



Four-Year Undergraduate Programme

Bachelor of Technology

Food Technology

Faculty of Engineering and Technology

Parul University

Vadodara, Gujarat, India

Faculty of Engineering and Technology
Bachelor of Technology in Food Technology

1. Vision of the Department

To produce world-class food technocrats by inculcating all facets of food.

2. Mission of the Department

M1 To become a recognized focal point for food science and technology education by offering undergraduate program.

M2 To create an educational ecosystem that fosters entrepreneurship, management, skill development, extension, interdisciplinary research, and development by becoming a centre of excellence in the food processing sector.

M3 To offer continual training to the stakeholders to enhance their skills and be updated on global trends in food research and technology by consultation with the stakeholders.

M4 To carry out Research & Development in frontier areas, and develop innovative technologies in the food processing sector.

3. Program Educational Objectives

The statements below indicate the career and professional achievements that the B.Tech. Food Technology curriculum enables graduates to attain.

PEO 1	Apply the knowledge of food Science to understand, evaluate and develop food products and preservation methods based on standard practices.
PEO 2	Employ technology to design and develop innovative food processing techniques for solving practical and real-world problems.
PEO 3	Demonstrate professional and ethical competency with effective communication and managerial skills to emerge as a responsible leader in the Food sector.

4. Program Learning Outcomes

Program Learning outcomes are statements conveying the intent of a program of study.

PLO 1	Engineering knowledge:	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PLO 2	Problem analysis:	Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using the first principles of mathematics, natural sciences, and engineering sciences.
PLO 3	Design/development of solutions:	Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.
PLO 4	Conduct	Use research-based knowledge and research methods

	investigations of complex problems:	including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PLO 5	Modern tool usage:	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PLO 6	The engineer and society:	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PLO 7	Environment and sustainability:	Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of, and need for sustainable development.
PLO 8	Ethics:	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PLO 9	Individual and team work:	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PLO 10	Communication:	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PLO 11	Project management and finance:	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PLO 12	Life-long learning:	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

5. Program Specific Learning Outcomes

PSO 1	Capable of implementing efficient and sustainable food processing techniques to ensure the production of safe, high-quality, and nutritious food products.
PSO 2	Possess skills to implement and manage quality control systems, ensuring compliance with safety regulations and conducting risk assessments to produce safe, high-quality food products.

6. Credit Framework

Semester wise Credit distribution of the programme	
Semester-1	22
Semester-2	23
Semester-3	23
Semester-4	24
Semester-5	24
Semester-6	23
Semester-7	24
Semester-8	22
Total Credits:	185

Category wise Credit distribution of the programme	
Category	Credit
Major Core	93
Minor Stream	0
Multidisciplinary	30
Ability Enhancement Course	10
Skill Enhancement Courses	23
Value added Courses	09
Summer Internship	20
Research Project/Dissertation	-
Total Credits:	185

7. Program Curriculum

Semester 1						
Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
1	20105102	English Language	2	1	2	-
2	20105103	General Microbiology	3	2	2	-
3	20105104	Engineering Mathematics - I	2	2	-	-
4	20105105	Engineering Drawing and Graphics	3	1	4	-
5	20105106	Electrical Engineering	3	2	2	-
6	20105107	Workshop Technology	3	1	4	-
7	20105108	Crop Production Technology	3	2	2	-
8	20105109	Environmental Sciences & Disaster Management	2	1	2	-
9	20193104	Communication Skills	1	0	2	-
Total			22	12	20	0

Semester 2						
Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
10	20105153	Food Chemistry of Macronutrients	3	2	2	0
11	20105154	Food Microbiology	3	2	2	0
12	20105155	Food Thermodynamics	3	2	2	0
13	20105156	Computer Programming and Data Structures	3	2	4	0
14	20105157	Fluid Mechanics	3	2	2	0
15	20105158	Basic Electronics Engineering	3	2	2	0
16	20105159	Engineering Mathematics - II	2	2	-	0
17	20105160	Post Harvest Engineering	3	2	2	0
Total			23	15	16	0
Semester 3						
Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
18	20105203	Fundamentals of Food Processing	3	2	2	0
19	20105204	Processing Technology of Liquid Milk	2	1	2	0
20	20105205	Processing Technology of Cereals	3	2	2	0
21	20105206	Industrial Microbiology	3	2	2	0
22	20105207	Food Chemistry of Micronutrients	3	2	2	0
23	20105208	Heat and Mass Transfer in Food Processing	3	2	2	0
24	20105209	Unit Operations in Food Processing - I	3	2	0	0
25	20105210	Statistical Methods and Numerical Analysis	2	1	2	0
26	20105211	Physical Education	1	-	2	0
Total			23	14	18	0
Semester 4						
Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
27	20105253	Processing Technology of Dairy Products	3	2	2	0
28	20105254	Processing Technology of Legumes and Oilseeds	3	2	2	0
29	20105255	Food Biochemistry and Nutrition	3	2	2	0
30	20105256	Unit Operations in Food Processing - II	3	2	2	0
31	20105257	Food Biotechnology	3	2	2	0
32	20105258	Food Refrigeration and Cold Chain	3	2	2	0
33	20105259	Processing of Spices and Plantation Crops	3	2	2	0

34	20105260	Business Management and Economics	2	2	-	0
35	20193201	Communication Skills & Personality Development	1	0	2	0
Total			24	16	16	0
Semester 5						
Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
36	20105302	Processing Technology of Fruits and Vegetables	3	2	2	0
37	20105303	Processing of Meat and Poultry Products	3	2	2	0
38	20105304	Instrumental Techniques in Food Analysis	3	1	4	0
39	20105305	ICT Applications in Food Industry	3	1	4	0
40	20105306	Food Process Equipment Design	3	2	2	0
41	20105307	Food Storage Engineering	3	2	2	0
42	20105308	Bakery, Confectionary and Snack Products	3	2	2	0
43	20105309	Marketing Management & International Trade	2	2	-	0
44	20193301	Employability Skills	1	0	2	0
Total			24	14	20	0
Semester 6						
Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
45	20105354	Processing Technology of Beverages	3	2	2	0
46	20105355	Food Plant Sanitation	2	1	2	0
47	20105356	Food Packaging Technology and Equipment	3	2	2	0
48	20105357	Processing of Fish and Marine Products	3	2	2	0
49	20105358	Sensory Evaluation of Food Products	3	1	4	0
50	20105359	Food Additives and Preservatives	2	1	2	0
51	20105360	Food Quality, Safety Standards and Certification	2	2	-	0
52	20105361	Instrumentation and Process Control in Food Industry	3	2	2	0
53	20105362	Project Preparation and Management	2	1	2	0
Total			23	14	18	0

Semester 7						
Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
54	20105402	Entrepreneurship Development	3	2	2	0
55	20105403	Students READY - Experiential Learning Programme - I	7	-	14	0
56	20105404	Students READY - Experiential Learning Programme - II	7	-	14	0
57	20105405	Students READY - Research Project	3	-	6	0
58	20105406	Students READY - Seminar	1	-	2	0
59	20105407	Financial Management & Cost Accounting	3	2	2	0
Total			24	4	40	0
Semester 8						
Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
60	20105451	Students READY - Industrial Tour	2	-	4	0
61	20105452	Students READY - Internship/In-Plant Training	20	-	40	0
Total			22	0	44	0
Total (08 Semester)			185	89	192	0

8. Detailed Syllabus

Semester 1 [01]

- a. **Course Name:** English Language
- b. **Course Code:**20105102
- c. **Prerequisite:** Knowledge of Physics and Mathematics up to 12thscience level.
- d. **Rationale:** English subject enhances communication skills, facilitating effective collaboration, documentation, and dissemination of technical knowledge crucial for innovation, research, and professional success in the global food industry.
- e. **Course Learning Objective:**

CLOBJ 1	Distinguish the various concepts of vocabulary.
CLOBJ 2	Understand the different phrases and verbs and their use in English language.
CLOBJ 3	Build their language skills especially in the areas of grammar and pronunciation.
CLOBJ 4	Adapt receptive skills through reading and listening to acquire good exposure to language and literature.

f. Course Learning Outcomes:

CLO 1	Develop the ability to recognize and differentiate between diverse vocabulary concepts in the English language.
CLO 2	Acquire a comprehensive understanding of distinct phrases and verbs, and their application within the context of English communication.
CLO 3	Analyse the significance and impact of effectively structured paragraphs in the composition of essays.
CLO 4	Evaluate and contrast the dynamics, characteristics, and importance of debates and discussions within the English language.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
1	-	2	2	30	-	20	50	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Introduction: Importance of language and communication skills in the engineering profession	6.67 %	1
2	Spoken and conversational English.	6.67 %	1

3	The main features are agreement, disagreement, likes, dislikes and inquiries.	6.67 %	1
4	Debate and discussion, Basic sentence patterns in English:	6.67 %	1
5	Agreement between subject and verb;	6.67 %	1
6	Proper use of pronouns, adjectives, and adverbs.	6.67 %	1
7	Proper use of phrases and clauses	6.67 %	1
8	Some basic rules of composition	6.67 %	1
9	Concept of the register; development of vocabulary	6.67 %	1
10	Reference skills: Dictionary, thesaurus, indexing, contents, glossary;	6.67 %	1
11	Reading of selected texts and discussions	6.67 %	1
12	Vocabulary building tasks	6.63 %	1
13	Note-taking and note-making	6.00 %	1
14	Linkage, development of paragraphs	6.00 %	1
15	Cohesion, coherence, and style.	8.00 %	2
Total		100%	16

i. Text Book and Reference Book:

1. Speak English Like a Star: Learning English was Never So Easy by Yogesh Vermani
2. How I Learnt to Speak in English? by Neetu Sugandh
3. Think English, Speak English by Julian Northbrook
4. Alice Oshima and Ann Hogue. 1998. Writing Academic English. Addison Wesley Longman, White Plains, NY, USA.

j. Experiment List:

Sr. NO.	Experiment List
1	Grammar tenses;
2	Voice-change;
3	Direct/indirect narration;
4	Prepositions and determiners;
5	Word-formation with parts of speech;
6	Types of sentences;
7	Elementary knowledge of English sound with word stress, intonation pattern;
8	Composition, letter, application, summary, and report writing.

Semester 1
[02]

- a. Course Name:** General Microbiology
b. Course Code: 20105103
c. Prerequisite: Knowledge of Biology & Chemistry up to 12th science level.
d. Rationale: General microbiology subject is pivotal for understanding the fundamental principles of microbial biology, fostering expertise essential for quality control, safety, and innovation in food processing and preservation.
e. Course Learning Objective:

CLOBJ 1	Distinguish the various types of microorganisms.
CLOBJ 2	Understand different staining techniques and their application in the Food industry.
CLOBJ 3	Utilize culturing and mutations in microbiology applications.
CLOBJ 4	Categorize bacteria based on growth temperature.

f. Course Learning Outcomes:

CLO 1	Identify different types of microorganisms.
CLO 2	Apply staining techniques in the Food industry.
CLO 3	Explore the impact of culturing and mutations in microbiology.
CLO 4	Differentiate bacteria based on growth temperature.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	2	3	50	-	30	10	10	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Evolution and scope of microbiology	6.25 %	2
2	History of microbiology	6.25 %	2
3	Microbial classification, nomenclature, and identification;	6.25 %	2
4	Taxonomic groups; General methods of classifying bacteria	9.37 %	3
5	Microscopy and microscopes:	6.25 %	2
6	Smears and staining;	3.12 %	1
7	Morphology and fine structure of bacteria;	6.25 %	2
8	Cultivation of bacteria, nutritional requirements;	6.25 %	2
9	Nutritional classification of bacteria; Phototrophs, chemotrophs, autotrophs and heterotrophs;	9.37 %	3
10	Obligate parasites; Bacteriological media, Growth of bacteria,	3.12 %	1
11	Reproduction of bacteria;	3.12 %	1
12	Introduction to fungi, algae and protozoa and viruses:	3.12 %	1
13	Nutrient transport phenomenon: Passive diffusion, facilitated diffusion; Group translocation, active transport.	6.25 %	2
14	Microbial genetics; Bacterial recombination; Bacterial conjugation, transduction; Bacterial transformation;	6.25 %	2
15	Mutations: Types of mutations, mutagenesis; Mutation rate, repair of mutations; Phenotypes of bacterial mutants; Designation of bacterial mutants;	6.25 %	2
16	Chemo therapeutic agents and chemotherapy;	3.12 %	1
17	Characteristics of antibiotics; Mode of action of antibiotics;	3.12 %	1
18	Pure culture: Methods of isolation of pure cultures; Maintenance and preservation of pure cultures.	6.25 %	2
Total		100%	32

i. Text Book and Reference Book:

1. Gerard J. Tortora, Berdell R. Funke, Christine L. Case. 2014. Microbiology: An Introduction, 12th Ed. Prentice-Hall, NY, USA.
2. Microbiology: An Introduction, 13th Edition by G J Tortora, Publisher. Addison-Wesley.
3. Johanne M. Willey, Linda M. Sherwood and Christopher J. Woolverton. 2013. Prescott's Microbiology, 9th Ed. McGraw-Hill Higher Education, NY, USA.
4. Michael J. Pelczar Jr, E.C.S. Chan and Noel R. Krieg. 1998. Microbiology, 5th Ed. Tata McGrawHill Education, New Delhi.

j. Experiment List:

Sr. No.	Experiment List
1	Practical o Microscopy;
2	Practical on Micrometry;
3	Cleaning and sterilization of glassware and acquainting with equipment used in microbiology;
4	Preparation of nutrient agar media and techniques of inoculation;
5	Staining methods (monochrome staining, gram staining, negative staining,
6	Staining methods - capsule- staining, flagella staining and endospore staining);
7	Pure culture techniques - Streak plate
8	Pure culture techniques - Pour plate
9	Pure culture techniques - Spread plate;
10	Identification procedures (morphology and cultural characteristics);
11	Growth characteristics of fungi:
12	Determination of microbial numbers
13	Determination of direct plate count
14	Determination of generation time;
15	Factors influencing growth: pH, temperature, growth curves for bacteria.

Semester 1

[03]

- a. **Course Name:** Engineering Mathematics - I
- b. **Course Code:** 20105104
- c. **Prerequisite:** Knowledge of Physics & Mathematics up to 12th science level.
- d. **Rationale:** Engineering Mathematics - I subject is crucial for providing students with the mathematical foundation essential for analysing and solving complex problems in food processing, quality control, and research, enabling them to apply advanced mathematical concepts to optimize processes and ensure the efficiency and safety of food production.

e. Course Learning Objective:

CLOBJ 1	Distinguish various calculus and their applications.
CLOBJ 2	Understand various equations and their importance in the food industry.
CLOBJ 3	Examine gradient in mathematics.
CLOBJ 4	Compare Bernoulli's equation with other equation and their importance.
CLOBJ 5	Outline the importance of Stokes's theorem

f. Course Learning Outcomes:

CLO 1	Differentiate between calculus types and apply them in diverse scenarios.
CLO 2	Identify equations and their significance in the food industry.
CLO 3	Describe the role of gradient in mathematical applications.
CLO 4	Contrast Bernoulli's equation with others and grasp their significance.
CLO 5	Elaborate the significance of Stokes's theorem in mathematical contexts.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	-	2	40	10	-	50	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Differential calculus: Taylor's and Maclaurin's expansions, indeterminate form.	6.25 %	2
2	Curvature, asymptotes, tracing of curves, the function of two or more independent variables, partial differentiation, homogeneous functions	9.37%	3
3	Euler's theorem, composite functions, total derivatives, a derivative of an implicit function, change of variables,	6.25 %	2
4	Jacobians, error evaluation, maxima, and minima	6.25 %	2
5	Integral calculus: Reduction formulae, the rectification of standard curves, volumes and surfaces of revolution of curves, double and triple integrals, change of order of integration, gamma and beta functions	9.37%	3
6	Application of double and triple integrals to find area and volume;	6.25 %	2
7	Ordinary differential equations: Exact and Bernoulli's differential equations, equations reducible to exact form by integrating factors, equations of the first order and higher degree,	6.25 %	2
8	Clairaut's equation, differential equations of high orders, methods of finding complementary functions and particular integrals, method of variation of parameters,	6.25 %	2
9	Cauchy's and Legendre's linear equations, simultaneous linear differential equations with constant coefficients, series solution techniques,	6.25 %	2
10	Bessel's and Legendre's differential equations; Vector calculus:	3.12%	1
11	Differentiation of vectors, scalar, and vector point functions, vector differential operator Del	9.37%	3
12	Gradient of a scalar point function	3.12%	1
13	Divergence and Curl of a vector point function and their physical interpretations, identities involving Del	6.25 %	2
14	Divergence and Curl of a vector point function and their physical interpretations, identities involving Del	6.25 %	2
15	second order differential operator;	3.12%	1

16	Line, surface, and volume integrals	3.12%	1
17	Stoke's, divergence and Green's theorems	3.12%	1
Total		100%	32

i. Text Book and Reference Book:

1. S. Prasad and U. Kumar. 2010. Principles of Horticulture. Agrobios, New Delhi.
2. T. Yellamanda Reddy and G.H. Shankar Reddy. 1995. Principles of Agronomy. Kalyani Publishers, Ludhiana.
3. S.S. Singh. Principles and Practices of Agronomy. 1985. Kalyani Publishers, Ludhiana.

Semester 1

[04]

- a. **Course Name:** Engineering Drawing and Graphics
- b. **Course Code:** 20105105
- c. **Prerequisite:** Knowledge of Physics & Mathematics up to 12th science level.
- d. **Rationale:** Engineering Drawing and Graphics subject is essential for fostering visual communication skills, enabling students to interpret, create, and communicate detailed drawings and graphics crucial for designing and understanding food processing equipment and components.

e. Course Learning Objective:

CLOBJ 1	Distinguish various projections and views used in Engineering.
CLOBJ 2	Understand various nuts and screws
CLOBJ 3	Implication foundation bolts and its applications.
CLOBJ 4	Solve the various CAD issues.
CLOBJ 5	Demonstrate the importance of CAD in Food industry.

f. Course Learning Outcomes:

CLO 1	Identify and differentiate between the diverse projections and views employed in Engineering Drawing.
CLO 2	Comprehend the characteristics and uses of different types of nuts and screws in engineering.
CLO 3	Apply foundational knowledge to understand the implications of bolts and their applications in engineering.
CLO 4	Resolve a variety of issues encountered in Computer-Aided Design (CAD) applications.
CLO 5	Recognize the significance of Computer-Aided Design (CAD) specifically in the context of the Food industry.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
1	-	4	3	30	-	20	50	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	First and third angle methods of projection	6%	1
2	Preparation of working drawing from models and isometric views;	6%	1
3	Drawing of missing views	6%	1
4	Different methods of dimensioning	6%	1
5	Concept of sectioning	5%	1
6	Revolved and oblique section	6%	1
7	Sectional drawing of simple machine parts	6%	1
8	Types of rivet heads and riveted joints	6%	1
9	Processes for producing leak proof joints	5%	1
10	Symbols for different types of welded joints	5%	1
11	Nomenclature, thread profiles, multi-start threads, left and right hand thread; Square headed and hexagonal nuts and bolts	12%	1
12	Conventional representation of threads	6%	1
13	Different types of lock nuts, studs, machine screws, cap screws and wood screws	12%	1
14	Foundation bolts; Design process, application of computers for design,	5%	1
15	Definition of CAD, benefits of CAD,	5%	1
16	CAD system components; Computer hardware for CAD	6%	1
Total		100%	16

i. Text Book and Reference Book:

1. B.L. Theraja and A.K. Theraja. 2005. A Textbook of Electrical Technology, Vol. II. S. Chand & Company Ltd., New Delhi.
2. Engineering Drawing” by Basant Agrawal and C M Agrawal
3. Vincent Del Toro. 2000. Electrical Engineering Fundamentals. Prentice-Hall India Private Ltd., New Delhi.

j. Experiment List:

Sr. NO.	Experiment List
1	Introduction of drawing scales
2	Principles of orthographic projections
3	References planes
4	Points and lines in space and traces of lines and planes
5	Auxiliary planes and true shapes of oblique plain surface
6	True length and inclination of lines
7	Projections of solids: Change of position method, alteration of ground lines; Section of solids and interpenetration of solid-surfaces;
8	Development of surfaces of geometrical solids;
9	Isometric projection of geometrical solids;
10	Preparation of manual drawings with dimensions from models and isometric drawings of objects and machine components;
11	Preparation of sectional drawings of simple machine parts;
12	Drawing of riveted joints and thread fasteners;
13	Demonstration on computer graphics and computer aided drafting use of standard software;
14	Sectional drawings of engineering machines; Computer graphics for food engineering applications; Interpretation of sectional views of food equipment and components; Practice in the use of basic and drawing commands on AutoCAD;
15	Generating simple 2-D drawings with dimensioning using AutoCAD;
16	Small Projects using CAD/CAM.

Semester 1
[05]

- a. **Course Name:** Electrical Engineering
- b. **Course Code:** 20105106
- c. **Prerequisite:** Knowledge of Physics & Mathematics up to 12th science level.
- d. **Rationale:** Electrical Engineering subject is crucial for equipping students with the foundational knowledge and skills to comprehend, design, and implement electrical systems vital for the automation, control, and efficient functioning of equipment in food processing, ensuring safety, reliability, and technological advancements in the food industry.

e. Course Learning Objective:

CLOBJ 1	Distinguish the various fundamentals unit for electrical engineering
CLOBJ 2	Illustrate various circuits and their connections.
CLOBJ 3	Understand AC and DC motor and their principles.
CLOBJ 4	Describe various equipment's and factors such as load and power.

f. Course Learning Outcomes:

CLO 1	Differentiate between fundamental units in electrical engineering.
CLO 2	Analyse circuits and their interconnections.
CLO 3	Explore the principles of AC and DC motors.
CLO 4	Describe equipment variations and consider factors like load and power.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	2	3	30	-	20	50	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	AC Fundamentals: Definitions of cycle, frequency, time period, amplitude.	3 %	1
2	Peak value, RMS value, Average value, Electro motive force, reluctance etc	3 %	1
3	Laws of magnetic circuits, Phase relations and vector representation,	6 %	2
4	AC through resistance, inductance and capacitance, A.C. series and parallel circuits,	7 %	2
5	Simple R-L, R-C and R-L-C circuits, 3 Phase Systems: Star and Delta connections,	7 %	2
6	Relationship between line and phase voltages and currents in Star and Delta connections,	7 %	2
7	Various methods of single and three phase power measurement.	7 %	2
8	Transformer : Principle of working, construction of single phase transformer, emf equation,	7 %	2
9	Phasor diagrams, Ideal transformer, transformer on no load, Transformer under load, Equivalent circuits, Transformer losses, efficiency,	7 %	2
10	Regulation, Open and short circuit test. Single phase induction motor: double field revolving theory, equivalent circuit, characteristics, phase split, shaded pole motors.	6 %	2
11	Poly-phase induction motor: Construction, operation, equivalent circuit, phasor diagram, effect of rotor resistance, torque equation, starting and speed control methods,	7 %	2
12	D.C. Machine (generator and motor): Types, Construction and Operation, EMF equation, armature reaction, commutation of D.C. generator and their characteristics,	10 %	3
13	D.C. Motors, their starting, speed controls and characteristics.	3 %	2
14	Electric Power Economics, Maximum demand charge, Load factor, power factor and power factor improvement,	6 %	2
15	Measuring Equipment's: Classification, Characteristics of	3 %	1

	different electrical measuring systems and equipment's,		
16	Electrical Wiring, system of wiring, domestic wiring installation, industrial electrification, protection devices,	7 %	2
17	Earthing, use of Multimeter, Circuit protection devices, fuses, MCB, ELCB & relays.	4 %	2
Total		100%	32

i. Text Book and Reference Book:

1. An Integrated Course in Electrical Engineering (Text Book) by . J. B. Gupta. (Publisher : S K Kataria & Sons).
2. An Introduction to Electrical Engineering Materials (Textbook) by C.S. Indulkar, S. Thiruvengadam (Publisher : S Chand & Company)
3. Fundamentals of Electric Circuits (Book) by Charles K. Alexander, Matthew N.O. Sadiku (Publisher : McGraw Hill Education).

j. Experiment List:

Sr. NO.	Experiment List
1	Study of voltage resonance in L.C.R. circuits at constant frequency: (a) Star connection study of voltage and current relation.
2	Study of voltage resonance in L.C.R. circuits at constant frequency (b) Delta connection study of voltage and current relation.
3	Measurement of Power in 3 phase circuit by wattmeter and energy meter: (a) for balanced loads
4	Measurement of Power in 3 phase circuit by wattmeter and energy meter (b) for unbalanced loads.
5	Polarity test, no-load test, efficiency and regulation test of single-phase transformer.
6	Starting of induction motors by; (a) D.O.L.
7	Starting of induction motors : (b) Manual star delta
8	Starting of induction motors by; (c) Automatic star delta starts.
9	Starting of slip ring induction motors by normal and automatic rotor resistance starters.
10	Test on 3 phase induction motor- determination of efficiency, line current, speed slip and power factor at various outputs.
11	Determination of relation between the induced armature voltage and speed of separately excited D.C. generator.
12	Magnetization characteristics of D.C. generator.
13	Study the starter connection and starting reversing and adjusting speed of a D.C. motor.
14	Problems on Industrial Electrification.
15	Study of various circuit protection devices.
16	Study of various measuring instruments.

