, HACCP and Ingredients*. Elsevier.
3.	Featherstone, S. (Ed.). (2015). *A Complete Course in Canning and Related Processes: Volume 3 Processing Procedures for Canned Food Products*. Woodhead Publishing.
4.	Saravacos, G. D., & Kostaropoulos, A. E. (2002). *Handbook of Food Processing Equipment* (Vol. 2012, pp. 331–381). Kluwer Academic/Plenum.

Eternal University, Baru Sahib
Dr. Khem Singh Gill Akal College of Agriculture

1.	**Course Code: 0140225031**	**Subject Code: SEC 123**	**Course Title: Introduction to Manufacturing of Bakery Products**	
2.	**Semester: I**		**Credits: 2(0+2)**	
3.	**Contact Hours:**	**P: 4**		
4.	**Relative weightage:**	**MTE: 24**	**Quiz/PA: 16**	**FPE: 40**
5.	**Objectives:**			
I.	To understand the market trends and preparation methods of various bakery products such as bread, biscuits, cakes, and cookies.			
II.	To develop skills in evaluating the functional and rheological properties of flour used in bakery formulations.			
III.	To gain hands-on experience in preparing and analyzing the quality of both traditional and value-added baked goods.			
IV.	To familiarize students with packaging, labelling, and regulatory standards (FSSAI) for bakery products and provide industry exposure through field visits.			
6.	**Course Outcomes:**			
CO1	Develop competency in the preparation and quality evaluation of various bakery products including cookies, cakes, breads, and cereal bars.			
CO2	Analyze functional properties of flour (gluten content, sedimentation value, water/oil absorption, etc.) to assess baking performance.			
CO3	Apply knowledge of composite and millet-based formulations for creating nutritionally enhanced bakery products.			
CO4	Demonstrate awareness of packaging, labeling, and FSSAI regulations related to bakery products, and gain industrial exposure through visits.			

Mapping of Course Outcomes (COs) to Program Outcomes (POs) & Program Specific Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	3	2	2	1	2	1	3	2	2	2	1	2
CO2	3	2	2	1	1	1	2	2	2	1	1	1
CO3	2	2	2	1	1	1	2	2	2	1	1	1
CO4	3	3	3	2	2	1	3	3	2	2	2	2
Avg	**2.75**	**2.25**	**2.25**	**1.25**	**1.5**	**1**	**2.5**	**2.25**	**2**	**1.5**	**1.25**	**1.5**

1= Weak Correlation 2= Moderate Correlation 3= Strong Correlation

7. Practical

Units	**Particulars**	**No. of Practical's**
I	Introduction and market survey of bakery products. Determination of Gluten Content in wheat flour. Determination of Sedimentation value of wheat flour. Study of different methods of preparation of bakery products (Bread, Biscuit, Cake, Cookies etc.).	**6**
II	Determination of Pelshenke value of wheat flour. Determination of water and oil absorption of flour. Determination of emulsion capacity and stability of flour. Determination of foaming capacity and stability of flour. Determination of alkaline water retention capacity of flour.	**6**

III	Preparation and quality evaluation of composite formulation of wheat-based cookies. Preparation and quality evaluation of millet-based cookie formulations. Preparation and quality evaluation of crackers. Preparation and quality evaluation of unleavened flat breads.	**6**
IV	Preparation and quality evaluation of leavened breads (White bread, Brown Bread). Preparation and quality evaluation of cake/muffin. Preparation and quality evaluation of baked cereal bar.	**6**
V	Study of packaging, labelling and FSSAI Regulations of bakery products. Visit a Commercial Bakery Unit.	**6**
	Total Practical's:	**30**

8 Suggested Books/Readings:

S. No.	Authors/ Name of Books/Publishers
1.	Amendola, J., & Rees, N. (2003). *Understanding Baking: The Art and Science of Baking* (3rd ed.). John Wiley & Sons, Inc.
2.	Grewling, P. P. (2013). *Chocolates & Confections* (2nd ed.). John Wiley & Sons, Inc.
3.	Kingslee, J. J. (2006). *A Professional Text to Bakery and Confectionery*. New Age International.
4.	NIIR Board of Consultants & Engineers. (2014). *The Complete Technology Book on Bakery Products (Baking Science With Formulation & Production)* (3rd ed.). NIIR, New Delhi.
5.	Pyler, E. J., & Gorton, L. A. (2009). *Baking Science & Technology, Vol. II: Formulation & Production* (4th ed.). Sosland Publishing Company.

SEMESTER-VIII					
S. No.	**Course Code**	**Subject Code**	**Course Title**	**Credit hours**	**Total Credit hours**
1.	0140288012	READY 421	Student Ready / Internship (at Industry/ Research Institutes, etc.) (20 weeks)	20 (0+20)	**20 (0+20)**
		MOOC etc	**Online courses**	6	**6**