Semester 1
[06]

- a. **Course Name:** Workshop Technology
- b. **Course Code:** 20105107
- c. **Prerequisite:** Knowledge of Physics & Mathematics up to 12th science level.
- d. **Rationale:** Workshop Technology subject provides hands-on knowledge and practical skills in the identification, operation, and maintenance of various tools, machines, and processes crucial for food industry applications, ensuring a comprehensive understanding of the practical aspects of food production and processing.

e. Course Learning Objective:

CLOBJ 1	Distinguish the various types welding techniques and equipment
CLOBJ 2	Understand various carpentry tools and materials
CLOBJ 3	Learn various workshop machine
CLOBJ 4	Differentiate forging operations

f. Course Learning Outcomes:

CLO 1	Identify different welding techniques and recognize the corresponding equipment used in each.
CLO 2	Comprehend the diverse carpentry tools and materials essential for woodworking.
CLO 3	Acquire knowledge about various workshop machines and their functionalities.
CLO 4	Differentiate between different forging operations employed in workshop technology.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
1	-	4	3	30	-	20	50	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Introduction to basic materials: Ferrous and non-ferrous materials and important engineering materials such as timber, abrasive materials, silica, ceramics, glasses, graphite, diamond, plastic polymers and composite materials, their properties and applications	13 %	2
2	Safety measures in workshop; Indian Factory Acts on safety; Measuring and Gauging: Basic measuring instruments and gauges	7 %	1
3	Heat treatment processes: Introduction to hardening, tempering, annealing, normalizing, etc.	7 %	1
4	Welding: Introduction, types of welding, types of electrodes, types of flames, types of welding joints, edge preparation, welding techniques and equipment; Gas welding and cutting, arc welding; Introduction to soldering and brazing and their uses; Estimation of welding and soldering cost	20 %	3
5	Smithy and forging: Introduction to different tools and their uses, different forging operations	13 %	2
6	Carpentry: Introduction to various carpentry tools and materials; Type of woods and their characteristics, brief ideas about band saw, wooden lathe circular saw, wood planner, etc.	13 %	2
7	Machinery: Introduction to various workshop machines (1) Lathe, (2) power hacksaw, (3) Shaper and planner, (4) Drilling, (5) Grinder and (6) CNC machines; Length of cut, feed, depth of cut, RPM, cutting speed, time, time allowances; Estimation of machining time for different lathe operations; Estimation of machining time for shaping, slotting and planning operations, work holding and tool holding devices	20 %	3
8	Sheet-metal: Introduction, different operations, sheet metal joints; Allowances for sheet metal, operations and joints, estimate of cost.	7 %	2
Total		100%	16

i. Text Book and Reference Book:

1. B.S. Raghuwamsi. 1996. A Course in Workshop Technology, Vols. I and II. Dhanpet Rai & Sons, New Delhi.
2. W.A.J. Chapman. 1989. Workshop Technology, Parts I and II. Arnold Publishers (India) Pvt. Ltd., New Delhi.
3. S.K. Hazra Choudari and S.K. Bose. 1982. Elements of Workshop Technology, Vols. I and II. Media Promoters and Publishers Pvt. Ltd., Mumbai.

j. Experiment List:

Sr. NO.	Experiment List
1	Identification of different engineering materials
2	Demonstration of different measuring instruments and measurement technique
3	Study of different types of gauges
4	Identification of various hand tools
5	Identification of various carpentry tools
6	Demonstration of various power tools
7	Demonstration of various machine tools
8	Simple exercises in filing
9	Simple exercises in fitting
10	Simple exercises in chipping
11	Simple exercises in hack sawing
12	Simple exercises in chiseling
13	Simple exercises in tapping
14	Introduction to arc welding machine, processes, tools, their use and precautions
15	Simple exercises on arc welding
16	Introduction to gas welding machine, processes, tools, their use and precautions
17	Simple exercises in gas welding
18	Demonstration of various casting processes and equipment, tools and their use
19	Introduction of Lathe machine
20	Simple exercises on turning
21	Simple exercises on step turning
22	Simple exercises on taper turning
23	Simple exercises on facing
24	Simple exercises on knurling
25	Introduction to drilling machines
26	Simple exercises on drilling
27	Simple exercises on threading
28	Introduction to shaper and planner machine
29	Simple exercises on shaper machine
30	Simple exercises on planner machine
31	Introduction of CNC machine
32	Simple exercises on CNC machine

Semester 1
[07]

- a. **Course Name:** Crop Production Technology
- b. **Course Code:** 20105108
- c. **Prerequisite:** Knowledge of Biology up to 12th science level.
- d. **Rationale:** Crop Production Technology subject is significant as it equips students with essential knowledge and skills in the cultivation and management of crops, fostering an understanding of agricultural practices crucial for ensuring a sustainable and quality supply of raw materials for food processing industries.

e. Course Learning Objective:

CLOBJ 1	Distinguish the production technology of various types of fruits and vegetables.
CLOBJ 2	Interpret the effect of different weather parameters on crop growth and development
CLOBJ 3	Calculate the maturity index, yield potential, cost of cultivation, etc.
CLOBJ 4	Solve the sowing time for major varieties.

f. Course Learning Outcomes:

CLO 1	Differentiate between the production techniques for various fruits and vegetables.
CLO 2	Comprehend the impact of diverse weather parameters on crop growth and development.
CLO 3	Calculate maturity index, yield potential, and cost of cultivation.
CLO 4	Determine optimal sowing times for major crop varieties.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	2	3	30	-	20	50	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Classification of crops; Effect of different weather parameters on crop growth and development.	6 %	2
2	Principles of tillage; Soil-water-plant relationship, crop rotation.	3 %	1
3	Cropping systems, relay cropping, and mixed cropping.	6 %	2
4	Crop production technology for major cereal crops viz., paddy, wheat, maize, pearl millet, sorghum, etc.;	9 %	3
5	Major varieties, sowing time, method of sowing, spacing, inter- culturing, fertilizer, and water requirement.	9 %	3
6	Time of harvest, maturity index, yield potential, cost of cultivation, income from production, etc.;	9 %	3
7	Crop production technology for major oilseed crops viz., groundnut, sesame, rapeseed, mustard, castor, etc.:	9 %	3
8	Crop production technology for major pulse crops viz., pigeon pea, cowpea, gram, green gram, black gram, etc.:	6 %	2
9	Crop production technology for major spices and cash crops viz., cumin, coriander, fennel, ginger, garlic, sugarcane, etc.	6 %	3
10	Horticulture: Scope of horticultural crops. Soil and climatic requirements for fruits and vegetables, nursery raising and management;	10 %	3
11	Crop production technology for major fruit crops viz., mango, banana, sapota, aonla, pomegranate, guava, etc.:	6 %	2
12	Crop production technology for major vegetable crops viz., potato, onion, tomato, chili.	9 %	3
13	Crop production technology for other green and leafy vegetables:	3 %	2
Total		100%	32

i. Text Book and Reference Book:

1. Principles of Agronomy" by Reddy T. Yellamanda, G. H. Shankar, and S. R. Anantha Singh
2. S. Prasad and U. Kumar. 2010. Principles of Horticulture. Agrobios, New Delhi.
3. T. Yellamanda Reddy and G.H. Shankar Reddy. 1995. Principles of Agronomy. Kalyani Publishers, Ludhiana.
4. S.S. Singh. Principles and Practices of Agronomy. 1985. Kalyani Publishers, Ludhiana.

j. Experiment List:

Sr. NO.	Experiment List
1	Examination of the soil profile in the field.
2	Introduction to different equipment utilized in a weather observatory.
3	Identification of seeds of different agricultural crops and their varieties.
4	Study of seed viability and germination test.
5	Identification of different weeds and methods of their control.
6	Use of different inter-culturing equipment.
7	Study of water requirement of different crops.
8	Fertilizer application methods and equipment.
9	Judging maturity time for harvesting of the crop.
10	Identification and description of important fruit and vegetable crops.
11	Preparation of nursery.
12	Study of different garden tools.
13	Practices of pruning and training in some important fruit crops.

Semester 1
[08]

- a. Course Name:** Environmental Sciences & Disaster Management
- b. Course Code:** 20105109
- c. Prerequisite:** Knowledge of Science up to 12th science level.
- d. Rationale:** Crop Production Technology subject is essential for cultivating a holistic understanding of the impact of environmental factors on food production, ensuring sustainable practices, and equipping students with skills to manage and mitigate potential disasters, fostering responsible and resilient practices within the food industry.

e. Course Learning Objective:

CLOBJ 1	Study environment components
CLOBJ 2	Distinguish the various types ecosystem
CLOBJ 3	Evaluate the role of smart citizens and approaches for citizen engagement
CLOBJ 4	Solve current environmental global issues

f. Course Learning Outcomes:

CLO 1	Understand the interrelation and interdependency of organisms and their interactions with environment.
CLO 2	Differentiate between various types of ecosystems.
CLO 3	Identify eco-friendly measures in engineering projects.
CLO 4	Assess and resolve contemporary global environmental issues.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
1	-	2	2	30	-	20	50	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Environment, components of environment, man-environment relationship, impact of technology on the environment, environmental degradation.	6.67 %	1
2	Ecology and ecosystems: introduction; ecology: objectives and classification, concepts of an ecosystem, structure and function of ecosystem, components of ecosystem, energy flow in ecosystem, food chains, ecological pyramids	20.00 %	3
3	Population and natural resources, population and pollution, Renewable and non-renewable energy resources, Water resources, Forest resources.	20.00 %	3
4	Environmental pollution - Water pollution: Introduction, water quality standards, sources of water pollution, Air pollution: Composition of air, structure of atmosphere, ambient air quality standards, Land and noise pollution: Introduction, lithosphere, land uses, causes of land degradation, sources of noise pollution.	20.00 %	3
5	Food processing industry waste and its management; Management of urban waste water; Recycling of organic waste; Recycling of factory effluent; Control of environmental pollution through law; Composting of biological waste; Sewage, uses of water disposal effluent treatment; Current environmental global issues: Global warming and greenhouses effects	20.00 %	3
6	Disaster management: natural and manmade disasters, disaster management, natural disaster management framework, financial management	13.33 %	3
Total		100%	16

i. Text Book and Reference Book:

1. Gilbert M. Masters and Wendell P. Ela. 2013. Introduction to Environmental Engineering and Science. Pearson Education Limited, NY, USA.
2. Suresh K. Dhameja. 2009. Environmental Engineering and Management. S. K. Kataria & Sons, New Delhi.
3. Bernard J. Nebel and Richard T. Wright. 1993. Environmental Science: The Way the World Works. Prentice Hall Professional, New Delhi.
4. Bharucha Erach. 2005. Text book of environment studies for undergraduate courses. University Grants Commission, University Press, Hyderabad.

5. Sharma J.P. 2003. Introduction to environment science, Lakshmi Publications, Delhi
6. Gupta P.K. 2004. Methods in environmental analysis, water, soil and air. Agro Bios, Jodhpur.
7. Sharma R.K. & Sharma G. 2005. Natural disaster. APH publishing corporation, New Delhi
8. Husain Majid.2013. Environment and Ecology: Biodiversity, Climate Change and Disaster Management, online book.

j. Experiment List:

Sr. NO.	Experiment List
1	Study of the earth's atmosphere & hydrosphere
2	Study of lithosphere and bio-sphere
3	Study of the ecosystem of a pond
4	Study of hydrological and carbon cycle
5	Study of nitrogen and sulphur cycle
6	Study of major ecosystem of the earth.
7	Study of population growth and method of population forecasting
8	Study of water resources, its overuse and related problems
9	Study of forest resources
10	Study of energy resources
11	Estimation of BOD
12	Estimation of COD
13	Study of water pollution, classification and their effects
14	Study of common air pollutants and their effects.
15	Visit to ETP unit & case studies

Semester 2
[09]

- a. Course Name:** Communication Skills
b. Course Code: 20193104
c. Prerequisite: Knowledge of English up to 12th science level.
d. Rationale: The Communication Skills course in B.Tech Food Technology is of paramount importance as it equips students with the essential abilities to effectively convey technical knowledge collaborate with industry stakeholders, and articulate ideas crucial for success in the dairy technology field.
e. Course Learning Objective:

CLOBJ 1	Develop the ability to express thoughts and ideas clearly and concisely through spoken language.
CLOBJ 2	Improve written communication skills, including composing clear and professional emails, reports, and other written documents.
CLOBJ 3	Explore and employ digital communication tools, platforms, and multimedia aids for professional communication, including virtual meetings, collaboration software, and social media.
CLOBJ 4	Cultivate interpersonal skills, including empathy and conflict resolution, to navigate various communication scenarios effectively.

f. Course Learning Outcomes:

CLO 1	Understand basics of English grammar
CLO 2	Display basic level of communication confidence
CLO 3	Study the basics of communication, types of communication, models of communication and barriers to communication
CLO 4	Distinguish the technical writing, scientific writing and resume writing

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
-	2	0	1	-	100	-	-	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Crazy Scientist The students will be taught the importance of invention and innovation using some examples that changed the world the way it worked.	6.66%	2
2	Phonetics IPA Introduction (listening tracks) Phonic Sounds Listening Activity Pronunciation Practice	6.66%	2
3	Vocabulary Building Word formation process: Compounding, clipping, blending, derivation, creative respelling, coining and borrowing Prefixes & suffixes, synonyms & antonyms, standard abbreviations (related activities will be provided) Methods to enhance Vocabulary	13.33%	4
4	Speaking Activity Role play	6.66%	2
5	Identifying Common Errors in Writing: Sentence structure Punctuations Subject-Verb Agreement Noun-Pronoun Agreement	6.66%	2
6	Reading Comprehension: The art of effective reading Employing different reading skills Practice	6.66%	2
7	Speech a Spoken Exchanges Stage; Delivering different types of speeches Welcome /Introductory speech Vote of Thanks speeches Farwell speeches	13.33%	4
8	Professional Presentations Combating stage fright Preparing power point presentation Delivering PPT	13.33%	4
9	Picture Connector In this class the students will be trained to form a logical connection between a set of pictures which will be shared with them. This is geared towards building creativity and presentation skills	6.66%	2
10	Movie Review Provides training of writing movie review by showing film. To develop speaking skills using presentation of movie review.	6.66%	3
11	Error analysis Tenses Active passive voice	6.66%	2

	Direct indirect speech		
12	Reporter Classroom Activity to encourage Communication and Convincing Skills.	6.66%	3
Total		100%	32

i. Text Book and Reference Book:

1. Ajmani, J. C. Good English: Getting it Right. New Delhi: Rupa Publications, 2012.
2. Adair, John. Effective Communication. London: Pan Macmillan Ltd., 2003.
3. Brown, Michele & Gyles Brandreth. How to Interview and be Interviewed. London: Sheldon Press, 1994.
4. Fitikides, T. J. Common Mistakes in English. London: Orient Longman, 1984.

Semester 2
[10]

- a. Course Name:** Food Chemistry of Macronutrients
- b. Course Code:** 20105153
- c. Prerequisite:** Knowledge of Physics & Mathematics up to 12th science level.
- d. Rationale:** Food Chemistry of Macronutrients subject provides essential insights into the physicochemical properties and transformations of carbohydrates, proteins, and lipids, laying the foundation for designing and optimizing food processes and formulations to meet nutritional and sensory requirements.

e. Course Learning Objective:

CLOBJ 1	Understand about the Scope and development of food chemistry.
CLOBJ 2	Elaborate the role and type of water in foods, functional properties of water, water activity and sorption isotherm.
CLOBJ 3	Discover the basic knowledge of Carbohydrates: Changes of carbohydrates on cooking, modification of carbohydrates, dietary fibers.
CLOBJ 4	Learn Proteins in foods: Processing induced, physical, chemical and nutritional changes in protein.
CLOBJ 5	Explain Role and use of lipids/fat, crystallization and consistency, chemical aspects of lipids, lipolysis, auto-oxidation, and its thermal decomposition.

f. Course Learning Outcomes:

CLO 1	Explore the scope and development of food chemistry.
CLO 2	Investigate the role and types of water in foods, focusing on functional properties, water activity, and sorption isotherms.
CLO 3	Acquire basic knowledge about carbohydrates, including their changes during cooking, modification, and dietary fiber.
CLO 4	Examine the impact of processing on proteins in foods, covering physical, chemical, and nutritional changes.
CLO 5	Understand the role and use of lipids/fat, including crystallization, consistency, chemical aspects, lipolysis, auto-oxidation, and thermal decomposition.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	2	3	30	-	20	50	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Nature Scope and development of food chemistry;	20%	6
2	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, emulsions); Rheology of diphase systems;	20%	7
3	Carbohydrates: Changes of carbohydrates on cooking, modification of carbohydrates, dietary fibres and carbohydrates digestibility; Enzymatic and chemical reactions of carbohydrates;	20%	6
4	Proteins in foods: Processing induced, physical, chemical and nutritional changes in protein, chemical and enzymatic modification of protein;	20%	6
5	Lipids in foods: 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, safety 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.	20%	7
Total		100%	32

i. Text Book and Reference Book:

1. John W. Brady. 2013. Introductory Food Chemistry. Comstock Publishing Associates, Cornell University Press, Ithaca, USA.
2. H.-D. Belitz, W. Grosch and P. Schieberle. 2009. Food Chemistry, 4th Ed. Springer-Verlag Berlin Heidelberg.
3. Owen R, Fennema. 1996. Food Chemistry, 3rd Ed. Marcel Dekker, Inc., New York, USA.

4. Lillian Hoagland Meyer. 1974. Food Chemistry. The AVI Publishing Co Inc., Connecticut, MA, USA.

j. Experiment List:

Sr. NO.	Experiment List
1	Determination of moisture content of foods using different methods;
2	Studies of sorption isotherms of different foods;
3	Swelling and solubility characteristics of starches;
4	Rheological properties of food systems;
5	Determination of crude proteins by micro-Kjeldhal method;
6	Determination of essential amino acids i.e. lysine, tryptophan, methionine, etc.;
7	Isolation of egg and milk protein;
8	Preparation of protein isolate and concentrate of proteins;
9	Determination of acid value, saponification value and iodine number of fat/oil;
10	Assay of amylases, papain and lipases.

Semester 2
[11]

- a. **Course Name:** Food Microbiology
- b. **Course Code:** 20105154
- c. **Prerequisite:** Knowledge of biology up to 12th science level.
- d. **Rationale:** The study of food microbiology aims to understand the interactions between microorganisms and food, crucial for ensuring food safety, quality, and preservation in the food industry.

e. Course Learning Objective:

CLOBJ 1	Recognize and characterize various microbial hazards commonly associated with food, including bacteria, viruses, fungi, and parasites
CLOBJ 2	Acquire knowledge about specific foodborne pathogens
CLOBJ 3	Develop proficiency in laboratory techniques used to isolate, enumerate, and identify microorganisms present in food samples
CLOBJ 4	learn to critically evaluate food safety practices and control measures
CLOBJ 5	Apply principles of food microbiology to implement quality assurance programs in food production, processing, and distribution.

f. Course Learning Outcomes:

CLO 1	Understanding about Importance and significance of microbes in food science.
CLO 2	Study the Microbial spoilage of foods Factors affecting kinds, numbers, growth and survival of microorganisms in foods.
CLO 3	Acquire the basic knowledge of Contamination of foods; Sources of contamination, microbiology of milk, meat, egg, sugar, spice, and other food products.
CLO 4	Learn Shelf-life requirements and calculation of the shelf-life.
CLO 5	Explain Food borne intoxications and infections types of food involved, toxicity and symptoms.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	2	3	30	-	20	50	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Importance and significance of microbes in food science;	10%	3
2	Microbial spoilage of foods Factors affecting kinds, numbers, growth and survival of microorganisms in foods; Intrinsic factors; pH, water activity, nutrients etc., Extrinsic factors: Relative humidity, temperature, gaseous atmosphere; Chemical changes caused by microorganisms: Changes in nitrogenous organic compounds, non-nitrogenous organic compounds, organic acids, other compounds, lipids, pectic substances;	20%	7
3	Contamination of foods; Sources of contamination, Genera of bacteria, Maintenance of anaerobic conditions; Asepsis, removal of microorganisms; Intermediate moisture foods; Microbiology of milk and milk products; Microbiology of fruits and vegetables, Microbiology of cereal and cereal products, Microbiology of meat and meat products, Microbiology of fish and other sea foods; Microbiology of poultry and eggs: Microbiology of sugar and sugar products; Microbiology of salts and spices, Microbiology of canned foods	30%	9
4	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;	20%	6
5	Food borne intoxications and infections types of food involved, toxicity and symptoms, chemical properties, environmental conditions; Food borne viruses: Polio, hepatitis A & E, noroviruses, rota viruses, prion diseases,	20%	7

	types of food involved, toxicity and symptoms, chemical properties, environmental conditions.		
Total		100%	32

i. Text Book and Reference Book:

1. Martin R. Adams and Maurice O. Moss. 2008. Food Microbiology, 3rd Ed., The Royal Society of Chemistry, Cambridge, UK.
2. James M. Jay. 2000. Modern Food Microbiology, 6th Ed. Aspen Publishers, Inc., Gaithersburg, Maryland, USA.
3. George J. Banwart. 1989. Basic Food Microbiology, 2nd Ed. Chapman & Hall, New York, USA.
4. William C. Frazier and Dennis C. Westhoff. 1987. Food Microbiology, 4th Ed. Tata McGrawHill Education, New Delhi.

j. Experiment List:

Sr. No.	Experiment List
1	Isolation of bacteria and molds from foods;
2	Microbial examination of cereal and cereal products: Identification, isolation and confirmation;
3	Microbial examination of vegetable and fruits: Identification, isolation and confirmation;
4	Microbial examination of meat and meat products: Identification, isolation and confirmation;
5	Microbial examination of fish and other sea foods: Identification, isolation and confirmation;
6	Microbial examination of eggs and poultry: Identification, isolation and confirmation;
7	Microbial examination of milk and milk products: Identification, isolation and confirmation;
8	Microbial examination of sugar, salts and spices:
9	Microbial examination of canned products: Identification, isolation and confirmation;
10	Determination and enumeration of pathogenic and indicator organisms in foods (Coliform/ Enterococcus);
11	Thermal death time determination;
12	Detection of Salmonella from food sample;
13	Detection of coliforms from water by MPN method;
14	Detection of <i>Staphylococcus aureus</i> from food sample.

Semester 2
[12]

- a. Course Name:** Food Thermodynamics
- b. Course Code:** 20105155
- c. Prerequisite:** Knowledge of Chemistry and Mathematics up to 12th science level.
- d. Rationale:** Understanding food thermodynamics is crucial for B Tech Food Technology students as it provides the foundational knowledge needed to comprehend energy transfer, heat preservation, and various thermal processes essential for food production, preservation, and quality maintenance.
- e. Course Learning Objective:**

CLOBJ 1	Understanding about Basic concepts: definitions, approaches, thermodynamic systems
CLOBJ 2	Study the Energy, enthalpy, specific heats, applications of first law, steady and unsteady flow analysis; Second law of thermodynamics.
CLOBJ 3	Adapt basic knowledge on Properties of Pure Substances: Thermodynamic properties of pure substances in solid, liquid and vapor phases.
CLOBJ 4	Learn the Carnot vapor power cycle, ideal Rankine cycle, Rankine Reheat cycle, air standard Otto cycle.
CLOBJ 5	Explain about thermodynamic properties of moist air.

f. Course Learning Outcomes:

CLO 1	Understand the basic principles of the first law of thermodynamics and its applications in food-related processes.
CLO 2	Apply the principles of steady and unsteady flow to food-related scenarios.
CLO 3	Understand the thermodynamic properties of pure substances in different phases—solid, liquid, and vapor.
CLO 4	Analyse the efficiency and practical applications of these cycles in food-related contexts.
CLO 5	Construct and apply the principles of thermodynamic properties of moist air, dehumidifying, and various food-related processes.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	1	3	30	-	20	50	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	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	20%	6
2	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, thermodynamic temperature scale, entropy, availability and irreversibility	20%	7
3	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	10%	3
4	Carnot vapor power cycle, ideal Rankine cycle, Rankine Reheat cycle, air standard Otto cycle, air standard Diesel cycle, air-standard Brayton cycle, vapor-compression refrigeration cycle	10%	4
5	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	40%	12

	temperature, adiabatic processes, wet bulb depression, humid heat, specific volume, heating, cooling, dehumidifying, sorption isotherms, three stages of water, phase diagram for water, vapour pressure-temperature curve for water, heat requirement for vaporization, measurement of humidity, Properties of steam: Wet, dry saturated, superheated steam, use of steam tables.		
Total		100%	32

i. Text Book and Reference Book:

1. R.K. Rajput. 2007. Engineering Thermodynamics, 3rd Ed. Laxmi Publications (P) Ltd., Bangalore.
2. J.M. Smith, H.C. Van Ness and M.M. Abbott. 2005. Introduction to Chemical Engineering Thermodynamics, 7th Ed. McGraw-Hill, Inc., NY, USA.
3. Warren L. McCabe, Julian Smith, Peter Harriott. 2004. Unit Operations of Chemical Engineering, 7th Ed. McGraw-Hill, Inc., NY, USA.
4. Christie John Geankoplis. 2003. Transport Processes and Separation Process Principles (Includes Unit Operations), 4th Ed. Prentice-Hall, NY, USA.
5. Donald B. Brooker, Fred W. Bakker-Arkema and Carl W. Hall. 1976. Drying Cereal Grains. The AVI Publishing Company, Inc., Connecticut, MA, USA.

j. Experiment List:

Sr. NO.	Experiment List
1	Determination of dryness fraction of steam.
2	Determination of state of air using psychometric chart and hygrometer;
3	Use of psychometric chart during drying process/ humidification process;
4	Demonstration of equilibrium sorption isotherms;
5	Use of psychometric chart during drying process/ humidification process;
6	Visit to food plant with steam utilization.

Semester 2
[13]

- a. **Course Name:** Computer Programming and Data Structures
- b. **Course Code:** 20105156
- c. **Prerequisite:** Knowledge of Computer and Mathematics up to 12th science level.
- d. **Rationale:** Computer Programming and Data Structures in B Tech Food Technology is essential for students to acquire fundamental skills in coding and algorithmic thinking, enabling them to develop efficient and innovative solutions for data management and programming challenges in the food technology domain.

e. Course Learning Objective:

CLOBJ 1	comprehensive understanding of computer technology.
CLOBJ 2	understanding of computer programming and data structures.
CLOBJ 3	Acquire foundational knowledge in Computer Programming and Data Structures by understanding the structure of a C program, simple data types etc.
CLOBJ 4	Develop a comprehensive understanding of high-level programming languages.

f. Course Learning Outcomes:

CLO 1	Understand the computer technology; Processor, memory, secondary storage, display devices and other peripheral devices
CLO 2	Study the types of systems software, applications software and programming language; Algorithms and flow-charts:
CLO 3	Assess the basic knowledge of Structure of a C program
CLO 4	Explain the high-level languages.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
1	-	4	3	30	-	20	50	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Introduction and historical background: Review of computer technology; Processor, memory, secondary storage, display devices and other peripheral devices; Basic computer organization, future trends; Brief review of present-day applications, programming;	13%	2
2	Introduction to systems software, applications software and programming language; Algorithms and flow-charts: Input- processing-output model of a computer program; Role of the compiler and the integrated development environment;	13%	3
3	Introduction to C: Structure of a C program, simple data types, declarations, operators and expressions; The assignment statement; Library functions; Control Structures: Conditional and iterative execution of statements	28%	4
4	Importance of documentation; Nesting of control structures and the use of indentation to indicate nesting levels; Labels and the “go to” statement; Arrays; Single and multi-dimensional arrays: Character strings and string functions; Functions: Scope rules; Argument passing by reference and by value; Storage classes; Use of function prototypes; Structures, unions and user-defined types; Operations on files: Concept of standard input and output files; Formatting of data on input and output; Use of include files;	20%	3
5	Introduction to high level languages; Primary data types and user defined data types, variables, typecasting, operators, building and evaluating expressions, standard library functions, managing input and output, decision making, branching, looping, arrays, user defined functions, passing arguments and returning values, recursion, scope and visibility of a variable, string functions, structures and union, pointers, stacks, push/pop operations, queues, insertion and deletion operations, linked lists.	26%	4
Total		100%	16

i. Text Book and Reference Book:

1. Mark Allen Weiss. 2014. Data Structures and Algorithm Analysis in C++, 4th Ed. Pearson Education, Boston, USA.
2. Svetlin Nakov & Co. 2013. Fundamentals of Computer Programming with c#. Sofia, Bulgaria.
3. F. Balagurusamy. 2008. Object Oriented Programming with C++, 4th Ed. Tata McGraw-Hill Publishing Company Limited, New Delhi.
4. Structure and Interpretation of computer programs (SICP), by Harold Abelson, Gerald Jay Sussman, Julie Sussman. MIT Press.

j. Experiment List:

Sr. NO.	Experiment List
1	Familiarizing with Turbo C IDE;
2	Building an executable version of C program;
3	Debugging a C program;
4	Developing and executing simple programs;
5	Creating programs using decision making statements such as if, go to and switch;
6	Developing program using loop statements while, do and for;
7	Using nested control structures; Familiarizing with one and two dimensional arrays;
8	Using string functions; Developing structures and union;
9	Creating user defined functions; Using local, global and external variables;
10	Using pointers; Implementing stacks;
11	Implementing push/ pop functions; Creating queues;
12	Developing linked lists in C language;
13	Insertion/deletion in data structures.

Semester 2
[14]

- a. **Course Name:** Fluid Mechanics
- b. **Course Code:** 20105157
- c. **Prerequisite:** Knowledge of Physics and Mathematics up to 12th science level.
- d. **Rationale:** Fluid Mechanics in B Tech Food Technology is significant for understanding the principles governing fluid behaviour, flow, and transport, crucial for optimizing processes in food technology, ensuring product quality, and enhancing efficiency in various applications such as pumping, mixing, and heat transfer.

e. Course Learning Objective:

CLOBJ 1	Develop a foundational comprehension of measurement units.
CLOBJ 2	Explore fluid flow classifications.
CLOBJ 3	Acquire fundamental knowledge in the flow through pipes.
CLOBJ 4	Discover the classification of turbines and pumps.
CLOBJ 5	Understand pressure variation and work efficiency in fluid systems.

f. Course Learning Outcomes:

CLO 1	Understanding about the Units and dimensions.
CLO 2	Classify fluid flows.
CLO 3	Apply the basic knowledge of Flow through pipes.
CLO 4	Explain the Turbines and pumps.
CLO 5	Examine about the Pressure variation and work efficiency.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	2	3	30	-	20	50	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
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; Floating bodies: Archimedes principle, stability of floating bodies; Equilibrium of floating bodies, metacentric height;	20%	6
2	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 equation: Laminar flow between two straight parallel boundaries; Flow past through the immersed solids, packed and fluidized beds;	20%	7
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;	20%	6
4	Turbines and 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	20%	6

	discharge, acceleration of piston and water, gear pump;		
5	Pressure variation, work efficiency; Pressure requirements for viscous foods to lift them to different heights and selection of pumps; Open channel hydraulics: Classification of open channel and definitions, most economical sections of regular cross-sections; Specific energy concept-critical depth, energy diagrams; Velocity and pressure profiles in open channels; Hydraulic jumps-types.	20%	7
Total		100%	32

i. Text Book and Reference Book:

1. Frank M. White. 2010. Fluid Mechanics, 7th Ed. McGraw-Hill Book Co., Inc., Boston, USA.
2. Yunus A. Çengel and John M. Cimbala. 2006. Fluid Mechanics: Fundamentals and Applications. McGraw-Hill, Inc., New York, USA.
3. Bruce R. Munson, Donald F. Young and Theodore H. Okiishi. 2002. Fundamentals of Fluid Mechanics, 4th Ed. John Wiley & Sons, Inc., New York, USA.
4. E. John Finnemore and Joseph B. Franzini. 2002. Fluid Mechanics with Engineering Applications, 10th Ed. McGraw-Hill, Inc., New York, USA.

j. Experiment List:

Sr. NO.	Experiment List
1	Study of different tools and fittings;
2	Study on flow rate versus pressure drop with U-tube manometer;
3	Verification of Bernoulli's theorem;
4	Determination of discharge co-efficient for venturi, orifice, V-notch;
5	Verification of emptying time formula for a tank;
6	Determination of critical Reynold's number by Reynold apparatus;
7	Study of reciprocating, centrifugal and gear pump;
8	Calibration of rotameter; Study of different types of valves;
9	Study of pumps for viscous fluid; Floating bodies, liquid flow, venturimeter, orifice, weir, flow through pipes.

Semester 2
[15]

- a. Course Name:** Basic Electronics Engineering
- b. Course Code:** 20105158
- c. Prerequisite:** Knowledge of Chemistry and Mathematics up to 12th science level.
- d. Rationale:** Understanding Basic Electronics Engineering equips B Tech Food technology students with foundational knowledge essential for efficient control and automation in food processing, ensuring the integration of electronic principles in advanced technologies within the food industry.
- e. Course Learning Objective:**

CLOBJ 1	Develop a comprehensive understanding of semiconductors, P-n junctions, V-I characteristics of P-n junctions.
CLOBJ 2	Explore types of diode circuits for OR and AND (positive and negative logic).
CLOBJ 3	Appraise Knowledge on Amplifier Coupling, Transistor Models, and Operational Amplifiers.
CLOBJ 4	Understand the basic theorems of Boolean algebra, explore combinational logic circuits, including basic gates, SOP rule, K-map, and binary ladder D/A converter.

f. Course Learning Outcomes:

CLO 1	Understand about Semiconductors, P-n junction, V-I characteristics of P-n junction.
CLO 2	Study the types of Diode circuits for OR and AND.
CLO 3	Appraise the knowledge on Coupling of amplifiers, h-parameter model of a transistor.
CLO 4	Learn Basic theorem of Boolean algebra; Combinational logic circuits.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	2	3	30	-	20	50	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Semiconductors, P-n junction, V-I characteristics of P-n junction, diode as a circuit element, rectifier, clipper, clamper, voltage multiplier, filter circuits;	20%	7
2	Diode circuits for OR and AND (both positive and negative logic) bipolar junction transistor: Operating point, classification (A, B and C) of amplifier, various biasing methods (fixed, self, potential divider);	30%	9
3	Coupling of amplifiers, h-parameter model of a transistor, analysis of small signal, CE amplifier, phase shift oscillator, analysis of differential amplifier using transistor, ideal OP-AMP characteristics, linear and non-linear applications of OP-AMP integrator, active rectifier, comparator, differentiator, differential, instrumentation amplifier and oscillator), Zener diode voltage regulator, transistor series regulator, current limiting, OP-AMP voltage regulators;	30%	9
4	Basic theorem of Boolean algebra; Combinational logic circuits (basic gates, SOP rule and K-map, binary ladder D/A converter of displacement, temperature, velocity, force and generalized instrumentation, measurement of displacement, temperature, velocity, force and pressure using potentiometer, resistance thermometer, thermocouples.	20%	7
Total		100%	32

i. Text Book and Reference Book:

1. A.K. Sawhney. 2010. Course in Electrical and Electronics Measurements and Instrumentation. Dhanpat Rai Publications (P) Limited, New Delhi.
2. V.K. Mehta and Rohit Mehta. 2008. Principles of Electronics. S. Chand and Co., New Delhi.
3. Anand Kumar. 2014. Fundamentals of Digital Circuits. PHI Pvt. Ltd., New Delhi.
4. D. Choudhury Roy. 2003. Linear Integrated Circuits. John Wiley International, NY.
5. Sanjeev Gupta. 2002. Electronic Devices and Circuits. Dhanpat Rai Publications (P) Limited, New Delhi.

j. Experiment List:

Sr. NO.	Experiment List
1	Study of diode characteristics;
2	Study of triode characteristics;
3	Study of Zener diode;
4	Study of V-I characteristics of P-n junction diode;
5	Study of RC coupled amplifier;
6	Study of RC phase shift oscillator;
7	Study of full wave rectifier;
8	Verification of logic gates;
9	Determination of energy gap in a junction diode;
10	Study of transistor characteristics in CE configuration;
11	Study of OP-Amp IC 741 as differential amplifier;
12	Study of half wave rectifier;
13	Study of OP-AMP IC 741 as a active rectifier;
14	Study of transistor characteristics;
15	Study of temperature characteristics of resistor;
16	Study of diode as clipper and clamper.

Semester 2
[16]

- a. **Course Name:** Engineering Mathematics-II
- b. **Course Code:** 20105159
- c. **Prerequisite:** Knowledge of Chemistry and Mathematics up to 12th science level.
- d. **Rationale:** Engineering Mathematics in B Tech Food Technology is significant for providing the foundational mathematical knowledge essential for understanding and solving engineering problems related to food processing, ensuring students have a strong mathematical background for their specialized field.
- e. **Course Learning Objective:**

CLOBJ 1	Develop a comprehensive understanding of elementary transformations, matrix rank.
CLOBJ 2	Explore the concepts of limits, continuity and derivatives of complex functions.
CLOBJ 3	Acquire foundational knowledge on Fourier series, including the understanding of infinite series and its convergence, periodic functions, and Euler's formulae.
CLOBJ 4	Understand the formation of differential equations.

f. Course Learning Outcomes:

CLO 1	Understanding about Elementary transformations, rank of a matrix, reduction to normal form, Gauss- Jordan method to find inverse of a matrix.
CLO 2	Study the Functions of a complex variable: Limit, continuity and derivative of complex functions, analytic function.
CLO 3	Appraise the basic knowledge on Fourier series: Infinite series and its convergence, periodic functions, Fourier series, Euler's formulae.
CLO 4	Explain differential equations.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	0	-	40	10	-	50	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Matrices: Elementary transformations, rank of a matrix, reduction to normal form, Gauss- Jordan method to find inverse of a matrix, consistency and solution of linear equations, Eigen values and Eigen vectors, Cayley-Hamilton theorem, linear transformation, orthogonal transformations, diagonalization of matrices, bilinear and quadratic forms;	26%	8
2	Functions of a complex variable: Limit, continuity and derivative of complex functions, analytic function, Cauchy-Reimann equations, conjugate functions, harmonic functions;	22%	7
3	Fourier series: Infinite series and its convergence, periodic functions, Fourier series, Euler's formulae, Dirichlet's conditions, functions having arbitrary period, even and odd functions, half range series, harmonic analysis;	24%	8
4	Partial differential equations: Formation of partial differential equations, Lagrange's linear equation, higher order linear partial differential equations with constant coefficients, solution of non-linear partial differential equations, Charpit's method, application of partial differential equations (one- dimensional wave and heat flow equations, two-dimensional steady state heat flow equation (Laplace equation).	28%	9
Total		100%	32

i. Text Book and Reference Book:

1. B.V. Ramana. 2008. Engineering Mathematics. Tata McGraw-Hill Book Co., New Delhi.
2. B.S. Grewal. 2004. Higher Engineering Mathematics. Khanna Publishers, Delhi.
3. Shanti Narayan 2004. A Textbook of Matrices. S. Chand and Co. Ltd., New Delhi.

Semester 2
[17]

- a. **Course Name:** Post - Harvest Engineering
- b. **Course Code:** 20105160
- c. **Prerequisite:** Knowledge of Chemistry and Mathematics up to 12th science level.
- d. **Rationale:** Post-Harvest Engineering equips students with essential knowledge and skills to optimize food preservation, reduce losses, and enhance the quality of harvested produce in the field of Food Technology.
- e. **Course Learning Objective:**

CLOBJ 1	Develop a comprehensive understanding of post-harvest technology.
CLOBJ 2	Explore various types of post-harvest operations, focusing on sorting and grading methods.
CLOBJ 3	Acquire foundational knowledge of material handling systems.
CLOBJ 4	Understand the theory of grain drying, the operation of grain dryers, liquid dryers, and various milling processes.
CLOBJ 5	Explore and explain the use of separation techniques for quality enhancement and preservation.

f. Course Learning Outcomes:

CLO 1	Understand about post-harvest technology.
CLO 2	Study the types of post-harvest operations Sorting and grading
CLO 3	Appraise the basic knowledge of material handling systems.
CLO 4	Learn Grain drying and milling theory.
CLO 5	Explain Magnetic separator, destoners, electrostatic separators, pneumatic separator.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	2	3	30	-	20	50	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Overview of post harvest technology: Concept and science, production and post harvest losses, reasons for losses, importance of loss reduction; Water activity, water binding and its effect on enzymatic and non-enzymatic reactions and food texture, control of water activity and moisture;	10 %	4
2	Post-Harvest Handling operations; 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; Sorting and grading: 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;	30 %	9
3	Separation: 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.;	20 %	6
4	Grain drying theory, grain dryers; Liquid dryers; Parboiling: process, changes during parboiling, parboiling methods, advantages and disadvantages of parboiling with respect to milling, nutritional and cooking quality of grain, significance of glass transition temperature; Milling: milling, polishing, grinding, milling equipments, dehuskers, polishers (abrasion, friction, water jet), flour milling machines, pulse milling machines, grinders, cutting machines, oil expellers, machine efficiency and power requirement	30 %	9
5	Materials handling: Introduction to different conveying equipments used for handling of grains, fruits and vegetables; Scope and importance of material handling devices; Study of different material handling systems: Classification, principles of operation, conveyor system selection/design; Belt conveyor: Principle,	10 %	4

	<p>characteristics, design, relationship between belt speed and width, capacity, inclined belt conveyors, idler spacing, belt tension, drive tension, belt tripper; Chain conveyor: Principle of operation, advantages, disadvantages, capacity and speed, conveying chain; Screw conveyor: Principle of operation, capacity, power, troughs, loading and discharge, inclined and vertical screw conveyors; Bucket elevator: Principle, classification, operation, advantages, disadvantages, capacity, speed, bucket pickup, bucket discharge, relationship between belt speed, pickup and bucket discharge, buckets types; Pneumatic conveying system: Capacity and power requirement, types, air/product separators; Gravity conveyor design considerations, capacity and power requirement.</p>		
Total		100%	32

i. Text Book and Reference Book:

1. Chakraverty. 2008. Post Harvest Technology of Cereals, Pulses and Oilseeds, 3rd Ed. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
2. Don W. Green and Robert H. Perry. 2008. Perry's Chemical Engineers' Handbook. McGraw Hill Co., Inc., NY, USA.
3. James G. Brennan. 2006. Food Processing Handbook. Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim, Germany.
4. K.M. Sahay and K.K. Singh. 2001. Unit Operations of Agricultural Processing. Vikas Publishing House Pvt. Ltd., Noida, UP.

j. Experiment List:

Sr. NO.	Experiment List
1	Study of cleaners for grains; Study of washers for fruits and vegetables;
2	Study of graders for grains;
3	Study of graders for fruits and vegetables;
4	Study of decorticators; Study of a maize/ sunflower sheller;
5	Study of crop dryers; Study of a RF/MW/tray dryer;
6	Study of hot air dryer and modelling drying kinetics;
7	Study of vacuum dryer and modelling drying kinetics;
8	Study of working principle of spray dryer and spray drying process;
9	Study of drum dryer and liquid food dehydration using drum drying;
10	Study of fluidized bed dryer and drying process;
11	Study of freeze dryer and freeze drying process;
12	Study of rice milling machines;
13	Study of pulse milling machines;
14	Study of different components of flour mill;
15	Study of different materials handling equipment

Semester 2
[18]

- a. Course Name:** Fundamentals of Food Processing
b. Course Code: 20105203
c. Prerequisite: Basic knowledge of milk and milk products studied upto 12th science.
d. Rationale: To able perform practical on milk products, different treatment applied to increase shelf life of milk.
e. Course Learning Objective:

CLOBJ 1	Explain the principles behind each preservation technique and their impact on the quality and safety of food products.
CLOBJ 2	Identify and describe the key unit operations involved in food processing, such as size reduction, mixing, heat transfer, and separation.
CLOBJ 3	Identify potential hazards and contaminants in food processing and understand methods to control and mitigate them.
CLOBJ 4	Explore the functions of different ingredients in food processing, such as emulsifiers, stabilizers, thickeners, and preservatives.
CLOBJ 5	Analyse and design simple food processing systems, considering factors like efficiency, sustainability, and cost-effectiveness.

f. Course Learning Outcomes:

CLO 1	Understand the basic of heat transfer and energy requirement in food industry, physical properties of water, water activity.
CLO 2	Learn different drying methods, quality of dried foods.
CLO 3	Acquire knowledge about preservation by chemicals- antioxidants, mould inhibitors, antibodies, acidulants, etc.
CLO 4	Describe different heat preservation techniques like pasteurization, sterilization, aseptic processing, UHT, thermal resistance of microorganisms.
CLO 5	Study about the basics, working principle, applications of high pressure processing method used in food industry.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	2	3	30	-	20	50	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Sources, types and perishability of foods; Causes and types of food spoilage; Scope and benefit of food preservation; Methods of food preservation; Preservation by salt and sugar: Principle, method and effect on food quality.	17%	6
2	Preservation by heat treatment: Principle and equipment for blanching, canning, pasteurization, sterilization;	13%	4
3	Preservation by use of low temperature: Principle, methods, equipment; Preservation by drying, dehydration and concentration: Principle, methods, equipment; Preservation by irradiation: Principle, methods, equipment.	20%	6
4	Preservation by chemicals- antioxidants, mould inhibitors, antibodies, acidulants, etc.;	13%	4
5	Preservation by fermentation: Principles, methods, equipment;	17%	5
6	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, etc.; Quality tests and shelf-life of preserved foods.	20%	7
Total		100%	32

i. Text Book and Reference Book:

1. Stavros Yanniotis. 2008. Solving Problems in Food Engineering. Springer Science + Business Media, NY, USA.
2. Gaurav Tewari and Vijay K. Juneja. 2007. Advances in Thermal and Non-Thermal Food Preservation. Blackwell Publishing, Ames, Iowa, USA.
3. M. Shafiur Rahman. 2007. Handbook of Food Preservation, 2nd Ed. CRC Press, Boca Raton, FL, USA.
4. James G. Brennan. 2006. Food Processing Handbook. Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim, Germany.

j. Experiment List:

Sr. NO.	Experiment List
1	Demonstration of various perishable food items and degree of spoilage;
2	Blanching of selected food items; Preservation of food by heat treatment-pasteurization; Preservation of food by high concentration of sugar: Jam;
3	Preservation of food by using salt: Pickle;
4	Preservation of food by using acidulants i.e. pickling by acid, vinegar or acetic acid;
5	Preservation of food by using chemical preservatives; Preservation of bread, cake using mold inhibitors;
6	Drying of fruit slices pineapple slices, apple slices in cabinet drier;
7	Drying of green leafy vegetables;
8	Drying of mango/ other pulp by foam-mat drying;
9	Drying of semisolid foods using roller dryers;
10	Drying of foods using freeze-drying process;
11	Demonstration of preserving foods under cold vs. freezing process;
12	Processing of foods using fermentation technique, i.e. preparation of sauerkraut;
13	Study on effect of high pressure on microbe; Study on effect of pulse electric field on food.

Semester 2
[19]

- a. Course Name:** Processing Technology of Liquid Milk
- b. Course Code:** 20105204
- c. Prerequisite:** Knowledge of Chemistry and Mathematics up to 12th science level.
- d. Rationale:** Understanding the principles and techniques involved in the production and processing of liquid milk, crucial for ensuring quality, safety, and efficiency in the dairy industry.
- e. Course Learning Objective:**

CLOBJ 1	Develop a comprehensive understanding of milk sources and its composition, including the essential components that contribute to its nutritional value.
CLOBJ 2	Acquire detailed knowledge of various milk processing methods, outlining the steps involved in transforming raw milk into market-ready products.
CLOBJ 3	Attain the skill to systematically classify and understand the diverse milk processing equipment employed in the dairy industry, recognizing their specific roles and applications.
CLOBJ 4	Acquire the expertise to formulate various dairy products by applying knowledge of processing methods and ingredient combinations.
CLOBJ 5	Develop the ability to critically assess safety and quality factors in dairy products, understanding their pivotal role in determining consumer acceptability.

f. Course Learning Outcomes:

CLO 1	Examine the knowledge on milk source and its composition
CLO 2	Describe the various milk processing methods
CLO 3	Classify the milk processing equipments used in milk industry
CLO 4	Formulate the different dairy products
CLO 5	Evaluate the safety and quality factors that determine the acceptability of the dairy products by consumers

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
1	-	2	2	30	-	20	50	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Historical development of dairy in India; Production and utilization of milk; Composition and properties of milk	13.33 %	2
2	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.	20 %	3
3	Cream: definition, classification, manufacture of different types of cream, processing of cream	13.33 %	2
4	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	20 %	4
5	Adulterations in milk and its detection; Quality defects in milk-causes and prevention, liquid milk collection, processing, packaging and storage systems and equipment - bulk milk coolers, milk chilling units, milk reception equipment, milk tanks/silos, pasteurizers, sterilizers, centrifuges, clarifiers, filtration units, homogenizers, packaging and filling machines, CIP units, etc.	26.67%	4
6	Hygienic design concepts, sanitary pipes and fittings, corrosion process and their control.	6.67 %	1
Total		100%	16

i. Text Book and Reference Book:

1. Adnan Y. Tamime. 2009. Milk Processing and Quality Management. Blackwell Publishing Ltd., UK.
2. Kanekanian. 2014. Milk and Dairy Products as Functional Foods. John Wiley & Sons, Ltd., UK
3. Pieter Walstra, Jan T.M. Wouters, Tom J. Geurts. 2006. Dairy Science and Technology, 2nd Ed. CRC Press, Boca Raton, FL, USA.
4. Sukumar De. 2005. Outlines of Dairy Technology. Oxford University Press, New Delhi.
5. H.G. Kessler. 1981. Food Engineering and Dairy Technology. Verlag A. Kessler, Fraising (F.R. Germany).

j. Experiment List:

Sr. NO.	Experiment List
1	Platform tests of raw milk (clot on boiling (COB) test, alcohol test)
2	Determination of physical properties of milk
3	Determination of proximate composition and biochemical properties of milk
4	Determination of microbiological properties of milk
5	Detection of adulterants in milk
6	Identification and demonstration of liquid milk processing equipment, pipes and fittings Preparing standardized milk as per requirement
7	Separation of fat from milk
8	Pasteurization and homogenization of milk
9	Packaging of liquid milk
10	Preparation of curd and yogurt
11	Visit to chilling centre and dairy plant

Semester 3
[20]

- a. **Course Name:** Processing Technology of Cereals
- b. **Course Code:** 20105205
- c. **Prerequisite:** Knowledge of Chemistry and Mathematics up to 12th science level.
- d. **Rationale:** The course in Processing Technology of Cereals equips students with essential knowledge and skills to master the intricate processes involved in converting raw cereals into a diverse range of food products, crucial for meeting global demands in the food technology industry.
- e. **Course Learning Objective:**

CLOBJ 1	Develop a comprehensive understanding on the classification of different grains, understanding their characteristics and categorization.
CLOBJ 2	Understand the various processing methods and machinery employed in the milling of cereals, gaining practical insights into the cereal processing industry.
CLOBJ 3	Acquire knowledge on the production of value-added products derived from a variety of cereal grains, exploring diverse applications in the food industry.
CLOBJ 4	Comprehend the processes involved in the utilization of by-products from cereal and millet processing.

f. Course Learning Outcomes:

CLO 1	Appraise information about the classification of various grains.
CLO 2	Exposed to various processing methods and machinery used in milling of cereals.
CLO 3	Learn value added products from all cereal grains.
CLO 4	Understand about by-product processing of cereal and millets.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	2	3	30	-	20	50	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Present status and future prospects of cereals and millets; Morphology, physico-chemical properties of cereals, major and minor millets; Chemical composition and nutritive value;	16.67 %	5
2	Paddy processing and rice milling: Conventional milling, modern milling, milling operations, milling machines, milling efficiency; Quality characteristics influencing final milled product; Parboiling; Rice bran stabilization and its methods.	16.67 %	6
3	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.	20.00 %	6
4	Corn milling: Dry and wet milling of corn, starch and gluten separation, milling fractions and modified starches;	13.33 %	4
5	Barley: Malting and milling; Oat/Rye: Processing, milling; Sorghum: Milling, malting, pearling; Millets (Pearl millets, finger millets): Processing of millets for food uses; Secondary and tertiary products processing of cereals and millets.	16.67 %	6
6	By-products processing of cereals and millets; Processing of infant foods from cereals and millets; Breakfast cereal foods: Flaked, puffed, expanded, extruded and shredded.	16.67 %	5
Total		100%	32

i. Text Book and Reference Book:

1. Amalendu Chakraverty and R. Paul Singh. 2014. Post Harvest Technology and Food Process Engineering. CRC Press, Boca Raton, FL, USA.
2. Khalil Khan and Peter R. Shewry. 2009. Wheat: Chemistry and Technology, 4th Ed., AACC International, Inc., St. Paul, MN, USA.
3. Colin Wrigley. 2004. Encyclopedia of Grain Science. Academic Press, London, UK.
4. Elaine T. Champagne. 2004. Rice: Chemistry and Technology, 3rd Ed., AACC International, Inc., St. Paul, MN, USA.

j. Experiment List:

Sr. NO.	Experiment List
1	Morphological characteristics of cereals
2	Physical properties of cereals
3	Chemical properties of cereals
4	Parboiling of paddy; Cooking quality of rice
5	Milling of rice
6	Conditioning and milling of wheat
7	Production of sorghum flakes
8	Production of popcorns, flaked rice, puffed rice, noodles
9	Preparation of sorghum malt
10	Determination of gelatinization temperature by amylograph
11	Processing of value added products from millets
12	Visit to Cereal processing unit

Semester 3
[21]

- a. **Course Name:** Industrial Microbiology
- b. **Course Code:** 20105206
- c. **Prerequisite:** Knowledge of Chemistry and Mathematics up to 12th science level.
- d. **Rationale:** Industrial Microbiology in B Tech Food Technology provides essential knowledge and skills for harnessing microorganisms in various industrial processes, fostering the production of food, beverages, and other biotechnological products.

e. Course Learning Objective:

CLOBJ 1	Develop a foundational understanding of basic microbiology concepts and the principles of various laboratory instruments, along with their practical applications.
CLOBJ 2	Acquire knowledge about industrial sterilization processes, including the definition of thermal death time and media heat sterilization techniques.
CLOBJ 3	Explore the concepts of probiotics and bacteriocins, understanding their roles and applications in microbiology.
CLOBJ 4	Provide an overview of fermenters by describing their components, parts, and types, emphasizing their significance in industrial processes.
CLOBJ 5	Explore various methods used for cell disruption, understanding their principles and applications in microbiological processes.

f. Course Learning Outcomes:

CLO 1	Understand the basic concepts in microbiology, principle and working of different instruments used in lab along with its application.
CLO 2	Learn about Industrial sterilization; Definition of thermal death time, media heat sterilization
CLO 3	Interpret the knowledge about the probiotics and bacteriocins.
CLO 4	Describe components of fermenter, parts of fermenter and types of fermenters.
CLO 5	Study cell disruption methods.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	2	3	30	-	20	50	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	History of industrial microbiology; Primary and secondary metabolites produced by the microorganisms; Screening of microorganisms; Preservation of microorganisms; Organizations involved in microbiological work; Fermentation media.	20%	7
2	Industrial sterilization; Definition, thermal death time, media heat sterilization, advantages of continuous sterilization, design of sterilization, deterministic and probabilistic approach in designing of sterilizing equipments, sterilization charts;	20%	7
3	Fermentor: Components of a fermentor, parts of fermentors, peripheral parts and accessories, additional accessories and peripherals. Types of fermentors: Types of fermentations; Industrially important secondary metabolites; and microorganisms involved;	20%	7
4	Probiotics: Importance, role in fermented foods, organisms involved, beneficial effects; Bacteriocins; Nisin: Production of microbial enzymes; Downstream processing	20%	7
5	Cell disruption methods: Mechanical disruption methods and non-mechanical disruption methods; Extraction; Purification; Concentration; Product recovery;	20%	6
Total		100%	32

i. Text Book and Reference Book:

1. Nduka Okafor. 2007. Modern Industrial Microbiology and Biotechnology. Science Publishers, Enfield, New Hampshire, USA.
2. Dennis E. Briggs, Chris A. Boulton, Peter A, Brookes and Roger Stevens. 2004. Brewing Science and Practice. Woodhead Publishing Ltd. Cambridge, England.
3. G. Reed. 2004. Prescott & Dunn's Industrial Microbiology, 4th Ed. AVI Publishers, Connecticut, USA.
4. Peter F. Stanbury, Allan Whitakar and Stephen J. Hall. 1995. Principles of Fermentation Technology, 2nd Ed. Elsevier Science Ltd., Burlington, MA, USA.

j. Experiment List :

Sr. NO.	Experiment List
1	Isolation and screening of citric acid/ amylase/ protease /antibiotic producing microbes,
2	Production of citric acid/Lactic acid/ Acetic acid,
3	Purification of citric acid/Lactic acid/ Acetic acid and Estimation of citric acid/Lactic acid/ Acetic acid;
4	Standardization of physical factors for higher yields of citric acid; Isolation, identification of cultures producing bio-colours;
5	Production, purification and estimation of beer/ ethanol; Production, purification and assay of fungal amylases/proteases/Lipase;
6	Production and assay of nisin from lactic acid bacteria;
7	Single cell protein production; Starter activity of Baker's yeast Mushroom production;

Semester 3
[22]

- a. Course Name: Food Chemistry of Micronutrients**
- b. Course Code: 20105207**
- c. Prerequisite:** Knowledge of chemistry and Mathematics up to 12th science level
- d. Rationale:** Knowledge of the fundamentals of macronutrients are essential for Food Technology.
- e. Course Learning Objective:**

CLOBJ 1	Appraise a foundational understanding of food chemistry and nutrition concepts.
CLOBJ 2	Explore the role and significance of pigments in plants within the context of food
CLOBJ 3	Study the intricate chemistry of vitamins and minerals present in various foods.
CLOBJ 4	Acquire knowledge about the application of diverse enzymes in food processing and preparation

f. Course Learning Outcomes:

CLO 1	Understand introduction to Food chemistry and nutrition concept
CLO 2	Knowledge about pigments in plants.
CLO 3	Study chemistry of vitamins and minerals in food.
CLO 4	Learn application of various enzyme in food.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	0	2	3	30	-	20	50	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Chemistry of food flavour; Philosophy and definitions of flavour, flavourmatics/flavouring compounds, sensory assessment of flavour, technology for flavour retention	25%	8
2	Pigments in animal and plants kingdoms: Heme pigments, chlorophyll, carotenoids, phenolic and flavonoids, betalins, effect of processing on pigment behaviour; Technology for retention of natural colours of food stuffs; Food colorants; Regulatory use of regulatory dyes; Colour losses during thermal processing	25%	8
3	Vitamins and minerals: Requirements, allowances, enrichment, restorations, fortifications, losses of vitamins and minerals, optimization and retention of vitamins and minerals; Chemistry of anti-nutritional factors.	25%	8
4	Enzymes in food industry: Carbohydrases, proteasase, lipases; Modification of food using enzymes: Role of endogenous enzymes in food quality, enzymes use as processing aid and ingredients	25%	8
Total		100%	32

i. Text Book and Reference Book:

1. Gaile Moe, Danita Kelley, Jacqueline Berning and Carol Byrd-Bredbenner. 2013. Wardlaw's Perspectives in Nutrition: A Functional Approach. McGraw-Hill, Inc., NY, USA.
2. David L. Nelson and Michael M. Cox. 2012. Lehninger Principles of Biochemisry, 6th Ed. Macmillan Learning, NY, USA.
3. Donald Voet and Judith G. Voet. 2011. Biochemisry, 4th Ed. John Wiley and Sons, Inc., NY, USA.
4. Carolyn D. Berdanier, Elaine B. Feldman and Johanna Dwyer. 2008. Handbook of Nutrition and Food, 2nd Ed. CRC Press, Boca Raton, FL, USA

j. Experiment List:

Sr. NO.	Experiment List
1	Determination of moisture content of foods using different methods;
2	Studies of sorption isotherms of different foods
3	Swelling and solubility characteristics of starches
4	Rheological properties of food systems
5	Determination of crude proteins by micro-Kjeldhal method
6	Determination of essential amino acids i.e. lysine, tryptophan, methionine, etc
7	Isolation of egg and milk protein
8	Preparation of protein isolate and concentrate of proteins
9	Determination of acid value, saponification value and iodine number of fat/oil
10	Assay of amylases, papain and lipases

Semester 3
[23]

- a. Course Name: Heat and Mass Transfer in Food Processing**
- b. Course Code: 20105208**
- c. Prerequisite:** Knowledge of chemistry and Mathematics up to 12th science level.
- d. Rationale:** Understanding Heat and Mass Transfer in Food Processing facilitates optimal preservation, cooking, and storage techniques by comprehending how thermal and molecular processes impact food quality and safety.
- e. Course Learning Objective:**

CLOBJ 1	Identify and differentiate between the different modes of heat transfer essential for the production of milk and milk products.
CLOBJ 2	Comprehend the principles and design considerations of heat exchangers employed in various applications within food processing.
CLOBJ 3	Apply fundamental equations such as Fick's law and diffusion constants to calculate molar coefficients in the context of heat and mass transfer.
CLOBJ 4	Demonstrate proficiency in solving design problems related to mass transfer and heat transfer in tubular heat exchangers.

f. Course Learning Outcomes:

CLO 1	Distinguish the various modes of heat transfer operation required for manufacturing of milk and milk products
CLO 2	Understanding the concepts and design of heat exchanger used in various application
CLO 3	Calculating the molar co-efficient using basic equations like Fick's law and diffusion constant
CLO 4	Solve the Design problems on Mass Transfer Heat transfer in tubular heat exchanger

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	0	2	3	30	-	20	50	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	<p>Basic heat transfer processes</p> <p>Heat transfer coefficients, properties related to heat transfer; 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.</p>	10%	3
2	<p>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; 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</p>	20%	7
3	<p>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; Concept of Nusselt number, Prandtl number, Reynolds number, Grashoff number, some important empirical relations used for determination of heat transfer coefficient; Heat transfer to flowing fluids; Radiation: Heat radiation, emissivity, absorptivity, transmissivity, radiation through black and grey surfaces, determination of shape factors.</p>	26.67%	8
4	<p>Introduction to condensing and boiling heat transfer: Film- and drop-wise condensation, effect of non-condensable gases, boiling heat transfer; 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; Application of different types of heat exchangers in dairy and food industry.</p>	23.33%	7

5.	Mass transfer: Fick's law of diffusion, steady state diffusion of gases and liquids through solids, equimolar diffusion, isothermal evaporation of water into air, mass transfer coefficient, application in dairy and food industry.	20%	7
Total		100%	32

i. Text Book and Reference Book:

1. Eduardo Cao. 2010. Heat Transfer in Process Engineering. The McGraw-Hill Companies, Inc., New York, USA.
2. J.P. Holman. 2010. Heat Transfer, 10th Ed. McGraw-Hill Book Co., Boston, USA.
3. Don W. Green and Robert H. Perry. 2008. Perry's Chemical Engineers' Handbook. McGrawHill Co., Inc., NY, USA.
4. John H. Lienhard IV and John H. Lienhard V. 2008. A Heat Transfer Textbook. Phlogiston Press, Cambridge, MA, USA

j. Experiment List:

Sr. NO.	Experiment List
1.	Heat transfer analysis during conduction and convection;
2.	Study on various types of heat exchangers used in food industry;
3.	Preparation and calibration of thermocouples;
4.	Determination of thermal conductivity of different food products;
5.	Study of working principle and constructional details of plate heat exchanger;
6.	Study of working principle and constructional details of shell and tube heat exchanger.
7.	Determination of overall heat transfer coefficient of shell and tube, plate heat exchangers, jacketed kettle used in food industry
8.	Studies on heat transfer through extended surfaces;
9.	Studies on temperature distribution and heat transfer in HTST pasteurizer.

Semester 3
[24]

- a. Course Name: Unit Operations in Food Processing-I**
- b. Course Code: 20105209**
- c. Prerequisite:** Knowledge of food equipment's studied up to 12th science
- d. Rationale:** The course provides students with a comprehensive understanding of the fundamental processes involved in food production. This includes the various stages from raw material handling to the final product, covering aspects such as cleaning, sorting, size reduction, mixing, heat transfer, and packaging.
- e. Course Learning Objective:**

CLOBJ 1	Appraise a comprehensive understanding of the diverse unit operations employed in food processing.
CLOBJ 2	Acquire knowledge of the designs and drawings of agitators, heat exchangers, evaporators, and crystallizers used in food processing.
CLOBJ 3	Explore the principles and applications of membrane separation in the context of food processing.
CLOBJ 4	Describe the theory of mixing and develop proficiency in the design of mixers used in food processing.

f. Course Learning Outcomes:

CLO 1	Understand different unit operations used in food processing.
CLO 2	Learn different designs and drawing of agitators, heat exchangers, evaporators and crystallizers.
CLO 3	Study about membrane separation
CLO 4	Describe theory of mixing and design of mixers.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	0	2	3	30	-	20	50	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	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	7%	2
2	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 effect evaporators, feeding methods of multiple effect evaporation systems, feed preheating, vapour recompression systems; Fouling of evaporators and heat exchanges; Recompression heat and mass recovery and vacuum creating devices	10%	3
3	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.	17%	5
4	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	13%	4
5	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	13%	4
6	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	13%	5
7	Pasteurization: Purpose, microorganisms and their reaction to temperature and other influences, methods of heating, design and mode of operation of heating	17%	6

	equipment, vat, tubular heat exchanger, plate heat exchanger; Sterilization: Principles, process time, T-evaluation, design of batch and continuous sterilization, different methods and equipments; UHT sterilization, in the package sterilization, temperature and pressure patterns, equipment for sterilizing goods in the package;		
8	Aseptic processing: principles, analysis of thermal resilience, duration mathematics of conduction heating; Blanching: principle and equipment; Homogenization, Emulsification.	10%	3
Total		100%	32

i. Text Book and Reference Book:

1. Warren L. McCabe, Julian Smith, Peter Harriott. 2004. Unit Operations of Chemical Engineering, 7th Ed. McGraw-Hill, Inc., NY, USA.
2. Christie John Geankoplis. 2003. Transport Processes and Separation Process Principles (Includes Unit Operations), 4th Ed. Prentice-Hall, NY, USA.
3. George D. Saravacos and Athanasios E. Kostaropoulos. 2002. Handbook of Food Processing Equipment. Springer Science+Business Media, New York, USA.
4. J. F. Richardson, J. H. Harker and J. R. Backhurst. 2002. Coulson & Richardson's Chemical Engineering, Vol. 2, Particle Technology and Separation Processes, 5th Ed. Butterworth Heinemann, Oxford, UK.

Experiment List:

Sr. NO.	Experiment List
1	Study of working principle open pan and vacuum evaporator;
2	Study of single effect evaporator and estimation of heat/mass balance during concentration of liquid foods;
3	Study of multiple effect evaporator and estimation of heat/mass balance during concentration of liquid foods;
4	Study of multiple effect evaporator and estimation of heat/mass balance during concentration of liquid foods;
5	Study of sterilizer;
6	Design problems on freezers;
7	Numerical problem on thermo bacteriology (D, Z and F);
8	Study of freezers; Freezing of foods by different methods;
9	Determination of freezing time of a food material;
10	Effect of sample particle size and time on solvent extraction process;
11	Effect of temperature on crystallization rate of sugar;
12	Study of blancher, pasteurizers, fryers, homogenizers, irradiators;
13	Determination of oil uptake by the food product during frying;
14	Study on qualitative changes in the fried food product;
15	Visit sugar processing industry

Semester 3
[25]

a. Course Name: Statistical Methods and Numerical Analysis

b. Course Code: 20105210

c. Prerequisite: Knowledge of chemistry and Mathematics up to 12th science level.

d. Rationale: The course in Statistical Methods and Numerical Analysis equips students with essential skills in numerical analysis, statistical principles, and experimental design, fostering the ability to apply these techniques effectively in solving real-life problems. The curriculum ensures proficiency in numerical analysis concepts, empowers understanding and implementation of statistical methods for diverse food processing data, and cultivates expertise in experimental design principles, enabling practical problem-solving and data-driven decision-making.

e. Course Learning Objective:

CLOBJ 1	Apply numerical analysis and statistical concepts to solve practical problems.
CLOBJ 2	Appraise proficiency in experimental design principles.
CLOBJ 3	Develop the ability to perform numerical analysis effectively.
CLOBJ 4	Apply statistical methods for the analysis of data related to various aspects of food processing.

f. Course Learning Outcomes:

CLO 1	Understand and implement various concepts of numerical analysis and statistics to solve real life problems.
CLO 2	Learn about experimental design.
CLO 3	Able to do numerical analysis.
CLO 4	Apply statistical methods in analysis of various food processing data

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
1	0	2	2	30	-	20	50	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Statistical methods, testing of hypothesis, concepts, testing of significance based on Z-test, t-test, F-test, Chi-square test, contingency table, correlation, regression, testing of significance of correlation and regression, multiple linear regression, ANOVA, one-way and two-way classifications, factorial experiment concepts (22, 23, mixed factorials)	20%	3
2	Numerical analysis: Finite differences, various difference operators and their relationships, factorial notation, interpolation with equal intervals, Newton's forward and backward interpolation formulae, numerical integration, numerical integration by Trapezoidal, Simpson's and Weddle's rules; Numerical solution of ordinary differential equations by Picard's method, Taylor's series method, Euler's method, modified Euler's method, Runge-Kutta method	26.67%	4
3	Laplace transforms: Definition of Laplace transform, Laplace transforms of elementary functions, properties of Laplace transforms, inverse Laplace transforms, transforms of derivatives, integrals, transform of function multiplied by tn , transform of function divided by t , convolution theorem, application of Laplace transforms to solve ordinary differential equations and simultaneous differential equations	33.33%	6
4	Experimental designs: Basic designs, completely randomized design (CRD) - Layout and analysis with equal and unequal number of observations, randomized block design (RBD) - Layout and analysis, Latin square design (LSD) - Layout and analysis; Response surface methodology.	20%	3
Total		100%	16

i. Text Book and Reference Book:

1. Erwin Kreyszig, 2006. Advanced Engineering Mathematics, 9th Ed. John Wiley & Sons, New York, USA.
2. B.S. Grewal. 2004. Higher Engineering Mathematics. Khanna Publishers, Delhi.
3. P.P. Gupta and C.C. Malik. 1993. Calculus of Finite Differences and Numerical Analysis. Krishna Prakash Mandor, Meerut.

j. Experiment List:

Sr. NO.	Experiment List
1	Problems on one sample, two sample Z-tests when population S.D. is known and unknown; Problems on one sample, two sample and paired t-test; Chi-square test - 2×2 and $m \times n$
2	Contingency table and F-test
3	Calculation of correlation coefficient and its testing
4	Fitting of simple linear regressions
5	Fitting of multiple regression equations; ANOVA: One way/two way; 22, 23 and mixed factorial experiments
6	Problems on Newton's forward and backward interpolation formula for equal intervals
7	Problems on trapezoidal rule; Problems on Simpson's $1/3$ and $3/8$ rules
8	Problems on solution of ordinary differential equations of first order and second orders by Runge-Kutta method
9	Problems on Euler's method; Problems on Laplace transforms
10	Problems on inverse transformations; Problems on solutions of first order differential equations
11	Problems on response surface methodology

Semester 3

[26]

a. Course Name: Physical Education

b. Course Code: 20105211

c. Prerequisite:

A basic prerequisite for the course of physical education is a commitment to an active and healthy lifestyle, emphasizing the importance of regular physical activity.

d. Rationale: The course of physical education holds significance as it fosters holistic development, promoting health, fitness, social skills, and lifelong physical activity habits among students.

e. Course Learning Objective:

CLOBJ 1	Demonstrate competence in fundamental motor skills such as running, jumping, throwing, and catching.
CLOBJ 2	Develop and maintain an optimal level of physical fitness through participation in a variety of cardiovascular exercises, strength training, and flexibility activities.
CLOBJ 3	Engage in team sports and group activities to foster the development of social skills.
CLOBJ 4	Integrate knowledge of health-related principles.

f. Course Learning Outcomes:

CLO 1	Exhibit competence in various fundamental movement skills, such as running, jumping, throwing, and catching.
CLO 2	Attain and sustain a desirable level of physical fitness through participation in diverse cardiovascular exercises, strength training, and flexibility activities, promoting lifelong health and well-being.
CLO 3	Develop effective communication, teamwork, and sportsmanship skills through participation in group sports and collaborative physical activities.
CLO 4	Integrate health-related knowledge, including nutrition, stress management, and the importance of regular physical activity.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
-	-	2	1	-	-	100	-	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content: NA

i. Text Book and Reference Book:

1. Introduction to Physical Education, Fitness, and Sport" by Daryl Siedentop, Hans van der Mars, and Thomas J. Templin
2. Exercise Physiology: Theory and Application to Fitness and Performance" by Scott K. Powers and Edward T. Howley
3. Foundations of Physical Education, Exercise Science, and Sport" by Deborah Wuest and Charles Bucher
4. Sport and Exercise Psychology: A Canadian Perspective" by Peter R. E. Crocker, Joan L. Duda, and Anne-Maree D. Gall
5. Physical Education for Lifelong Fitness: The Physical Best Teacher's Guide" by SHAPE America - Society of Health and Physical Educators

j. Experiment List:

Sr. No.	Experiment List
1	Running and warming up: Exercise for good posture and physical fitness and the exercise for Agility
2	Strength, Coordination, Endurance and Speed.
3	Yoga : Any five Asana
4	Athletics : a) Running : 100,200,400, 800 mts. B) Jumping : Long Jump, High Jump c) Throwing: Shot- put, Disc Throw Participant should participate at least in one event Athletics group.
5	Skill development in any one of the following game: a) Out-door: Volley ball, Basketball, Football, Cricket, Kaabaddi, Kho-kho B) Indoor : Table tennis, Badminton, Wrestling, best -Physique
6	Dand Baithkas : Skipping, Hoping and Gym. Exercises.

Semester 4
[27]

- a. Course Name:** Processing Technology of Dairy Products
b. Course Code: 20105253
c. Prerequisite: Basic knowledge of milk and milk products studied upto 12th science
d. Rationale: Understanding human nutrition in B. Tech Dairy Technology as it equips students with the knowledge to optimize dairy product development, ensuring the creation of nutritious and health-promoting dairy products for consumers.

e. Course Learning Objective:

CLOBJ 1	Demonstrate Proficiency in Dairy Processing Techniques
CLOBJ 2	Analyze and Optimize Dairy Product Quality
CLOBJ 3	Apply Quality Control Measures and Compliance Standards
CLOBJ 4	Innovate and Develop New Dairy Products

f. Course Learning Outcomes:

CLO 1	Evaluate the diverse composition and types of milk and milk products.
CLO 2	Summarize the various products derived from milk and outline their processing methods.
CLO 3	Describe the technology involved in the production of various frozen milk products.
CLO 4	Explain the different methods employed in the processing of milk.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	2	3	30	-	20	50	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	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	16.67 %	05

	and storage;		
2	Butter oil and ghee: Definition, composition, processing, equipment, quality tests	16.67 %	05
3	Paneer and Cheese: Definition, composition, types, processing steps, process flow diagram, equipment, quality defects, causes and prevention, packaging and storage	16.67 %	05
4	Ice cream and frozen desserts: Definition, composition, types, processing steps and flow diagram, equipment, quality testing, defects causes and prevention, packaging and storage.	16.67 %	06
5	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;	16.67 %	06
6	Traditional Indian Dairy Products: Definitions, compositions, processing, packaging, storage, equipment and quality testing; By- products of dairy industry and their utilization.	16.67 %	05
Total		100%	32

i. Text Book and Reference Book:

1. Adnan Y. Tamime. 2009. Milk Processing and Quality Management. Blackwell Publishing Ltd., UK.
2. Kanekanian. 2014. Milk and Dairy Products as Functional Foods. John Wiley & Sons, Ltd., UK.
3. Pieter Walstra, Jan T.M. Wouters, Tom J. Geurts. 2006. Dairy Science and Technology, 2nd Ed. CRC Press, Boca Raton, FL, USA.
4. Sukumar De. 2005. Outlines of Dairy Technology. Oxford University Press, New Delhi.

j. Experiment List:

Sr. NO.	Experiment List
1	Preparation of butter/ table butter
2	Preparation of ghee
3	Preparation of paneer
4	Preparation of selected type of cheese
5	Preparation of ice-cream and selected frozen desserts
6	Preparation of condensed milk
7	Preparation of milk powder
8	Preparation of selected Indian dairy Products
9	Determination of selected quality parameters of selected dairy products
10	Visit to dairy plant

Semester 4

[28]

a. Course Name: Processing Technology of Legumes and Oilseeds

b. Course Code: 20105254

c. Prerequisite: Knowledge of basic food science upto 12th science

d. Rationale: The rationale for offering a course in processing technology of legumes and oilseeds stems from the nutritional importance of these food sources, the diverse product applications, economic impact, sustainability considerations, quality control, and the growing global demand for processed legume and oilseed products. The course prepares students to contribute to the development and improvement of processing methods in these crucial sectors of the food industry.

e. Course Learning Objective:

CLOBJ 1	Analyze the fundamental composition and structural components of food grains.
CLOBJ 2	Describe the essential aspects of milling operations for food grains.
CLOBJ 3	Emphasize the importance of cleaning cereals and grains in food processing.
CLOBJ 4	Summarize the production of value-added products derived from cereals and pulses.

f. Course Learning Outcomes:

CLO 1	Examine the basic composition and structural parts of food grains.
CLO 2	Describe the basics of milling operations for food grains.
CLO 3	Determine the importance of cleaning of cereals and grains
CLO 4	Summarize the value added products from cereals and pulses.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	2	3	30	-	20	50	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	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;	20.00 %	6
2	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 affecting cooking of dhal; Quick cooking dhal, instant dhal; Soybean milk processing and value addition; Fermented products of legumes	23.33 %	7
3	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;	20.00 %	7
4	Refining of oils: Degumming, neutralization, bleaching, filtration, deodorization, their principles and process controls; Hydrogenation of oils; New technologies in oilseed processing	20.00 %	6
5	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.	16.67 %	6
Total		100%	32

i. Text Book and Reference Book:

1. Frank D. Gunstone. 2008. Oils and Fats in the Food Industry. John Wiley and Sons, Ltd., West Sussex, UK
2. Chakraborty, 1988, Post Harvest Technology of Cereals, Pulses and Oilseeds, revised ed., Oxford & IBH Publishing Co. Pvt Ltd,
3. Amalendu Chakraverty, Arun S. Mujumdar, G.S. Vijaya Raghavan and Hosahalli S. Ramaswamy. 2003. Handbook of Post Harvest Technology: Cereals, Fruits, Vegetables, Tea, and Spices. Marcel Dekker, Inc., NY, USA.

4. K.M. Sahay and K.K. Singh. 2001. Unit Operations of Agricultural Processing, 2nd Ed. Vikas Publishing House Pvt. Ltd., Noida.

j. Experiment List:

Sr. NO.	Experiment List
1	Determination of physical properties of legumes and oil seeds;
2	Determination of proximate composition of selected pulses and oilseeds;
3	Determination of nutritional quality of selected pulses and oilseeds;
4	Study of mini dhal mill;
5	Study of mini oil mill;
6	Preconditioning of pulses before milling;
7	Preconditioning of oilseeds before milling;
8	Removal of anti-nutritional compounds from selected pulses and oilseeds;
9	Laboratory milling of selected pulses and its quality evaluation;
10	Laboratory milling of selected oilseeds and its quality evaluation;
11	Laboratory refining of selected oils;
12	Laboratory hydrogenation of selected oils; Study of cooking quality of dhal;
13	Processing of composite legume mix and preparation of value added products;
14	Visit to commercial dhal mills and oil mills.

Semester 4
[29]

- a. Course Name:** Food Biochemistry and Nutrition
b. Course Code: 20105255
c. Prerequisite: Knowledge of Chemistry up to 12th science level.
d. Rationale: The significance of Food Biochemistry and Nutrition lies in understanding the molecular and nutritional aspects of food, enabling the development of health-promoting and sustainable food products while addressing global challenges related to malnutrition and chronic diseases.
e. Course Learning Objective:

CLOBJ 1	Analyze the Biochemical Composition of Foods
CLOBJ 2	Evaluate Food Processing Techniques and Their Impact on Nutrient Retention
CLOBJ 3	Understand the Role of Nutrients in Human Metabolism
CLOBJ 4	Assess the Impact of Food Choices on Public Health
CLOBJ 5	Apply Principles of Food Biochemistry and Nutrition in Product Development

f. Course Learning Outcomes:

CLO 1	Identify the Magnitude and Interdependent activities and food processing agencies
CLO 2	Describe the structures of the following food components: simple carbohydrates, starches, dietary fibers, fatty acids, polyphenols, and some vitamins
CLO 3	Relate the structures of these food components to their chemical properties.
CLO 4	Explain the structure of these food components to their physical and chemical solution properties.
CLO 5	Categorize their roles in the functional properties of foods.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	2	3	30	-	20	50	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1.	Biochemistry and its scope, cellular biochemistry; Carbohydrates: Occurrence, classification and structures, physicochemical and metabolic functions, metabolism;	16.67%	5
2	Proteins: Occurrence, classification and structures, physicochemical and metabolic functions, metabolism; Lipids: Occurrence, classification and structure, physicochemical and metabolic functions, metabolism; Nucleic acids: Properties, structure and metabolism, Vitamins and minerals: Chemistry and metabolic functions;	16.67%	5
3	Enzymes: Chemical nature and nomenclature, classification, sources and properties, mechanism of action, coenzyme and prosthetic groups; Concepts and content of nutrition: metabolic function of nutrients; 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; Functions of food; Basic food groups; nutrients supplied by food	16.67%	6
4	Mechanism of enzyme action: Introduction to enzymes, coenzymes, regulation of enzymatic activity, enzyme kinetics, inhibition effects of pH, allosteric enzymes, derivation of Michaelis-Menten equation; Nucleic acids	16.67%	5
5	Nutrients: Sources, functions, digestion, absorption, assimilation and transport of carbohydrates, proteins and fats in human beings; Metabolism of carbohydrates: Biological role of carbohydrates, glycolysis and respiration, production of ATP, brief description of electron transport chain, oxidative and substrate phosphorylation; Metabolism of lipids: Biological role of lipids, breakdown of triglycerides and phospholipids, β -oxidation of long chain fatty acids, ketosis, biosynthesis of fatty acids, triglycerides and phospholipids; Metabolism of proteins: Breakdown of proteins, transamination, deamination, decarboxylation, nitrogen fixation, urea cycle	16.67%	6
6	Minerals: Functions, sources, factors affecting absorption of minerals, absorption promoters, absorption inhibitors, effect of deficiency; Vitamins and hormones: Classification, functions, sources, effects of deficiency, fat	16.67%	5

	soluble vitamins, water soluble vitamin; Relationship between vitamins and hormones in terms of their biological role; Physico-chemical and nutritional changes during processing: Changes during food processing treatment of drying and dehydration, irradiation, freezing, fermentation, canning, restoration, enrichment, fortification and supplementation of foods.		
Total		100%	32

i. Text Book and Reference Book:

1. Gaile Moe, Danita Kelley, Jacqueline Berning and Carol Byrd-Bredbenner. 2013. Wardlaw's Perspectives in Nutrition: A Functional Approach. McGraw-Hill, Inc., NY, USA.
2. David L. Nelson and Michael M. Cox. 2012. Lehninger Principles of Biochemistry, 6th Ed. Macmillan Learning, NY, USA.
3. Donald Voet and Judith G. Voet. 2011. Biochemistry, 4th Ed. John Wiley and Sons, Inc., NY, USA.
4. Carolyn D. Berdanier, Elaine B. Feldman and Johanna Dwyer. 2008. Handbook of Nutrition and Food, 2nd Ed. CRC Press, Boca Raton, FL, USA.

j. Experiment List:

Sr. NO.	Experiment List
1	Preparation of various solutions and buffers;
2	Qualitative and quantitative determination of carbohydrates;
3	Qualitative and quantitative determination of amino acids;
4	Qualitative and quantitative determination of proteins;
5	Qualitative and quantitative determination of lipids;
6	Qualitative and quantitative determination of vitamins;
7	Isolation of enzymes from various sources;
8	Measurement of energy using bomb calorimeter;
9	Determination of pka of acid;
10	Determination of pI for casein;
11	Estimation of sugars by Anthrone method; Estimation of protein by Lowry method;
12	Estimation of amino acid using Biuret reaction;
13	Separation of amino acids using paper chromatography;
14	Separation of amino acids using thin layer chromatography;
15	Separation of amino acids using electrophoresis; Estimation of phosphorus in food sample.
16	Estimation of iron content in foods;
17	Determination of calcium in food samples;
18	Estimation of β -carotene using column chromatography;
19	Estimation of ascorbic acid using dye method;
20	Effects of acids and alkali on pigments.

Semester 4
[30]

- a. Course Name: Unit Operations in Food Processing-II**
- b. Course Code: 20105256**
- c. Prerequisite:** Knowledge of food equipment's studied up to 12th science
- d. Rationale:** the course aims to equip students with in-depth knowledge of advanced unit operations in food processing, providing a foundation for their roles in the food industry, research, and development of innovative food products. The rationale lies in the practical application of these unit operations for efficient and sustainable food processing.
- e. Course Learning Objective:**

CLOBJ 1	Understand the significance of engineering operations in relation to food processing and their role in fostering industrial growth.
CLOBJ 2	Articulate the fundamental principles underlying various food processing operations.
CLOBJ 3	Analyze and compile the diverse factors influencing unit operations in the context of food processing.
CLOBJ 4	Apply knowledge to judiciously select and employ appropriate unit operations tailored to specific purposes in food processing.

f. Course Learning Outcomes:

CLO 1	Explain the engineering operations that are critical to the food processing operations and industrial growth.
CLO 2	Define the principles of food processing operations.
CLO 3	Compile the factors affecting unit operations.
CLO 4	Make a use of the suitable unit operations for a specific purpose.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	2	3	30	-	20	50	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	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	6.67 %	2
2	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 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	10.00%	3
3	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.	16.67%	5
4	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	10.00%	3
5	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	10.00%	3
6	Baking: Principles, baked foods, baking equipment;	13.33%	4

	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		
7	Pasteurization: Purpose, microorganisms and their reaction to temperature and other influences, methods of heating, design and mode of operation of heating equipment, vat, tubular heat exchanger, plate heat exchanger; Sterilization: Principles, process time, T-evaluation, design of batch and continuous sterilization, different methods and equipments; UHT sterilization, in the package sterilization, temperature and pressure patterns, equipment for sterilizing goods in the package;	16.67%	5
8	Aseptic processing: principles, analysis of thermal resilience, duration mathematics of conduction heating; Blanching: principle and equipment; Homogenization, Emulsification.	10.00%	4
9	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	6.67%	3
Total		100%	32

i. Text Book and Reference Book:

1. P. Fellows. 2000. Food Processing Technology: Principles and Practice, 2nd Ed. CRC Press, Boca Raton, FL, USA.
2. R. K. Sinnott. 1999. Chemical Engineering, Vol. 6, Chemical Engineering Design, 3rd Ed. Butterworth-Heinemann, Oxford, UK.
3. Kenneth J. Valentas, Enrique Rotstein and R. Paul Singh. 1997. Handbook of Food Engineering Practice. CRC Press, Boca Raton, FL, USA.
4. Robert E. Treybal. 1980. Mass Transfer Operations, 3rd Ed. McGraw-Hill Book Company, Auckland, USA.

j. Experiment List :

Sr. NO.	Experiment List
1	Study of working principle open pan and vacuum evaporator;
2	Study of single effect evaporator and estimation of heat/mass balance during concentration of liquid foods;
3	Study of multiple effect evaporator and estimation of heat/mass balance during concentration of liquid foods;
4	Study of multiple effect evaporator and estimation of heat/mass balance during concentration of liquid foods;
5	Study of sterilizer;
6	Design problems on freezers;
7	Numerical problem on thermo bacteriology (D, Z and F);
8	Study of freezers; Freezing of foods by different methods;
9	Determination of freezing time of a food material;
10	Effect of sample particle size and time on solvent extraction process;
11	Effect of temperature on crystallization rate of sugar;
12	Study of blancher, pasteurizers, fryers, homogenizers, irradiators;
13	Determination of oil uptake by the food product during frying;
14	Study on qualitative changes in the fried food product;
15	Visit sugar processing industry

Semester 4
[31]

a. Course Name: Food Biotechnology

b. Course Code: 20105257

c. Prerequisite: Knowledge of general microbiology studied upto 12th science

d. Rationale: This course aims to prepare students for roles at the intersection of biology and food science, fostering innovation, sustainability, and improved food production practices in response to the dynamic challenges facing the global food industry.

e. Course Learning Objective:

CLOBJ 1	Demonstrate the application of aseptic techniques for proper handling of microorganisms and prevention of contamination.
CLOBJ 2	Estimate pure cultures from mixed populations in contaminated foods.
CLOBJ 3	Apply knowledge to handle microscopes for the observation of stained microorganisms.
CLOBJ 4	Differentiate microorganisms using staining techniques.

f. Course Learning Outcomes:

CLO 1	Study functions of aseptic technique to properly handle microorganisms to avoid contamination.
CLO 2	Choose the pure culture from mixed population found in contaminated foods.
CLO 3	Interpret knowledge to handle microscopes to observe stained microorganisms.
CLO 4	Distinguish the microorganisms using staining techniques

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	2	3	30	-	20	50	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Chemical nature of the genetic material, properties and functions of the genetic material, organization of the genetic material in bacteria, eukaryotes and viruses	16.67%	5
2	DNA replication: Replication fork, DNA polymerases, other enzymes and proteins required for DNA replication, origin of replication, replication of circular DNA molecule;	16.67%	5
3	Transcription and translation: RNA synthesis, types of RNA, genetic code; Mutation and DNA repair, mechanisms of repair of damaged DNA (photo reactivation, excision repair, recombination repair, SOS repair, mismatch repair), transposable elements, plasmids, types of plasmids, genetic recombination in bacteria, transformation, transduction, conjugation, regulation of gene expression in prokaryotes; Expression of foreign genes; Promoter enzymes	16.67%	5
4	Recombinant DNA technology: Restriction enzymes, cloning vectors, cloning procedure, cloning of specific gene and their identification (colony hybridization, C-DNA, southern blotting, polymerase chain reaction); Gene cloning: Production of identical cells, isolation and purification of insert DNA, isolation of vector DNA, construction of recombined DNA, introduction of recombined DNA into host cell, identification and selection of cells containing cloned genes	16.67%	6
5	Biosensors: Classification, application in food industry; Application of biotechnology in food: Immobilization of enzymes: Arresting of cell in insoluble matrix, immobilized cell systems, cell attachment in a surface, aggregation, entrapment, containment, physical adsorption, covalent bonding, cross linking, entrapment into polymeric films, microencapsulation, large scale cell immobilization, uses and applications in industries	16.67%	6
6	Ethical issues concerning GM foods: Testing for GMOs, current guidelines for production, release and movement of GMOs, labeling and traceability, trade related aspects, bio-safety, risk assessment, risk management, public perception of GM foods, IPR, GMO Act 2004	16.67%	5
Total		100%	32

i. Text Book and Reference Book:

1. B.D. Singh. 2014. Biotechnology - Expanding Horizons. Kalyani Publishers, New Delhi.
2. Meenakshi Paul. 2007. Biotechnology and Food Processing Mechanics. Gene-Tech Books, New Delhi.
3. James D. Watson. 2013. Molecular Biology of the Gene, 7th Ed. Benjamin Cummings, San Francisco, USA.
4. Oliver Brandenberg, Zephaniah Dhlamini, Alessandra Sensi, Kakoli Ghosh and Andrea Sonnino 2011. Introduction to Molecular Biology and Genetic Engineering. FAO, Rome, Italy

j. Experiment List:

Sr. NO.	Experiment List
1	Study of auxotroph; Micro-propagation through tissue culture;
2	Strain improvement through U.V. mutation for lactose utilization;
3	Chemical mutagenesis using chemical mutagens (Ethidium bromide);
4	Determination of survival curves using physical and chemical mutagens;
5	Isolation and analysis of chromosomal/genomic DNA from <i>E. coli</i> and <i>Bacillus cereus</i> ;
6	Separation of protoplast using cellulytic enzymes;
7	Production of biomass from fruit and vegetable waste;
8	Introduction of ELISA/Southern blot/DNA finger printing, etc.;
9	Agarose gel electrophoresis of plasmid DNA; Pesticide degradation by <i>pseudomonas</i> spp.

Semester 4
[32]

- a. Course Name: Food Refrigeration and Cold Chain**
- b. Course Code: 20105258**
- c. Prerequisite:** Students should have basic knowledge of science
- d. Rationale:** This designed to equip students with the knowledge and skills necessary to navigate the complexities of refrigeration in the food industry. It addresses not only the technical aspects of refrigeration but also its broader impact on food quality, safety, sustainability, and market dynamics within the global food supply chain.
- e. Course Learning Objective:**

CLOBJ 1	Articulate the concept of refrigeration and its indispensable role in the food industry.
CLOBJ 2	Understand how refrigeration methods can be employed to extend the shelf life of food products.
CLOBJ 3	Elaborate on various methods of refrigeration in the context of food preservation.
CLOBJ 4	Provide a detailed summary of the ice manufacturing process.

f. Course Learning Outcomes:

CLO 1	Explain the concept of refrigeration and its necessity in food industry.
CLO 2	Know that how to increase shelf life of food by using refrigeration methods
CLO 3	Elaborate different methods of refrigeration.
CLO 4	Summarize the ice manufacturing process in detail.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	2	3	30	-	20	50	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
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.	10%	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;	10%	4
3	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 cycle on pressure- enthalpy diagram, super heating, sub cooling; Liquid-vapour regenerative heat exchanger for vapour compression system, effect of suction vapour super heat and liquid sub cooling, actual vapour compression cycle	16.67%	5
4	Vapour-absorption refrigeration system: Process, calculations, maximum coefficient of performance of a heat operated refrigerating machine, Common refrigerants and their properties: classification, nomenclature, desirable properties of refrigerants-physical, chemical, safety, thermodynamic and economical; Azeotropes; Components of vapour compression refrigeration system, evaporator, compressor, condenser and expansion valve; Ice manufacture, principles and systems of ice production, Treatment of water for making ice, brines, freezing tanks, ice cans, air agitation, quality of ice	16.67%	6
5	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,	13.33%	4

	automated cold stores, security of operations		
6	Refrigerated transport: Handling and distribution, cold chain, refrigerated product handling, order picking, refrigerated vans, refrigerated display	13.33%	4
7	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 load calculations: Load sources, product cooling, conducted heat, convected heat, internal heat sources, heat of respiration, peak load; etc.	20%	6
Total		100%	32

i. Text Book and Reference Book:

1. Ajay Kumar Gupta. 2022. The Complete Book on Cold Storage, Cold Chain & Warehouse (with Controlled Atmosphere Storage & Rural Godowns) 5th Edition. NIIR project consultancy services.
2. Adithan, M. and Laroiya, S. C. 1991. Practical Refrigeration and Air Conditioning. Wiley Eastern Ltd., New Delhi
3. Arora, C. P. 1993. Refrigeration and Air Conditioning. Tata MC Graw Hill Publishing Co.Ltd.,New Delhi.

j. Experiment List:

Sr. NO.	Experiment List
1	Study of vapour compression refrigeration system;
2	Determination of COP of vapour compression refrigeration system;
3	Study of various types of compressors, condensers, expansion valves and evaporative coils used in refrigeration systems;
4	Study of refrigerants, their properties and charts;
5	Study of direct and indirect contact freezing equipment for foods;
6	Study of spray freezing process for foods;
7	Study of food cold storage;
8	Estimation of refrigeration load for cold storage;
9	Estimation of refrigeration load for meat and poultry products;
10	Study of refrigeration system of dairy plant;
11	Estimation of refrigeration load for ice-cream;
12	Study of cooling system for bakery and estimation of refrigeration loads;
13	Estimation of refrigeration load during chocolate enrobing process;
14	Study of refrigerated van;
15	Study of deep freezing and thawing of foods;
16	Study of refrigerated display of foods and estimation of cooling load.

Semester 4
[33]

- a. Course Name:** Processing of Spices and Plantation Crops
b. Course Code: 20105259
c. Prerequisite: Knowledge of general food science
d. Rationale: The course on Processing of Spices and Plantation Crops in B Tech Food Technology is pivotal for equipping students with the knowledge and skills essential for efficient and value-added processing, contributing to the quality and market viability of spice and plantation crop products.

e. Course Learning Objective:

CLOBJ 1	Summarize the botanical characteristics and classification of major spices and plantation crops.
CLOBJ 2	Demonstrate various processing technologies used in the industry, such as cleaning, grading, milling, and extraction methods.
CLOBJ 3	Outline and implement quality control measures to ensure the final processed products meet industry standards and consumer expectations.
CLOBJ 4	Acquire skills in value addition, including the development of spice blends, extraction of essential oils, and creation of processed products with enhanced market value.

f. Course Learning Outcomes:

CLO 1	Summarize importance of scope, processing and production of spices and plantation crops.
CLO 2	Compare about processing methods for value addition of spices and condiment
CLO 3	Summarize the packaging of spices and condiments.
CLO 4	Experiment the oil extraction from different spices.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	2	3	30	-	20	50	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Production and processing scenario of spice, flavour and plantation crops and its scope;	20%	06
2	Major spices: Post harvest technology, composition; processed products of spices: Ginger, chilli, turmeric, onion and garlic, pepper, cardamom.	20 %	06
3	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; Post harvest technology for Tea, coffee, cocoa;	20%	07
4	Vanilla and annatto processing; Post harvest technology and processing of areca nut, cashew nut, oil palm; Flavours of minor spices; Flavour of major spices;	20 %	06
5	Spice oil and oleoresins: Extraction techniques; Standard specification of spices; Functional packaging of spices and spice products; By-products of plantation crops and spices.	20%	07
Total		100%	32

i. Text Book and Reference Book:

1. K.G. Shanmugavelu. Spices and Plantation Crops. Oxford & IBH Publishing Co., New Delhi
2. J.W. Pursegrove, E.G. Brown, C.L. Green and Robins. Spices, Vol. I and II. SRJ Academic Press, New Delhi.
3. J.S. Pruthi. 2001. Spices and Condiments – Major Spices of India. National Book Trust, New Delhi.

j. Experiment List:

Sr. NO.	Experiment List
1	Identification and characterization of flavouring compounds of spices
2	Valuable oil determination
3	Extraction of oil from clove, pepper, cardamom, chilli
4	Extraction of oleoresins: Turmeric, ginger, pepper, clove
5	Peperine estimation in pepper oleoresin; Steam distillation of spices
6	Determination of curcumin content in turmeric
7	Chemical analysis of spices: Moisture, valuable oil, specific gravity, refractive index, acid value
8	Study of standard specification of spices; Packaging study of spices
9	Preparation of curry powder
10	Visit to spice industry

Semester 4
[34]

- a. Course Name:** Business Management and Economics
- b. Course Code:** 20105260
- c. Prerequisite:** Knowledge of Mathematics up to 12th science level.
- d. Rationale:** The course in Business Management and Economics in B Tech Food Technology holds significance by providing students with essential knowledge and skills to navigate the complexities of the food industry, fostering a strategic understanding of economic principles and effective business management crucial for success in the field.
- e. Course Learning Objective:**

CLOBJ 1	Comprehend the basic principles of economics, including the concepts of supply and demand, scarcity, and opportunity cost.
CLOBJ 2	Explore marketing strategies, including product development, pricing, promotion, and distribution.
CLOBJ 3	Develop an understanding of entrepreneurship, including the identification of business opportunities and the creation of new ventures.
CLOBJ 4	Understand the dynamics of organizational change and develop skills to manage and adapt to change.

f. Course Learning Outcomes:

CLO 1	Recognize the basic principles of management and applying knowledge in field of food technology.
CLO 2	Explain the need of different types of market for food industry .
CLO 3	Identify comprehensive new thinking as well as to innovation processes.
CLO 4	Illustrate the food international laws and their implementation in food industry.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	-	2	40	10	-	50	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Definitions, management principles, scientific principles, administrative principles; Maslow's Hierarchy of needs theory; Functions of management: Planning, organizing, staffing, directing, controlling; Organizational structures, principles of organization; Types of organization: Formal and informal, line, line and staff, matrix, hybrid	20%	6
2	Introduction to economics: Definitions, nature, scope, difference between microeconomics and macroeconomics; Theory of demand and supply, elasticity of demand, price and income elasticity;	20%	6
3	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	20%	7
4	Cost: Short run and long run cost, fixed cost, variable cost, total cost, average cost, marginal cost, opportunity cost; Break even analysis; Finance management: Definition, scope, objective	20%	6
5	Different systems of accounting: Financial accounting, cost accounting, management accounting; Human resource management: Definitions, objectives of manpower planning, process, sources of recruitment, process of selection; Corporate social responsibility: Importance, business ethics.	20%	7
Total		100%	32

i. Text Book and Reference Book:

1. D.David and S.Erickson. Principles of Agri business Management. Mc Graw Hill Book Co. New York
2. Acharya SS and Agarwal NL. Agricultural Marketing in India. Oxford and IBM Publishers, New Delhi
3. Cundiff Higler. Marketing in the International Environment. P H I New Delhi.
4. G. S. Batr a & Narindev Kumar. GATT implications of Denkel proposals. Azmol publications Pvt. Ltd., - New Delhi.
5. Philip Kotler. Market Management. Prentice Hall of India, New Delhi.

Semester 4
[35]

- a. Course Name:** Communication Skills & Personality Development
- b. Course Code:** 20193201
- c. Prerequisite:** Knowledge of chemistry and Mathematics up to 12th science level.
- d. Rationale:** The course in Communication Skills & Personality Development in B Tech Food Technology is pivotal for equipping students with effective communication abilities and fostering personal development, essential for successful collaboration, leadership, and professional growth in the food industry.

e. Course Learning Objective:

CLOBJ 1	Develop the ability to articulate ideas clearly and concisely in both written and verbal communication.
CLOBJ 2	Cultivate the ability to build and maintain positive relationships with peers, colleagues, and superiors.
CLOBJ 3	Develop a professional online presence, including effective use of email, social media, and other digital communication tools.
CLOBJ 4	Explore techniques for building self-confidence and overcoming public speaking anxiety.

f. Course Learning Outcomes:

CLO 1	Speak and participate in oral organizational communication
CLO 2	Use of technology to facilitate efficient interpersonal communication
CLO 3	Effective use of verbal & non-verbal communication for delivering a business presentation
CLO 4	Understand soft skills required for professional growth

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
-	2	-	1	-	100	-	-	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Email etiquette & Email writing Trains students on detailed email and letter writing etiquette. Students will be able to write formal letters following certain spatulated formats. They will learn different types of letters for different official purposes.	6.66%	2
2	Interpersonal Communication at Workplace Dynamics of communication: process, concept, nature and barriers to communication. Non-verbal Communication Activity	13.33%	4
3	Précis Writing Develop adequate knowledge of presic writing techniques.	6.66%	2
4	Paragraph Development: Structure of Paragraph Construction of Paragraph Using transitions and connecting Devices	6.66%	2
5	Paragraph Jumbles Students will be able to solve the jumbled paragraph which comes in different exams by solving the worksheet	6.66%	2
6	Public Speaking: Choosing appropriate pattern Selecting appropriate method Art of persuasion Making speeches effective Delivering different types of speeches	10%	3
7	Reading Comprehension: Worksheets To enable the students develop the knowledge, skills, and strategies they must possess to become proficient and independent readers	3.33%	2
8	Listening Skills (practice & test): Small everyday conversation & comprehension Inquiry based listening questions	6.66%	2
9	Misplaced Modifiers Students will understand how to place the improperly separated word, phrase or clause from the word it describes.	3.33%	2
10	Advanced vocabulary Building: Phrasal verbs Idiotic Expression(Chart Activity) Developing Technical vocabulary (Memory Game) Homophones, Homonyms & Confusable	13.33%	4
11	Letter writing: Layout Appreciation letter Apology letter Acknowledgement letter	6.66%	2
12	Resume Building: Cover letter resume	6.66%	2
13	Group Discussion: Communication core Definition, types, process, guidelines Mock round	10%	3
Total		100%	32

i. Text Book and Reference Book:

1. Mamatha Bhatnagar and Nitin Bhatnagar. 2011. Effective Communication and So" Skills. Person Education.
2. Meenakshi Raman, Sangeeta Sharma. Technical Communication Principles and Practice
3. Harold Wallace and Ann Masters. Personality Development. Cengage Publishers.
4. Andrea J. Rutherford. Basic Communication Skills for Technology. Pearson Education.

Semester 5
[36]

- a. Course Name:** Processing Technology of Fruits and Vegetables
- b. Course Code:** 20105302
- c. Prerequisite:** Knowledge of chemistry and Mathematics up to 12th science level.
- d. Rationale:** The course in Processing Technology of Fruits and Vegetables in B Tech Food Technology is significant for imparting students with the specialized knowledge and practical skills necessary to optimize and innovate fruit and vegetable processing methods, ensuring quality, safety, and market competitiveness in the food industry.

e. Course Learning Objective:

CLOBJ 1	Develop a comprehensive understanding of the physical, chemical, and biological characteristics of various fruits and vegetables.
CLOBJ 2	Learn principles and techniques of post-harvest handling to minimize losses and maintain the quality of fruits and vegetables during storage and transportation.
CLOBJ 3	Acquire knowledge of various processing technologies for fruits and vegetables, including cleaning, sorting, grading, blanching, canning, freezing, drying, and juicing.
CLOBJ 4	Understand packaging materials, techniques, and storage conditions suitable for different processed fruit and vegetable products to extend shelf life.

f. Course Learning Outcomes:

CLO 1	Demonstrate a comprehensive understanding of various processing methods employed in the food industry for fruits and vegetables.
CLO 2	Acquire the skills needed to implement quality assurance protocols in fruit and vegetable processing.
CLO 3	Learn basic sciences of Minimal processing of fruits and vegetables.
CLO 4	Showcase the ability to develop innovative products from fruits and vegetables.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	2	3	30	-	20	50	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Production and processing scenario of fruits and vegetables in India and world; Scope of fruit and vegetable processing industry in India;	20%	6
2	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;	20%	7
3	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;	20%	6
4	FSSAI specifications and preparation and preservation of juices, squashes, syrups, sherbets, nectars, cordials, etc.; Processing and equipment for above products; FSSAI specifications;	20%	6
5	Preparation, preservation and machines for manufacture of crystallized fruits and preserves, jam, jelly and marmalades, candies, Preparation, preservation and machines for manufacture of chutney, pickles, sauce, puree, paste, ketchup; toffee, cheese, lather, dehydrated, wafers and papads, soup powders; Production of pectin and vinegar; Commercial processing technology of selected fruits and vegetables for production of various value added processed products.	20%	7
Total		100%	32

i. Text Book and Reference Book:

1. U.D. Chavan and J.V. Patil. 2013. Industrial Processing of Fruits and Vegetables. Astral International Pvt. Ltd., New Delhi.
2. S. Rajarathnam and R.S. Ramteke. 2011. Advances in Preservation and Processing Technologies of Fruits and Vegetables. New India Publishing Agency, New Delhi.
3. Y.H. Hui. 2006. Handbook of Fruits and Fruit Processing. Blackwell Publishing Ltd., Oxford, UK.
4. W.V. Cruess. 2004. Commercial Fruit and Vegetable Products. Agrobios India, Jodhpur

j. Experiment List:

Sr. NO.	Experiment List
1	Primary processing of selected fruits and vegetables;
2	Canning of Mango/Guava/ Papaya;
3	Preparation of jam from selected fruits;
4	Preparation of jelly from selected fruits;
5	Preparation of fruit marmalade;
6	Preparation of RTS; Preparation of squash;
7	Preparation of syrup;
6	Preparation of raisins, dried fig and dried banana;
7	Preparation of anardana
8	Preparation of papain;
9	Preparation of pickles;
10	Preparation of dried ginger;
11	Preparation of dried onion and garlic;
12	Preparation of banana and potato wafers

Semester 5

[37]

- a. **Course Name:** Processing of Meat and Poultry Products
- b. **Course Code:** 20105303
- c. **Prerequisite:** Knowledge of chemistry and Mathematics up to 12th science level.
- d. **Rationale:** The course in Processing of Meat and Poultry Products in B Tech Food Technology is significant for equipping students with specialized knowledge and skills essential for the efficient and hygienic processing of meat and poultry, ensuring quality, safety, and compliance with industry standards in the food production sector.
- e. **Course Learning Objective:**

CLOBJ 1	Develop a comprehensive understanding of the physical, chemical, and microbiological characteristics of different meat and poultry products.
CLOBJ 2	Learn techniques for evaluating and selecting quality carcasses based on factors such as size, fat content, and meat colour.
CLOBJ 3	Acquire knowledge of various processing technologies, including cutting, grinding, curing, smoking, marinating, and cooking for meat and poultry products.
CLOBJ 4	Implement quality control measures throughout the processing chain to ensure the safety, nutritional value, and sensory attributes of meat and poultry products.

- f. **Course Learning Outcomes:**

CLO 1	Understand the Sources and importance of meat and poultry
CLO 2	Increase the basic knowledge of Preservation of meat by chilling, freezing, pickling, curing, cooking and smoking, dehydration, radiation, chemical and biological preservatives.
CLO 3	Explain in detail regarding Eggs: Structure, composition, quality characteristics, processing, preservation of eggs
CLO 4	Able to develop new and innovative meat and poultry products, considering factors such as flavour profiles, texture, packaging, and market trends to meet consumer demands and preferences.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	2	3	30	-	20	50	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Sources and importance of meat and poultry; Status of Meat and poultry industry in India;	10%	5
2	Pre- slaughter operations and slaughtering operations for animals and poultry; 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;	30%	9
3	Preservation of meat by chilling, freezing, pickling, curing, cooking and smoking, dehydration, radiation, chemical and biological preservatives; Meat tenderization; Meat emulsions; 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; Abattoir design and layout;	30%	9
4	Eggs: Structure, composition, quality characteristics, processing, preservation of eggs; Processing and preservation of poultry meat and chicken patties; Meat plant sanitation and safety; By-products of meat, poultry and eggs and their utilization; Safety standards in meat industry: HACCP/ISO/MFPO/FSSAI/Kosher/Halal	30%	9
Total		100%	32

i. Text Book and Reference Book:

1. Vikas Nanda. 2014. Meat, Egg and Poultry Science & Technology. I.K. International Publishing House Pvt. Ltd., New Delhi.
2. B.D. Sharma and Kinshuki Sharma. 2011. Outlines of Meat Science and Technology. Jaypee Brothers Medical Publishers Pvt. Ltd., New Delhi.
3. Fidel Toldrá, Y. H. Hui, Iciar Astiasarán, Wai-Kit Nip, Joseph G. Sebranek, Expedito-Tadeu F. Silveira, Louise H. Stahnke, Régine Talon. 2007. Handbook of Fermented Meat and Poultry. Blackwell Publishing Professional, Ames, Iowa, USA.

4. Joseph Kerry, John Kerry and David Ledward. 2005. Meat Processing-Improving Quality. Woodhead Publishing Ltd., Cambridge, England.

j. Experiment List:

Sr. NO.	Experiment List
1	Pre-slaughter operations of meat animals and poultry birds
2	Slaughtering and dressing of meat animals
3	Study of post-mortem changes; Meat cutting and handling;
4	Preservation of meat by freezing;
5	Preservation of meat by curing and pickling
6	Preservation of meat by dehydration; Evaluation of quality and grading of eggs
7	Preservation of shell eggs
8	Preparation of value added poultry meat products; Value added egg products
9	Visit to abattoir

Semester 5
[38]

- a. Course Name:** Instrumental Techniques in Food Analysis
- b. Course Code:** 20105304
- c. Prerequisite:** Knowledge of chemistry and Mathematics up to 12th science level.
- d. Rationale:** The course in Instrumental Techniques in Food Analysis in B Tech Food Technology holds significance by providing students with essential expertise in utilizing advanced analytical instruments, fostering precision and efficiency in food quality assessment, ensuring compliance with industry standards, and promoting innovation in food technology.

e. Course Learning Objective:

CLOBJ 1	Comprehend the underlying principles and mechanisms of different instrumental techniques employed in food analysis.
CLOBJ 2	Increase practical skills in the operation and maintenance of analytical instruments used in food analysis, ensuring accurate and reliable results.
CLOBJ 3	Learn to select appropriate instrumental techniques based on the specific characteristics of food samples and the information required for analysis.
CLOBJ 4	Understand the principles of quality assurance and control in instrumental food analysis.

f. Course Learning Outcomes:

CLO 1	Understanding the Concepts of food analysis; Rules and regulations of food analysis.
CLO 2	Increase the basic knowledge of Instrumentation and sensors for the food industry.
CLO 3	Learn about Separation techniques: Dialysis, electrophoresis, sedimentation, ultra- filtration, ultracentrifugation, iso-electric focusing, isotopic techniques, manometric techniques.
CLO 4	Explain about Electronic noses and tongues.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
1	-	4	3	30	-	20	50	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1.	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, moisture, adulterations, minerals analysis;	13.33%	2
2	Principles and methodology involved in analytical techniques: ion selective electrodes, spectroscopy, ultraviolet visible, fluorescence, infrared spectro-, atomic absorption and emission, mass spectroscopy, nuclear magnetic resonance and electron spin resonance;	13.33%	2
3	Chromatography: Adsorption, column, partition, gel-filtration, affinity, ion-exchange, size-exclusion method, gas-liquid, high performance liquid chromatography;	13.33%	2
4	Separation techniques: Dialysis, electrophoresis, sedimentation, ultra- filtration, ultracentrifugation, iso-electric focusing, isotopic techniques, manometric techniques; Immuno assay techniques in food analysis;	13.33%	2
5	Evaluation of analytical data: Accuracy and precision, statistical significance, co-relations regression, result interpretation;	6.67%	1
6	Instrumentation and sensors for the food industry; Food compositional analysis using near infra-red absorption technology: Principles of measurement, instrumentation, applications in the food industry, power of process monitoring and trending, practical considerations for implementing on-line measurement, practical aspects of infra-red remote thermometry, radiation thermometers, measurement principles, practical situations, miscellaneous techniques; In-line and off-line FTIR measurements, food applications, calibration and general aspects of routine use;	13.33%	2
7	Rapid microbiological methods: Overview,	13.33%	2

	Conductance/impedance techniques for microbial assay; chemosensors, biosensors, immunosensors;		
8	Electronic noses and tongues: Sensors for food flavour and freshness, electronic noses, tongues and testers; Introduction to flavour assessment, modelling the human nose, electronic nose, electronic tongue, marker chemical approach, Chemically sensitive semiconductor devices: Solid-state sensors for pH, acidity, ions, gases and volatiles, amperometric, potentiometric and thermometric biosensors; Acoustic sensors, optical immunosensors; Fluorescence sensor systems; Novel sensing receptors, sensor arrays, commercial biosensors.	13.33%	1
Total		100%	16

i. Text Book and Reference Book:

1. AOAC International, "Official methods of Analysis", AOAC International, 18th edition, Gaithersburg, Mary Land, 2007.
2. Y. Pomeranz and C.E. Meloan, "Food Analysis: Theory and practice", 3rd edition, A.V.I Publishing Company, INC West Port, U.S.A, 2013.
3. J. Jayaraman, "Laboratory Manual in Biochemistry", 3rd edition, Wiley Eastern Publishers, New Delhi, 1980.
4. D. T. Plummer, "An introduction to Practical Biochemistry", 2nd edition, Tata Mc Graw-Hill Publishing Co., New Delhi, 1979.
5. S. Sadasivam and A. Manickam, "Biochemical methods for Agricultural Sciences", 2nd edition, New Age International Publisher, New Delhi, 1996.

j. Experiment List:

Sr. NO.	Experiment List
1	Sampling plan; Sample collection and preparation for analysis;
2	Sensory evaluation of products; Quality evaluation of raw materials: Fruits, vegetables, cereals, dairy products, meat, poultry products;
3	Quality evaluation of food products for color and taste of marketed products;
4	Analysis of heavy metals using atomic absorption spectrophotometer;
5	Estimation of physico acid using spectrophotometer;
6	Separation of amino acids by two-dimensional paper chromatography;
7	Identification of sugars in fruit juice using TLC;
8	Separation of pralines by ion- exchange chromatography;
9	Molecular weight determination using sephadox-gel;
10	Identification of organic acids by paper electrophoresis;
11	Gel-electrophoresis for analytic techniques;
12	Quantitative determination of sugars and fatty acid profile by GLE;
13	Quantitative make-up of water and fat soluble vitamins using HPLC;
14	Separation of sugars by paper chromatography;
15	Analysis of wheat flour; Analysis of foods for pesticide and drug residues;
16	Study of colorimetry and spectrophotometry;
17	Spectrophotometric method of total chlorophyll (A & B).

Semester 5

[39]

- a. **Course Name:** ICT Applications in Food Industry
- b. **Course Code:** 20105305
- c. **Prerequisite:** Knowledge of chemistry and Mathematics up to 12th science level.
- d. **Rationale:** ICT Applications in Food Industry in B Tech Dairy Technology is crucial for students as it enables the integration of cutting-edge information and communication technologies to enhance efficiency, traceability, and quality control in the dairy food processing sector.

e. Course Learning Objective:

CLOBJ 1	Acquire knowledge about various processes and operations within the food industry, including production, distribution, quality control, and supply chain management.
CLOBJ 2	Explore how ICT can be integrated into food processing techniques to enhance efficiency, quality, and safety.
CLOBJ 3	Learn how ICT tools can be used to establish traceability in the food supply chain and ensure quality assurance throughout the production and distribution processes.
CLOBJ 4	Understand the ethical implications and regulatory considerations associated with implementing ICT solutions in the food industry.
CLOBJ 5	Analyse real-world case studies and engage in hands-on projects to apply theoretical knowledge to practical situations in the food industry.

f. Course Learning Outcomes:

CLO 1	Understand the Importance of computerization in food industry.
CLO 2	Study the types of Spreadsheet applications like data interpretation and solving problems.
CLO 3	Appraise the knowledge on MATLAB programs, applications to simulations; Plotting and model building in MATLAB.
CLO 4	Learn the applications of CFD in food and beverage industry; Introduction to CFD software, GAMBIT and FLUENT software.
CLO 5	Explain the Components of a Lab VIEW application: Creating a VI, data Flow execution and debugging techniques.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
1	-	4	3	30	-	20	50	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Importance of computerization in food industry, operating environments and information systems for various types of food industries, Supervisory control and data acquisition (SCADA); SCADA systems hardware, firmware, software and protocols, landlines, local area network systems, modems;	13.33%	2
2	Spreadsheet applications: Data interpretation and solving problems, preparation of charts, use of macros to solve engineering problems, use of add-ins, use of solver; Web hosting and webpage design; file transfer protocol (FTP), on-line food process control from centralized server system in processing plant;	13.33%	2
3	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 defined functions, programming using MATLAB; debugging	13.33%	2
4	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, 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;	13.33%	2
5	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;	13.33%	2
6	Applications of CFD in food and beverage industry; Introduction to CFD software, GAMBIT and FLUENT software; LabVIEW – LabVIEW environment: Getting data into computer, data acquisition devices, NI-DAQ,	20%	3

	simulated data acquisition, sound card, front panel/block diagram, toolbar/tools palette;		
7	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.	13.33%	3
Total		100%	16

i. Text Book and Reference Book:

1. R. Paul Singh. 2014. Computer Applications in Food Technology: Use of Spreadsheets in Graphical, Statistical and Process Analysis. Academic Press, London.
2. William J. Palm III. 2011. Introduction to MATLAB for Engineers, 3rd Ed. McGraw-Hill Companies, Inc., NY, USA.
3. Da-Wen Sun. 2007. Computational Fluid Dynamics in Food Processing. CRC Press, Boca Raton, FL, USA.
4. Nigel Chapman and Jenny Chapman. 2006. Web Design: A Complete Introduction. John Wiley & Sons, USA.

j. Experiment List:

Sr. NO.	Experiment List
1	Introduction to various features in spreadsheet;
2	Solving problems using functions in spreadsheets;
3	Use of Add-Ins in spread sheet and statistical data analysis using Analysis Tool pack;
4	Solution of problems on regression analysis using Analysis Tool pack in spreadsheet;
5	Solution of problems on optimization using solver package in spreadsheet;
6	Introduction to MATLAB; Writing code using MATLAB programming;
7	Solution of problems using Curve Fitting Toolbox in MATLAB;
8	Solution of problems using Fuzzy Logic Toolbox in MATLAB;
9	Solution of problems using Neural Network Toolbox in MATLAB;
10	Solution of problems using Image Processing Toolbox in MATLAB;
11	Introduction to GAMBIT software;
12	Creation of geometry for laminar flow through pipe using GAMBIT;
13	Introduction to FLUENT software; Import of geometry and application of boundary conditions;
14	Solution of problems on laminar flow using FLUENT; Introduction to LabVIEW and NI-DAQ.

Semester 5
[40]

- a. Course Name:** Food Process Equipment Design
- b. Course Code:** 20105306
- c. Prerequisite:** Knowledge of chemistry and Mathematics up to 12th science level.
- d. Rationale:** Food Process Equipment Design in B Tech Dairy Technology is significant as it equips students with the essential skills to design and optimize efficient machinery for the processing and production of dairy products, ensuring quality and safety in the food industry.
- e. Course Learning Objective:**

CLOBJ 1	Develop a comprehensive understanding of various unit operations involved in food processing, such as mixing, heat transfer, mass transfer, and separation.
CLOBJ 2	Learn principles of heat transfer and apply them to the design of equipment for thermal processing in food manufacturing.
CLOBJ 3	Appraise knowledge of instrumentation and control systems used in food processing equipment to monitor and control various parameters for optimal performance.
CLOBJ 4	Explore strategies for designing energy-efficient food processing equipment, considering sustainability and cost-effectiveness.
CLOBJ 5	Familiarize with relevant industry standards and regulations governing the design and operation of food processing equipment.

f. Course Learning Outcomes:

CLO 1	Understand Materials for fabrication, mechanical properties, ductility, hardness, corrosion, protective coatings.
CLO 2	Study the Design considerations, theories of failure, safety factor, temperature effects and radiation effects.
CLO 3	Appraise the knowledge on design of types of heat exchanger.
CLO 4	Learn types of extruder design, design of screw and barrel, design of twin screw extruder.
CLO 5	Explain analysis of hazards, safety measures, safety measures in equipment design, pressure relief devices.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	2	3	30	-	20	50	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Materials and properties: Materials for fabrication, mechanical properties, ductility, hardness, corrosion, protective coatings, corrosion prevention linings equipment, choice of materials, material codes;	13.33%	4
2	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;	13.33%	4
3	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:	13.33%	4
4	Design of shell and tube heat exchanger, plate heat exchanger, scraped surface heat exchanger, sterilizer and retort; 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 crystalliser and entrainment separator;	13.66%	5
5	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;	13.00%	4
6	Design of freezing equipment: Design of ice-ream freezers and refrigerated display system; Design of dryers: Design of tray dryer, tunnel dryer, fluidized dryer, spray dryer, vacuum dryer, freeze dryer and microwave dryer;	13.33%	4

7	Design of conveyors and elevators: Design of belt, chain and screw conveyor, design of bucket elevator and pneumatic conveyor; Design of extruders: Cold and hot extruder design, design of screw and barrel, design of twin screw extruder; Design of fermenters:	13.33%	4
8	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.	6.67%	3
Total		100%	32

i. Text Book and Reference Book:

1. R. Paul Singh and Dennis R. Heldman. 2014. Introduction to Food Engineering, 5th Ed. Elsevier, Amsterdam, The Netherlands.
2. Albert Ibarz and Gustavo V. Barbosa-Cánovas. 2003. Unit Operations in Food Engineering. CRC Press, Boca Raton, FL, USA.
3. George D. Saravacos and Athanasios E. Kostaropoulos. 2002. Handbook of Food Processing Equipment. Springer Science+Business Media, New York, USA.
4. R. K. Sinnott. 1999. Chemical Engineering, Vol. 6, Chemical Engineering Design, 3rd Ed. Butterworth-Heinemann, Oxford, UK.

j. Experiment List:

Sr. NO.	Experiment List
1	Design of pressure vessel
2	Design of shell and tube heat exchangers and plate heat exchanger
3	Design of sterilizers and retort;
4	Design of single and multiple effect evaporators
5	Design of rising film and falling film evaporator
6	Design of crystallizer; Design of tray dryer
7	Design of fluidized bed dryer
8	Design of spray dryer
9	Design of vacuum dryer
10	Design of microwave dryer
11	Design of belt and chain conveyor
12	Design of screw conveyor
13	Design of bucket elevator and pneumatic conveyor
14	Design of twin screw extruder; Design of fermenter

Semester 5
[41]

- a. Course Name:** Food Storage Engineering
- b. Course Code:** 20105307
- c. Prerequisite:** Knowledge of chemistry and Mathematics up to 12th science level.
- d. Rationale:** Food Storage Engineering in B Tech Food Technology is crucial for imparting students with the expertise to design and optimize storage systems, ensuring the preservation, quality, and safety of food products throughout the supply chain.
- e. Course Learning Objective:**

CLOBJ 1	Learn the principles of temperature and humidity control in food storage facilities.
CLOBJ 2	Understand the principles of refrigeration and freezing technologies used in food storage, including the design and operation of cold storage facilities.
CLOBJ 3	Understand safety considerations and regulatory requirements related to food storage engineering to ensure compliance with industry standards and government regulations.
CLOBJ 4	Develop skills in implementing monitoring systems to ensure the quality and safety of stored food products, including the use of sensors and data analytics.
CLOBJ 5	Appraise knowledge of packaging materials, design principles, and technologies to optimize packaging for food storage, considering factors such as barrier properties and sustainability.

- f. Course Learning Outcomes:**

CLO 1	Understanding the Importance of scientific storage systems, post-harvest physiology of semi-perishables and perishables, climacteric and non-climacteric fruits, respiration, ripening, changes during ripening, ethylene biosynthesis.
CLO 2	Study the Storage structures: Traditional storage structures, improved storage structures, modern storage structures; Farm silos: capacity of silos.
CLO 3	Appraise the basic knowledge of Damage due to storage insects and pests, its control, seed coating, fumigations, etc.; Damage caused by rodents and its control; Horizontal silos, tower silos, pit silos, trench silos.
CLO 4	Learn about cold storage, controlled and modified atmospheric storage, hypobaric storage, evaporative cooling

	storage, conditions for storage of perishable products.
CLO 5	Explain the Design of storage structures: Functional and structural design of grain storage structures, pressure theories, pressure distribution in the bin, grain storage loads.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	2	3	30	-	20	50	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1.	Storage: 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;	23.33%	8
2.	Storage structures: Traditional storage structures, improved storage structures, modern storage structures; Farm silos: capacity of silos; Storage of grains: respiration of grains, moisture and temperature changes in stored grains; conditioning of environment inside storage through ventilation; 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; Horizontal silos, tower silos, pit silos, trench silos, size.	30%	9
3.	Storage of perishables: cold storage, controlled and modified atmospheric storage, hypobaric storage, evaporative cooling storage, conditions for storage of perishable products, control of temperature and relative humidity inside storage;	23.33%	8

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.	23.33%	7
Total		100%	32

i. Text Book and Reference Book:

1. P.H. Pandey. 2014. Principles and Practices of Agricultural Structures and Environmental Control. Kalyani Publishers, Ludhiana.
2. Myer Kutz. 2007. Handbook of Farm, Dairy, and Food Machinery. William Andrew, Inc., Norwich, NY, USA.
3. A.M. Michael and T.P. Ojha. 2004. Principal of Agricultural Engineering, Vol. I. Jain Brothers, New Delhi.
4. L.W. Newbaver and H.B. Walker. 2003. Farm Buildings Design. Prentice-Hall Inc., New Jersey, USA.

j. Experiment List:

Sr. NO.	Experiment List
1	Visits to traditional storage structures;
2	Layout design, sizing, capacity and drawing of traditional storage structures;
3	Measurement of respiration of fruits/grains in the laboratory;
4	Study on fumigation; Visits to FCI godowns;
5	Design of grain godowns for particular capacity and commodity;
6	Drawing and layout of grain godown for particular commodity and capacity;
7	Visits to cold storage;
8	Design of cold storage for particular capacity and commodity;
9	Drawing and layout of cold storage for particular commodity and capacity;
10	Visits to CA storage;
11	Design of CA storage for particular capacity and commodity;
12	Drawing and layout of CA storage for particular commodity and capacity;
13	Visits to evaporative cooling system for storage; Storage study in the MAP.

Semester 5
[42]

- a. Course Name:** Bakery, Confectionery and Snack Products
- b. Course Code:** 20105308
- c. Prerequisite:** Knowledge of chemistry and Mathematics up to 12th science level.
- d. Rationale:** Ice cream and frozen desserts hold crucial significance in B Tech Dairy Technology as they serve as a practical application of dairy processing techniques, offering students valuable insights into emulsion formation, freezing technology, and quality control within the dairy industry.

e. Course Learning Objective:

CLOBJ 1	Develop a comprehensive understanding of various ingredients used in bakery, confectionery, and snack product manufacturing, including flours, sugars, fats, leavening agents, flavourings and additives.
CLOBJ 2	Appraise knowledge of baking processes and techniques, including mixing, fermentation, shaping, proofing, baking, and finishing, for the production of a variety of bakery products.
CLOBJ 3	Learn methods for quality control and assurance in the production of bakery, confectionery, and snack products, including sensory evaluation and laboratory testing.
CLOBJ 4	Explore packaging techniques and presentation strategies for bakery, confectionery, and snack products, considering both aesthetic appeal and functionality.

f. Course Learning Outcomes:

CLO 1	Understanding about the Bakery products: Types, specifications, compositions, ingredients, formulations.
CLO 2	Study the Confectionery and chocolate products: Types, specifications, compositions, ingredients, formulations, processing, equipment, packaging, and storage.
CLO 3	Appraise the knowledge on Snack foods: Types, specifications, compositions, ingredients, formulations, processing, equipment, packaging, storage and quality testing.
CLO 4	Explain about Breakfast cereals, macaroni products and malts: Specifications, compositions, ingredients, formulations, processing, equipment.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	2	3	30	-	20	50	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1.	Bakery products: Types, specifications, compositions, ingredients, formulations, processing, equipment, packaging, storage and quality testing;	22%	7
2.	Confectionery and chocolate products: Types, specifications, compositions, ingredients, formulations, processing, equipment, packaging, storage and quality testing; Product quality characteristics, defects, causes and corrective measures	28%	9
3.	Snack foods: Types, specifications, compositions, ingredients, formulations, processing, equipment, packaging, storage and quality testing; Snack food seasonings	25%	8
4.	Breakfast cereals, macaroni products and malts: Specifications, compositions, ingredients, formulations, processing, equipment, packaging, storage and quality testing.	25%	8
Total		100%	32

i. Text Book and Reference Book:

1. NIIR Board of Consultants & Engineers. 2014. The Complete Technology Book on Bakery Products (Baking Science with Formulation & Production), 3rd Ed. NIIR, New Delhi.
2. Peter P. Grewling. 2013. Chocolates & Confections, 2nd Ed. John Wiley & Sons, Inc., Hoboken, New Jersey, USA.
3. E.J. Pyler and L.A. Gorton. 2009. Baking Science & Technology, Vol. II: Formulation & Production, 4 th Ed. Sosland Publishing Company, Kansas City, MO, USA.
4. E.J. Pyler and L.A. Gorton. 2008. Baking Science & Technology, Vol. I: Fundamentals & Ingredients, 4th Ed. Sosland Publishing Company, Kansas City, MO, USA.
5. Y.H. Hui. 2007. Handbook of Food Products Manufacturing: Principles, Bakery, Beverages, Cereals, Cheese, Confectionary, Fats, Fruits, and Functional Foods. John Wiley & Sons, Inc., Hoboken, New Jersey, USA.

j. Experiment List:

Sr. NO.	Experiment List
1	Identifications and composition of various ingredients for snacks
2	Flours, their classifications and characterization; preparation, packaging and quality evaluation of selected snack items
3	Preparation, packaging and quality evaluation of selected bakery items
4	Preparation, packaging and quality evaluation of selected confectionery items
5	Preparation, packaging and quality evaluation of selected chocolates
6	Preparation of traditional Indian confection.
7	Visit to bakery

Semester 5
[43]

- a. Course Name:** Marketing Management and International Trade
- b. Course Code:** 20105309
- c. Prerequisite:** Knowledge of Physics and Mathematics up to 12th science level.
- d. Rationale:** Knowledge of Marketing Management and International Trade is essential for Food Technology.
- e. Course Learning Objective:**

CLOBJ 1	Understanding Marketing Fundamentals, Define the concept, Identify and analyze various market structures and their implications on business strategies.
CLOBJ 2	Explore and assess the factors influencing consumer buying behaviors. Apply theories to analyze and predict consumer decision-making processes.
CLOBJ 3	Analyze present and future demand trends using market measurement tools and techniques. Evaluate the marketing planning processes and their application in diverse business scenarios.
CLOBJ 4	Examine the organization of product policy and its role in business planning. Assess advertising strategies and their impact on consumer perception and market positioning.
CLOBJ 5	Investigate the composition of Indian exports and the factors influencing their direction. Formulate new strategies and plans to enhance and steer Indian exports effectively.

- f. Course Learning Outcomes:**

CLO 1	Understanding of Marketing: Concept, functions, scope and marketing management.
CLO 2	Appraise the basic concepts of Market measurement, market forecasting, market segmentation, targeting and positioning; Allocation and marketing resources; Marketing planning process.
CLO 3	Learn about Government institutions related to international food trade: APEDA, Tea Board, Spice Board, MOFPI, etc.
CLO 4	Explain about Patterns and types of food consumption across the globe; Salient features of international marketing, composition and direction of Indian exports.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	-	2	40	10	-	50	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Marketing: Concept, functions, scope and marketing management; Process: Concepts of marketing-mix, elements of marketing-mix; Market structure and consumer buying behaviour: micro- and macro-environments; Marketing research and marketing information systems	13%	04
2	Market measurement, market forecasting, market segmentation, targeting and positioning; Allocation and marketing resources; Marketing planning process; Product policy and planning: Product-mix, product line, product life cycle;	18 %	06
3	New product development process; Product brand, packaging, services decisions; Marketing channel decisions; Retailing, wholesaling and distribution; Pricing decisions; Price determination and pricing policy of milk products in organized and unorganized sectors of dairy industry; Promotion-mix decisions; Advertising: Objectives, budget and advertising message, media planning, personal selling, publicity, sales promotion	19 %	06
4	World consumption of food: Patterns and types of food consumption across the globe; Salient features of international marketing, composition and direction of Indian exports, international marketing environment, deciding which and how to enter international market; Direct exports, indirect exports, licensing, joint ventures, direct investment and internationalization process, distribution channels	19 %	06
5	WTO and world trade agreements related to food business, export trends and prospects of food products in India; Government institutions related to international	31 %	10

	food trade: APEDA, Tea Board, Spice Board, MOFPI, etc.		
Total		100%	32

i. Text Book and Reference Book:

1. William J. Stanton. 1984. Fundamentals of Marketing. Tata McGraw-Hill Publication, New Delhi.
- a. Philip Kotler, Kevin Lane Keller, Abraham Koshy, Mithileshwar Jha. 2013. Marketing Management: A South Asian Perspective, 14th Ed. Pearson Education.
2. C.N. Sontakki. Marketing Management. Kalyani Publishers, New Delhi.
3. John Daniels, Lee Radebaugh, Brigham, Daniel Sullivan. International Business, 15th Ed., Pearson Education

Semester 5
[44]

- a. Course Name:** Employability Skills
b. Course Code: 20193301
c. Prerequisite: Knowledge of chemistry and Mathematics up to 12th science level.
d. Rationale: Knowledge of Employability Skills is essential for Food Technology.
e. Course Learning Objective:

CLOBJ 1	Identify, recognize and demonstrate various soft skills relevant to professional development.
CLOBJ 2	Enhance, apply and practice problem-solving abilities through logical reasoning and critical thinking.
CLOBJ 3	Identify and explain different aspects of workplace etiquette in professional environment.
CLOBJ 4	Recognize, evaluate and analyse the potential job roles and industries where food technology expertise is applicable

f. Course Learning Outcomes:

CLO 1	Understand importance of soft skills required for professional growth.
CLO 2	Develop aptitude & reasoning skills.
CLO 3	Study the workplace etiquettes, and emotional intelligence.
CLO 4	Explain about the Opportunities after successful completion of food technology course

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
-	-	2	1	-	-	100	-	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content: NA

i. Text Book and Reference Book:

1. "The New Rules of Work: The Modern Playbook for Navigating Your Career" by Alexandra Cavoulacos and Kathryn Minshew (2018 edition).
2. "What Color Is Your Parachute? A Practical Manual for Job-Hunters and Career-Changers" by Richard N. Bolles (2022 edition).
3. "Soft Skills: The Software Developer's Life Manual" by John Sonmez (2014 edition).
4. "Emotional Intelligence 2.0" by Travis Bradberry and Jean Greaves (2009 edition).

j. Experiment List:

Sr. No.	Content
1	Introductory session for the students about soft-skills and An activity based session intended to improve students' reasoning and convincing skill;
2	Goal Setting: Students will learn to set their short term & long term goal. Attention to details: Students will able to capture every minute detail and present the work in a clear, complete, precise and easy to understand language. Critical thinking: students will be able to think out-of-the-box to solve various problems and to assess the effectiveness of the opposing argument to test the validity of the proposition. Logical reasoning: Students will able to think logically when it comes to their problem solving ability
3	Data arrangement (Analytical reasoning): To help students to acquire skill in analytical reasoning & Implementation of some tricks to do the same. Workplace Etiquette.: Students will learn about Dress Etiquette, Cubical Etiquette, Telephone Etiquette. Emotional Intelligence: Student will be able to build high IQ after analyzing their IQ. Advanced Listening skills: Demonstrate ability to listen more than two minutes audio clips & solve questions based on it. Team-Building & Team work: To help students to understand importance of team building & how to work along with team.
4	Abstract Reasoning: Students will learn how to measure their abstract reasoning ability & how we can improve the same to reason logically. Generally, abstract reasoning tests measure non-verbal abilities. Coding & Decoding (Verbal & non-verbal): Students will learn to improve verbal & non verbal ability to understand how to

	crack basic puzzles.
5	Future Guidance: Opportunities after successful completion of dairy technology course) Personal Interview with Resume: Session based on Personal Interview(Basics), Personal Interview (Advanced), Mock session

Semester 6
[45]

- a. **Course Course Name:** Processing Technology of Beverages
- b. **Course Code:** 20105354
- c. **Prerequisite:** Knowledge of Chemistry and Mathematics up to 12th science level.
- d. **Rationale:** Knowledge of processing of beverages is essential for Food Technology.
- e. **Course Learning Objective:**

CLOBJ 1	Understanding the Food and Beverage Industry
CLOBJ 2	Learn the principles of quality control and assurance specific to beverage production.
CLOBJ 3	Explore the selection and role of raw materials in beverage formulation.
CLOBJ 4	Familiarize oneself with Fruit Processing and Waste Management
CLOBJ 5	Acquire Non-Alcoholic Beverage Processing
CLOBJ 6	Stay updated on the latest trends and innovations in the beverage industry, including emerging technologies, sustainable practices, and consumer preferences.

- f. **Course Learning Outcomes:**

CLO 1	Explain the scope, importance, industrial growth and safety measures to be followed in food beverages market.
CLO 2	Demonstrate selection of equipments and machineries for food and beverage industry, maintenance of equipments, troubleshooting and repair of machineries.
CLO 3	Analyse water sample and explain the techniques of purification of water for preparation of packaged drinking water.
CLO 4	Determine extraction of fruits, addition of sugar & preservatives as per standards and utilization of industry wastes.
CLO 5	Evaluate processing of Non Alcoholic Beverages (Tea and Coffee) as per standards.
CLO 6	Learn about preparation, packaging, labelling and storage of carbonated water and carbonated non alcoholic drinks as per standard.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	2	3	30	-	20	50	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	History and importance of beverages and status of beverage industry	10%	4
2	Processing of beverages: Packaged drinking water, juice based beverages, synthetic beverages, still, carbonated, low-calorie and dry beverages, isotonic and sports drinks, dairy based beverages, alcoholic beverages, fruit beverages, speciality beverages, tea, coffee, cocoa, spices, plant extracts, etc	36%	11
3	FSSAI specifications for beverages; 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; Quality tests and control in beverages	36%	11
4	Miscellaneous beverages: Coconut water, sweet toddy, sugar cane juice, coconut milk, flavoured syrups.	18%	6
Total		100%	32

i. Text Book and Reference Book:

1. Hans Michael Eblinger. 2009. Handbook of Brewing: Processes, Technology, Markets. WileyVCH Verlag GmbH & Co. KGaA, Weinheim. Germany.
2. Y.H. Hui. 2007. Handbook of Food Products Manufacturing: Principles, Bakery, Beverages, Cereals, Cheese, Confectionary, Fats, Fruits, and Functional Foods. John Wiley & Sons, Inc., Hoboken, New Jersey, USA.
3. Philip R. Ashurst. 2005. Chemistry and Technology of Soft Drinks and Fruit Juices, 2nd Ed. Blackwell Publishing Ltd., Oxford, UK.
4. Amalendu Chakraverty, Arun S. Mujumdar, G.S. Vijaya Raghavan and Hosahalli S. Ramaswamy. 2003. Handbook of Post Harvest Technology: Cereals, Fruits, Vegetables, Tea, and Spices. Marcel Dekker, Inc., NY, USA

j. Experiment List:

Sr. NO.	Experiment List
1	Quality analysis of raw water
2	Determination of density and viscosity of caramel
3	Determination of colours in soft drinks by wool technique
4	Preparation of iced and flavored tea
5	Preparation of carbonated and non-carbonated beverages
6	Determination of caffeine in beverages
7	Determination of brix value, gas content, pH and acidity of beverages
8	Quality analysis of tea and coffee
9	Preparation of miscellaneous beverages
10	Visit to carbonation unit
11	Visit to mineral water plant

Semester 6
[46]

- a. Course Name:** Food Plant Sanitation
- b. Course Code:** 20105355
- c. Prerequisite:** Knowledge of Physics, Chemistry and Mathematics up to 12th science level.
- d. Rationale:** Food plant sanitation is essential for ensuring food safety, compliance with regulations, maintaining product quality, and fostering consumer trust. It also contributes to operational efficiency, employee health and safety, risk mitigation, and environmental impact considerations within food production facilities.
- e. Course Learning Objective:**

CLOBJ 1	Identify, differentiate, Recognize, Explain and evaluate various sanitation components and equipment with their applications in different settings.
CLOBJ 2	Comprehensive Understanding of Sanitation Practices
CLOBJ 3	Appraise the knowledge of Regulatory Standards and Quality Assurance, differentiate between Good Manufacturing Practices (GMP), Current Good Manufacturing Practices (CGMP), Good Laboratory Practices (GLP), and Hazard Analysis and Critical Control Points (HACCP). Apply regulatory guidelines to ensure compliance and efficacy of sanitation procedures.

f. Course Learning Outcomes:

CLO 1	Explain various types of Sanitizers, sanitizing methods, sanitation equipment.
CLO 2	Understand contamination sources, sanitary construction considerations, cleaning considerations, cleaning of processing plants, cleaners and sanitizers, cleaning procedures, Evaluate sanitation effectiveness.
CLO 3	Learn GMP, CGMP, GLP and HACCP in sanitation, quality assurance for sanitation.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
1	-	2	2	30	-	20	50	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Good manufacturing practices, current good manufacturing practices; Standard operating procedures, good laboratory practices, sanitation	6.67%	1
2	Sanitation and the food industry: Sanitation, sanitation laws and regulations and guidelines, establishment of sanitary, potential risks of food borne bioterrorism, bioterrorism protection measures, role of pest management in bio-security; Relationship of microorganisms to sanitation, allergens, allergen control; Food contamination, protection against contamination	13.33%	2
3	Personal hygiene and sanitary food handling: Role of HACCP in sanitation, quality assurance for sanitation cleaning compounds, handling and storage precautions; Sanitizers, sanitizing methods, sanitation equipment, waste product handling, solid waste disposal, liquid waste disposal	13.33%	2
4	Pest control: Insect infestation, cockroaches, insect destruction, rodents, birds, use of pesticides, integrated pest management; Sanitary design and construction for food processing: Site selection, site preparation, building construction considerations, processing and design considerations, pest control design	13.33%	2
5	Low-moisture food manufacturing and storage sanitation: Sanitary construction considerations, receipt and storage of raw materials, cleaning of low-moisture food manufacturing plants; Dairy processing plant sanitation: Role of pathogens, sanitary construction considerations, soil characteristics in dairy plants, sanitation principles, cleaning equipment	13.33%	2
6	Meat and poultry plant sanitation: Role of sanitation, sanitation principles, cleaning compounds for meat and poultry plants, sanitizers for meat and poultry plants, sanitation practices, sanitation procedures	6.67%	1
7	Sea food plant sanitation: Sanitary construction considerations, contamination sources, sanitation principles, recovery of by-products	6.67%	1
8	Fruit and vegetable processing plant sanitation:	13.33%	2

	Contamination sources, sanitary construction considerations, cleaning considerations, cleaning of processing plants, cleaners and sanitizers, cleaning procedures, evaluation of sanitation effectiveness		
9	Beverage plant sanitation: Mycology of beverage manufacture, sanitation principles, non-alcoholic beverage plant sanitation, brewery sanitation, winery sanitation, distillery sanitation	13.33%	3
Total		100%	16

i. Text Book and Reference Book:

1. Michael M. Cramer. 2013. Food Plant Sanitation: Design, Maintenance, and Good Manufacturing Practices. CRC Press, Boca Raton, FL, USA.
2. Ralph Mitchell and Ji-Dong Gu. 2010. Environmental Microbiology, 2nd Ed. John Wiley & Sons, Inc., Hoboken, New Jersey, USA.
3. Norman G. Marriott and Robert B. Gravani. 2006. Principles of Food Sanitation, 5th Ed. Springer Science+Business Media, Inc., NY, USA.
4. I.L. Pepper and C.P. Gerba. 2005. Environmental Microbiology: Laboratory Manual, 2nd Ed. Elsevier Academic Press, Amsterdam.

j. Experiment List:

Sr. NO.	Experiment List
1	Estimation of BOD (Biological Oxygen Demand)
2	Estimation of COD (Chemical Oxygen Demand)
3	Determination of hardness of water
4	Good Manufacturing Practices (GMPs) and personal hygiene
5	Sewage treatment: Primary, secondary, tertiary and quaternary
6	Aerobic and anaerobic sludge treatment; Lab demonstration on state of water
7	Study of CIP plant; Isolation and identification of Actinomycetes
8	Enrichment and isolation of cellulose degrading bacteria
9	Biodegradation of phenol compounds
10	Bacteriological examination of water: Coliform MPN test; Sampling of airborne microorganisms
11	Sampling of surfaces - equipment and physical plant; Aerosol sampling and measurement guidelines

Semester 6
[47]

- a. Course Name:** Food Packaging Technology and Equipment
- b. Course Code:** 20105356
- c. Prerequisite:** Knowledge of Physics, Chemistry and Mathematics up to 12th science level.
- d. Rationale:** Food Packaging Technology and Equipment is a crucial subject because it delves into the intricate methods and tools used to preserve, protect, and deliver food products to consumers. Understanding this field is essential as it ensures the safety, shelf life, and quality of food items, integrating knowledge of materials, machinery, and regulations. It covers innovations that optimize packaging design, sustainability, and efficiency, ultimately impacting both consumer satisfaction and global food supply chains.

e. Course Learning Objective:

CLOBJ 1	Identify and classify various types of packaging materials commonly used in the food industry.
CLOBJ 2	Formulate creative and sustainable packaging solutions.
CLOBJ 3	Investigate how package properties impact food conversion processes and packaging techniques.
CLOBJ 4	Utilize standardized methods to measure chemical properties (e.g., barrier properties, material composition) of packaging materials.
CLOBJ 5	Examine the design principles behind laminates and their application in enhancing packaging functionality.
CLOBJ 6	Apply knowledge of production, shaping, and printing techniques to optimize packaging design and functionality.

f. Course Learning Outcomes:

CLO 1	Describe the role and function of packaging materials used for a range of consumer food needs and wants.
CLO 2	Design solutions to packaging problems.
CLO 3	Relate the properties of food packages to conversion technologies, processing and packaging technologies and user requirements including safety, convenience and environmental issues.
CLO 4	Measure and evaluate the chemical, physical and mechanical properties of

	packages and packaging.
CLO 5	Analyse the principles and practices of laminates, active packaging materials and edible films.
CLO 6	Describe the technology involved in the production, shaping and printing of various packaging materials and packages.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	2	3	30	-	20	50	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Packaging situations in World, India; Need of packaging; Package requirements, package functions;	13.33%	4
2	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 (Aluminium/ tin/ SS) as package material-manufacture, advantages, disadvantages, plastic as package material, classification of polymers, properties of each plastics, uses of each plastics	26.67%	8
3	Lamination: Moulding-Injection, blow, extrusion; Coating on paper and films	10.00%	4
4	Aseptic packaging: Need, advantages, process, comparison of conventional and aseptic packaging, system of aseptic packaging and materials used in aseptic packaging	20.00%	6
5	Permeability: Theoretical considerations, permeability of gases and vapours; Permeability of multilayer materials; Permeability in relation to packaging requirement of foods; Transport properties of barriers	16.67%	6
6	Simulations of product: Package environment interaction;	13.33%	4

	Packaging of specific foods, mechanical and functional tests on package.		
Total		100%	32

i. Text Book and Reference Book:

1. Gordon L. Robertson. 2010. Food Packaging and Shelf Life – A Practical Guide. CRC Press, Boca Raton, FL, USA.
2. Jung H. Han. 2007. Packaging for Nonthermal Processing of Food. Blackwell Publishing Ltd., Oxford, UK.
3. Jung H. Han. 2005. Innovations in Food Packaging. Elsevier Science & Technology Books, UK.
4. Richard Coles, Berek McDowell and Mark J. Kirwan. 2003. Food Packaging Technology. Blackwell Publishing Ltd., Oxford, UK

j. Experiment List :

Sr. NO.	Experiment List
1	Classification of various packages based on material and rigidity
2	Measurement of thickness of paper, paper boards
3	Measurement of basic weight and grammage of paper and paperboards
4	Measurement of water absorption of paper, paper boards
5	Measurement of bursting strength of paper, paper boards
6	Measurement of tear resistance of papers
7	Measurement of puncture resistance of paper and paperboard
8	Measurement of tensile strength of paper, paper boards
9	Measurement of grease resistance of papers
10	Determination of gas and water transmission rate of package films
11	Determination of laquer integrity test; Drop test, Box compression test
12	Identification of plastic films
13	Determination of seal integrity, ink adhesion;
14	Packaging practices followed for packing fruits and vegetables
15	Shelf life calculations for food products
16	Head space analysis of packaged food
17	Study of vacuum packaging machine, bottle filling machine and form-fill-seal machine.

Semester 6

[48]

- a. **Course Name:** Processing of Fish and Marine Products
- b. **Course Code:** 20105357
- c. **Prerequisite:** Knowledge of Chemistry and Mathematics up to 12th science level.
- d. **Rationale:** Processing fish and marine products ensures their preservation, extending their shelf life and making valuable sources of protein available globally, contributing significantly to addressing nutritional deficiencies.
- e. **Course Learning Objective:**

CLOBJ 1	Identify various microorganisms present in fish and their characteristics.
CLOBJ 2	Outline the key principles of Hazard Analysis and Critical Control Points (HACCP).
CLOBJ 3	Analyze the biochemical processes involved in spoilage and preservation of fishery products.
CLOBJ 4	Critically assess compare and contrast the various methods used in fish and marine processing.

f. Course Learning Outcomes:

CLO 1	Explain the composition and role of microorganisms in Fish and Marine
CLO 2	Construct the HACCP and GMP for Fish and Marine processing industry
CLO 3	Explicate role of microorganisms in spoilage, biochemistry, preservation and fishery products
CLO 4	Evaluate the processing of Fish and marine products

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	2	3	30	-	20	50	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Fisheries resources, global and Indian scenario; Types of fish and other marine products; Classification of fish (fresh water and marine), composition of fish, characteristics of fresh fish, spoilage of fish-microbiological, physiological, biochemical; Relationship between chilling and storage life, MAP, general aspects of fish freezing, changes in quality during chilled and frozen storage; Principles of canning, effect of heat processing on fish, storage of canned fish, pre- process operations, post-process operations, cannery operations for specific canned products	34 %	11
2	Fish products: Introduction, fish muscle proteins, surimi process, traditional and modern surimi production lines, quality of surimi products, comparison of surimi and fish mince products; Fish protein concentrates (FPC), fish protein extracts (FPE), fish protein hydrolysates (FPH)	31 %	10
3	Preparation protocols of indigenous products: Fish sauce and paste. Novel methods; Low dose irradiation; High pressure treatment, MAP, vacuum packaging, gas packaging; Oxygen absorbents and CO2 generators, ethanol vapour generation, hurdle barrier concept, value added fish products, packaging; Sea food quality assurance, HACCP, EU hygienic regulations and ISO 9000 standards; New kinds of quality and safety problems emerging in sea food processing and preservation.	35%	11
Total		100%	32

i. Text Book and Reference Book:

1. Shafiur Rahman, M. (Ed.). (2012). Handbook of Seafood Quality, Safety, and Health Applications. John Wiley & Sons.
2. Hall, George M. (Ed.). (2017). Fish Processing: Sustainability and New Opportunities. CRC Press.
3. Alasalvar, Cesarettin, Miyashita, Kazuo, Shahidi, Fereidoon, & Wanasundara, Udaya (Eds.). (2011). Handbook of Seafood Quality, Safety, and Health Applications. John Wiley & Sons.
4. Shahidi, Fereidoon, & Simpson, Benjamin K. (Eds.). (2012). Seafood Authenticity and Traceability. Elsevier.

j. Experiment List:

Sr. NO.	Experiment List
1	Study of anatomy and dressing of fish;
2	Study of anatomy and dressing of prawn and other marine products;
3	Identification of different types of fish - Selection and grading;
4	Identification of different types of prawn and other marine products - Selection and grading;
5	Quality evaluation of fish;
6	Preparation of sun dried and salt cured fish, fish sauce;
7	Chilling and freezing of fish;
8	Preparations of fish protein concentrate;
9	Preparation of fish meal;
10	Preparation of marine fish oils and various fish products;
11	Utilization of fish by-products;
12	Preparation of marine algal products
13	Preservation of fish: Drying, pickling; Preservation of marine products using fermentation process
14	Preparation of value added sea products: Cutlets, bullets, wafers
15	Processing of fish oils; Canning methods for marine fishery products; Estimation of TVB and TMA
16	Determination of iodine value; Protein estimation by Folin-Lowrey's method
17	Visit to fish and prawn processing industry.

Semester 6
[49]

- a. Course Name:** Sensory Evaluation of Food Products
- b. Course Code:** 20105358
- c. Prerequisite:** Knowledge of Chemistry and Mathematics up to 12th science level.
- d. Rationale:** The subject of Sensory Evaluation of Food Products is crucial as it focuses on assessing food quality through human senses. Understanding sensory attributes like taste, aroma, texture, and appearance helps ensure consumer satisfaction, product consistency, and informed decision-making in food production, ultimately aiming to meet consumer preferences and expectations.
- e. Course Learning Objective:**

CLOBJ 1	Define the structures and functions of key sensory organs involved in food evaluation, such as the tongue, nose, eyes, and tactile receptors.
CLOBJ 2	Familiarize, Demonstrate, Compare and contrast different sensory evaluation techniques and their suitability for specific food-related assessments.
CLOBJ 3	Discuss, Explain and Analyze the interplay between psychological and physiological variables in shaping individual sensory experiences.
CLOBJ 4	Develop protocols for conducting sensory tests considering the research objectives and characteristics of the food being evaluated.
CLOBJ 5	Evaluate and select appropriate sensory methodologies based on the nature of the food-related problem or inquiry.
CLOBJ 6	Interpret sensory data obtained from various testing methodologies using statistical and analytical tools.

f. Course Learning Outcomes:

CLO 1	Study the basic anatomy and physiology of the sensory organs used to evaluate food
CLO 2	Perceive the sensory evaluation techniques
CLO 3	Describe psychological and physiological variables that influence sensory perception
CLO 4	Understand how to design and undertake sensory testing using different types of methodologies
CLO 5	Identify which sensory methodology is the most suitable for a given problem, question, or situation
CLO 6	Analyse sensory data and draw appropriate conclusions

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
1	-	4	3	30	-	20	50	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Introduction, definition and importance of sensory evaluation in relation: to consumer acceptability and economic aspects; factors affecting food acceptance. Terminology related to sensory evaluation.	13.33%	2
2	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.	20.00%	3
3	Discrimination Tests, Procedure: Types of tests – difference tests (Paired comparison, due-trio, triangle) ranking, scoring, Hedonic scale and descriptive tests. Panel selection, screening and training of judges; Requirements of sensory evaluation, sampling procedures; Factors influencing sensory measurements	20.00%	3
4	Consumer Research – Affective Tests: Objectives. Methods, types or questionnaires, development of questionnaires, comparison of laboratory testing and Consumers studies, limitations. Interrelationship between sensory properties of food products and various instrumental and physico-chemical tests	26.67%	4
5	Quality Evaluations Application of sensory testing: sensory evaluation in food product development, sensory evaluation in quality control.	20.00%	4
Total		100%	16

i. Text Book and Reference Book:

1. Amerine, M.A., Pangborn, R.M. and Rossles, E.B. 1965. Principles of Sensory Evaluation of Food. Academic Press, London.
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. and Klein, B.P. 1991. Sensory Science Theory and Applications in Foods. Marcel Dekker.

j. Experiment List:

Sr. NO.	Experiment List
1	Determination of threshold value for basic tastes;
2	Odour recognition, difference (PC, Duo- trio, triangle);
3	Determination of threshold value for various odours;
4	Selection of judging panel;
5	Training of judges, for recognition of certain common flavour and texture defects using different types of sensory tests;
6	Descriptive analysis methodology;
7	Sensory evaluation of various food products using different scales, score cards and tests; Texture profile methodology;
8	Estimation of color;
9	Relationship between objective and subjective methods;
10	Designing a sensory laboratory.

Semester 6
[50]

- a. Course Name:** Food Additives and Preservatives
b. Course Code: 20105359
c. Prerequisite: Knowledge of Chemistry and Mathematics up to 12th science level.
d. Rationale: The subject of Food Additives and Preservatives is integral for B.Tech in Food Technology students as it acquaints them with essential knowledge of substances added to foods to enhance their safety, flavor, texture, and shelf life.
e. Course Learning Objective:

CLOBJ 1	Understand the role of food additives. Analyze different categories. Evaluate the impact.
CLOBJ 2	Explain the purpose, Outline methodologies and Discuss regulatory frameworks and guidelines concerning the use and safety evaluation of food additives.
CLOBJ 3	Differentiate between different types of food additives based on their chemical properties and functions.
CLOBJ 4	Evaluate the feasibility and potential impact of implementing novel additive-based strategies in food production.
CLOBJ 5	Construct informed arguments advocating for or against the use of additives based on scientific evidence and societal needs.

f. Course Learning Outcomes:

CLO 1	Develop the additives in maintaining or improving food quality
CLO 2	Explain applications of food additives and how to study the toxicity of food additives
CLO 3	Develop the properties, levels of addition and toxicity data of various food additives
CLO 4	Identify and design newer products, with better quality using additives which are economical and safe
CLO 5	Analyze the importance of additives in maintaining or improving food quality

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	2	3	30	-	20	50	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Intentional and unintentional food additives, their toxicology and safety evaluation; Naturally occurring food additives	25%	8
2	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	25%	8
3	Food preservatives and their chemical action. Role and mode of action of salts, chelating agents, stabilizers and thickeners; Humectants/polyhydric alcohol, anti-caking agent, firming agent, flour bleaching and maturing agents, antioxidants, nutritional and non-nutritional sweeteners	25%	8
4	Production of enzymes, leavening agents, fat substitutes, flavor and taste enhancers in food processing; Acidity regulators; Emulsifiers.	25%	8
Total		100%	32

i. Text Book and Reference Book:

1. Branen AL, Davidson PM & Salminen S. (2001). Food Additives. 2nd Ed. Marcel Dekker.
2. Gerorge AB. (1996). Encyclopedia of Food and Color Additives. Vol. III. CRC Press.
3. Gerorge AB. (2004). Fenaroli's Handbook of Flavor Ingredients. 5th Ed. CRC Press.
4. Madhavi DL, Deshpande SS & Salunkhe DK. (1996). Food Antioxidants: Technological, Toxicological and Health Perspective. Marcel Dekker.
5. Morton ID & Macleod AJ. (1990). Food Flavours. Part A, B & C. Elsevier.
6. Nakai S & Modler 6. HW. (2000). Food Proteins: Processing Applications. Wiley VCH.
7. Stephen AM. (2006). Food Polysaccharides and Their Applications. Marcel Dekker

j. Experiment List:

Sr. NO.	Experiment List
1	Evaluation of GRAS aspect of food additives
2	Estimation of chemical preservatives by TLC (organic and inorganic)
3	Identification of food colour by TLC (organic and inorganic)
4	Quantitative estimation of added dyes
5	Isolation and identification of naturally occurring food pigments by paper and TLC
6	Role and mode of action of chelating agent in fruit juice
7	Role and mode of action of stabilizer and thickener in frozen dairy products (ice-cream)
8	Role and mode of clarifying agent in fruit juices; Role and mode of antioxidant in frozen fish; Role of leaving agent in baked food product; Preservation of coconut shreds using humectants.

Semester 6
[51]

- a. **Course Name:** Food Quality, Safety Standards and Certification
- b. **Course Code:** 20105360
- c. **Prerequisite:** Knowledge of Chemistry and Mathematics up to 12th science level.
- d. **Rationale:** Understanding Food Quality, Safety Standards, and Certification is crucial as it ensures consumer protection by establishing stringent benchmarks for food safety, fostering confidence in products.

e. Course Learning Objective:

CLOBJ 1	Identify and differentiate between qualitative and quantitative analyses in the context of food samples.
CLOBJ 2	Analyze and evaluate how qualitative and quantitative analyses contribute to food quality control measures.
CLOBJ 3	Classify key parameters, Analyze the relationship between various parameters.
CLOBJ 4	Explore, Describe and Evaluate the significance of quality management systems for ensuring food safety and meeting regulatory standards.

f. Course Learning Outcomes:

CLO 1	Assume the various qualitative and quantitative analyses food samples
CLO 2	Elaborate the knowledge gained can be used for food quality control
CLO 3	Explain the different parameters of food products
CLO 4	Understand quality management system.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	-	2	40	10	-	50	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Food quality: Definition and its role in food industry; Quality attributes, classification	6%	1
2	Color and gloss: Definition, different colors, color measurement by spectrophotometer, Muncell color system and Lovibond tintometer; role in food qualities. Role of viscosity and consistency in food quality; Physical properties: Size and shape, weight, volume, weight volume ratio, length, width, diameter, symmetry, curvature, area; 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: Improving visibility by dilution, white background, color differences, standardization of conditions, reference standards, counts and measures, isolation of defects by floatation, elution, electronic sorting and internal defects	3.33%	6
3	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	20.00%	4
4	Odour: Definition, classification, neutral-mechanisms, olfactory abnormalities, odor testing, techniques, thresholds, odor intensities, olfaction; Visual, auditory, tactile and other senses, vision, audition, oral perception other than taste; Factors influencing sensory measurements: Attitudinal factors, motivation psychological errors in judgment, relation between stimulus and perception adaptation; Correlation of sensory and instrumental analysis	10.00%	4
5	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, three- sample tests, multisampling tests, comparison of procedures, ranking, scoring, hedonic scaling, dilution procedures, descriptive sensory analysis,	13.33%	4

	contour method, other procedures		
6	Consumer measurement: Factors influencing acceptance and preference, objectives 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	13.33%	4
7	Quality of raw materials: Physical, chemical and microbial quality; Quality of products during processing and after processing: Color, taste, texture, flavour, appearance; Factors influencing the food qualities: Soil, field practices, harvesting practices, procedures, packaging, transportation, storage, conditions, processing conditions, packaging and storage conditions of finished products. Recording and reporting of quality. Quality inspection, quality control	13.33%	5
8	Quality management and quality assurance: Total quality management, good manufacturing practices, good agricultural practices, good laboratory practices; Quality management systems, QSS; Quality circles, SQC; ISO system. HACCP: Principles, implementation; Plan documentation, types of records; Auditing: Surveillance, audit, mock audit, third party quality certifying audit, auditors and lead auditors; Certification, certification procedures, certifying bodies, accrediting bodies, international bodies.	13.33%	4
Total		100%	32

i. Text Book and Reference Book:

1. Early. R. (1995): Guide to Quality Management Systems for the Food Industry, Blackie, Academic and professional, London.
2. Gould, W.A and Gould, R.W. (1998). Total Quality Assurance for the Food Industries, CTI Publications Inc. Baltimore.
3. Pomeraz, Y. and MeLoari, C.E. (1996): Food Analysis: Theory and Practice, CBS publishers and Distributor, New Delhi.
4. Bryan, F.L. (1992): Hazard Analysis Critical Control Point Evaluations A Guide to Identifying Hazards and Assessing Risks Associated with Food Preparation and Storage. World Health Organization, Geneva

Semester 6
[52]

- a. Course Name:** Instrumentation and Process Control in Food Industry
- b. Course Code:** 20105361
- c. Prerequisite:** Knowledge of Physics and Mathematics up to 12th science level.
- d. Rationale:** Instrumentation and Process Control in the Food Industry is vital as it ensures precision and consistency in food production, maintaining quality, safety, and efficiency through the automated monitoring and regulation of processes, safeguarding against variations and ensuring adherence to industry standards.

e. Course Learning Objective:

CLOBJ 1	Define, Identify different types of flow meters used in the food industry. Explain the principles behind flow measurement techniques.
CLOBJ 2	Define process control and its importance in food manufacturing. Differentiate between different types of process control systems.
CLOBJ 3	Understand the role of computers in monitoring and controlling food processing operations.
CLOBJ 4	Analyze factors affecting precision and accuracy in weigh measurement in food processing.

f. Course Learning Outcomes:

CLO 1	Understand flow meters and flow measurement in food processing.
CLO 2	Study process control.
CLO 3	Apply Computer-based monitoring and control.
CLO 4	Learn weight measurement and its application in food processing industry.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	2	3	30	-	20	50	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	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; Liquid level measurement, different methods of liquid level measurement;	13%	4
2	Flow measurement: Kinds of flow, rate of flow, total flow differential pressure meters, variable area meters, food flow metering	12.50%	4
3	Weight measurement: Mechanical scale, electronic tank scale, conveyor scale; Measurement of moisture content, specific gravity, measurement of humidity, measurement of viscosity, turbidity, color, measurement of density, brix, pH, enzyme sensors, automatic valves	12.50%	4
4	Transmission: Pneumatic and electrical; Control elements, control actions, pneumatic and electrical control systems	12%	4
5	Process control: Definition, simple system analysis, dynamic behaviour of simple process, Laplace transform, process control hardware; Frequency response analysis, frequency response characteristics, Bode diagram and Nyquist plots and stability analysis	12.50%	4
6	Transducers: Classification, self-generating transducers, variable parameter type, digital, actuating and controlling devices	12.50%	4
7	Controllers and indicators: Temperature control, electronic controllers, flow ratio control, atmosphere control, timers and indicators, food sorting and grading control, discrete controllers, adaptive and intelligent controllers	12.50%	4
8	Computer-based monitoring and control: Importance, hardware features of data acquisition and control computer, signal interfacing, examples in food processing.	12.50%	4
Total		100%	32

i. Text Book and Reference Book:

1. Don W. Green and Robert H. Perry. 2008. Perry's Chemical Engineers' Handbook. McGrawHill Co., Inc., NY, USA.
2. Bela G. Liptak. 2003. Instrument Engineer's Handbook, Vol. I and II, 4th Ed. CRC Press, Boca Raton, FL, USA.
3. Curtis D. Johnson. 2003. Process Control Instrumentation Technology, 7th Ed. Prentice Hall of India Pvt. Ltd., New Delhi.
4. D.V.S. Murty. 2004. Transducers and Instrumentation. Prentice-Hall of India Pvt. Ltd. New Delhi.

j. Experiment List:

Sr. NO.	Experiment List
1	Study on instrumentation symbols;
2	Determination of relative humidity by wet and dry bulb thermometer;
3	Measurement of wind velocity by anemometer;
4	Measurement of intensity of sun shine by sunshine recorders;
5	Study of characteristics of pressure transducers, real-time study of pressure transducers characteristics with PC, characteristics of IC temperature sensor, characteristics of platinum RTD, temperature controlled alarm system;
6	Study of water level to current conversion; Study of characteristics of capacitive transducer.

Semester 6
[53]

- a. Course Name:** Project Preparation and Management
- b. Course Code:** 20105362
- c. Prerequisite:** Knowledge of Mathematics up to 12th science level.
- d. Rationale:** Project Preparation and Management equips individuals with the essential skills to effectively plan, execute, and oversee successful projects, ensuring efficient resource utilization and achieving desired outcomes
- e. Course Learning Objective:**

CLOBJ 1	Develop proficiency in project planning methodologies, enabling students to create comprehensive project plans encompassing scope, timelines, resources, and risk management strategies.
CLOBJ 2	Acquire skills in project assessment and feasibility analysis to identify viable projects, evaluate potential risks, and make informed decisions prior to project initiation.
CLOBJ 3	Cultivate effective communication and leadership skills essential for managing project teams, fostering collaboration, resolving conflicts, and ensuring project goals are achieved efficiently.
CLOBJ 4	Appraise expertise in utilizing project management tools and techniques.

f. Course Learning Outcomes:

CLO 1	Appraise knowledge in essential elements of management
CLO 2	Acquire skill in designing project proposal for various domains
CLO 3	Understand and analyze different techniques of project management- financial, technical, environmental and market demand
CLO 4	Develop the abilities in project evaluation techniques like PERT, CPM etc.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
1	-	2	3	30	-	20	50	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, CE- Continuous Evaluation, ESE- End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1	Overview of project management: Overview of project management: Functions and viewpoints of management, evolution of project management, forms and environment of project management; Project life cycle	6.67%	1
2	Project selection Project selection: Project identification and screening, project appraisal, project charter, project proposal, project scope, statement of work	13.33%	2
3	Project planning and scheduling Project planning and scheduling: Work breakdown structure, planning and scheduling of activity networks, network scheduling, precedence diagrams, critical path method, program evaluation and review technique, assumptions in PERT modelling, decision CPM, GERT	26.67%	4
4	Project cost estimating Project cost estimating: Types of estimates and estimating methods, dynamic project planning and scheduling, time-cost trade-offs, resource considerations in projects, resource profiles and levelling, limited resource allocation	20%	3
5	Project implementation, monitoring and control Project implementation, monitoring and control: Project management process and role of project manager, team building and leadership in projects, organizational and behavioural issues in project management, project monitoring and control, PERT/cost method, earned value analysis	20%	4
6	Project completion and future directions Project completion and future directions: Project completion and review; Project management: Recent trends and future directions; Computers in project management	13.33%	2
Total		100%	16

i. Text Book and Reference Book:

1. Lewis, James. Team-Based Project Management. Beard Books, 2003.
2. Lewis, James. Mastering Project Management. New York: McGraw-Hill, 1998.
3. Graham, Robert J., and Randall L. Englund. Creating an Environment for Successful Projects. San Francisco: Jossey-Bass, 1997.
4. Lewis, James. The Project Manager's Desk Reference, Third edition. New York: McGraw-Hill, 2006.

j. Experiment List:

Sr. No.	Experiment List
1.	Comparative Analysis of Project Management Methodologies Across Various Stages of the Project Life Cycle.
2.	Evaluating the Effectiveness of Advanced Planning and Scheduling Techniques in Enhancing Project Success Rates.
3.	Assessment for Effectiveness of the Program Evaluation and Review Technique (PERT) in Complex Project Management.
4.	Investigate the Accuracy and Efficiency of PERT Modelling in Predicting Project Timelines.
5.	Comparative analysis of Critical Path Method (CPM), Graphical Evaluation and Review Technique (GERT), and traditional methods in project cost estimation accuracy.
6.	Explore the effectiveness of various project management processes in enhancing project outcomes.
7.	Assessment of Project Performance and Forecasting Using Earned Value Analysis: A Comprehensive Study.

Semester 7
[54]

- a. **Course Name:** Entrepreneurship Development
- b. **Course Code:** 20105402
- c. **Prerequisite:** Knowledge of Mathematics up to 12th science level.
- d. **Rationale:** Entrepreneurship Development course fosters innovative thinking and equips individuals with the skills to identify, create, and manage successful ventures in a dynamic business landscape."

e. Course Learning Objective:

CLOBJ 1	Foster a deep understanding of entrepreneurial traits, attitudes, and mindsets necessary for identifying opportunities, taking calculated risks, and innovating in various business contexts.
CLOBJ 2	Equip students with the skills to create comprehensive business plans, including market analysis, financial projections, and strategic planning, enabling them to build viable and sustainable ventures.
CLOBJ 3	Provide insights into effective marketing strategies, customer acquisition, and sales techniques.
CLOBJ 4	Teach financial literacy, including budgeting, managing cash flow, and seeking funding sources such as venture capital.

f. Course Learning Outcomes:

CLO 1	Elaborate theories of entrepreneurship and business development.
CLO 2	Simplify the key resources required to develop an existing business.
CLO 3	Describe the central role of opportunity recognition and marketing to business development.
CLO 4	Design the business sustainability.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	2	3	30	-	20	50	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage	Teaching Hours
1.	<i>Entrepreneurship</i> : Importance and growth, characteristics and qualities of entrepreneur; role of entrepreneurship, ethics and social responsibilities	16%	5
2	Entrepreneurship development: Assessing overall business environment in the Indian economy; Overview of Indian social, political and economic systems and their implications for decision making by individual entrepreneurs; Globalization and the emerging business/entrepreneurial environment; Concept of entrepreneurship, entrepreneurial and managerial characteristics, managing an enterprise, motivation and entrepreneurship development, importance of planning, monitoring, evaluation and follow up, managing competition, entrepreneurship development programs, SWOT analysis, generation, incubation and commercialization of ideas and innovations;	31%	10
3	Women entrepreneurship: Role and importance, problems; Corporate entrepreneurship: Role, mobility of entrepreneur; Entrepreneurial motivation	19%	6
4	Planning and evaluation of projects: Growth of firm, project identification and selection, factors inducing growth; Project feasibility study: Post planning of project, project planning and control; New venture management; Creativity. Government schemes and incentives for promotion of entrepreneurship; Government policy on small and medium enterprises (SMEs)/SSIs; Export and import policies relevant to food processing sector; Venture capital; Contract farming and joint ventures, public-private partnerships; Overview of food industry inputs; Characteristics of Indian food processing industries and export; Social responsibility of business.	34%	11
Total		100%	32

i. Text Book and Reference Book:

1. C.B. Gupta and N.P. Srinivasan. 2012. Entrepreneurship Development. S. Chand & Sons, New Delhi.
2. Anil Kumar, S., Poornima, S.C., Mini, K., Abraham and Jayashree, K. 2003. Entrepreneurship Development. New Age International Publishers, New Delhi.
3. Gupta, C.B. 2001. Management: Theory and Practice. Sultan Chand & Sons, New Delhi.

4. Vasant Desai. 2000. Dynamics of Entrepreneurial Development and Management. Himalaya Publishing House, New Delhi.

j. Experiment List:

Sr. NO.	Experiment List
1	Visit to public enterprise;
2	Visit to private enterprise;
3	Visit to agro-processing/food business centres;
4	SWOT analysis of public enterprises;
5	SWOT analysis of private enterprises;

Semester 7
[55]

- a. Course Name:** Students READY - Experiential Learning Programme - I
b. Course Code: 20105403
c. Prerequisite: Knowledge of Mathematics up to 12th science level.
d. Rationale: Students READY - Experiential Learning Programme - I fosters hands-on learning experiences that empower students with practical skills and real-world knowledge essential for their personal and professional development.
e. Course Learning Objective:

CLOBJ 1	Apply theoretical concepts learned in the classroom to real-world scenarios, fostering critical thinking and problem-solving skills within diverse environments.
CLOBJ 2	Develop effective teamwork, communication, and leadership abilities through interactive projects or group activities.
CLOBJ 3	Enhance professional skills such as time management, decision-making, and self-reflection.

f. Course Learning Outcomes:

CLO 1	Understand the food processing equipment and their working principle
CLO 2	Appraise the knowledge about new product development
CLO 3	Learn the basic idea of product formulation and consumer buying behavior

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
-	-	14	7	-	-	100	-	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

Semester 7
[56]

- a. Course Name:** Students READY - Experiential Learning Programme - II
- b. Course Code:** 20105404
- c. Prerequisite:** Knowledge of Mathematics up to 12th science level.
- d. Rationale:** Students READY - Experiential Learning Programme - I Experiential Learning Programme - II fosters practical skill development and real-world application through hands-on experiences, enhancing critical thinking and problem-solving abilities.
- e. Course Learning Objective:**

CLOBJ 1	Develop practical skills: Enable students to apply theoretical knowledge gained in the classroom to real-world situations, fostering hands-on experience in their respective field of study.
CLOBJ 2	Foster critical thinking: Encourage students to analyze, evaluate, and solve problems by engaging in experiential activities that challenge their ability to think critically and creatively.
CLOBJ 3	Enhance teamwork and collaboration: Promote effective communication, teamwork, and collaboration skills.
CLOBJ 4	Cultivate adaptability and resilience: Provide opportunities for students to adapt to new environments, handle uncertainties, and learn from setbacks.

f. Course Learning Outcomes:

CLO 1	Understand the food processing equipment and their working principle
CLO 2	Appraise the knowledge about new product development
CLO 3	Learn the basic idea of product formulation and consumer buying behavior
CLO 4	Explain the upcoming opportunities in food Industry

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
-	-	14	7	-	-	100	-	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

Semester 7
[57]

- a. Course Name:** Students READY - Research Project
- b. Course Code:** 20105405
- c. Prerequisite:** Knowledge of Mathematics up to 12th science level.
- d. Rationale:** Students READY - Research Project course equips students with essential skills for conducting thorough research, fostering critical thinking, and preparing them for academic and professional success.

e. Course Learning Objective:

CLOBJ 1	Develop proficient research skills
CLOBJ 2	Foster critical thinking and problem-solving abilities
CLOBJ 3	Enhance project management competencies
CLOBJ 4	Cultivate effective communication skills

f. Course Learning Outcomes:

CLO 1	Carry out a substantial research-based project
CLO 2	Demonstrate capacity to lead and manage change through collaboration with others
CLO 3	Analyse data and synthesize research findings

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
-	-	6	3	-	-	100	-	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

Semester 7
[58]

- a. Course Name:** Students READY - Seminar
- b. Course Code:** 20105406
- c. Prerequisite:** Knowledge of Mathematics up to 12th science level.
- d. Rationale:** "Students READY Seminar equips students with essential skills and knowledge to thrive academically and professionally."
- e. Course Learning Objective:**

CLOBJ 1	Develop enhanced readiness skills.
CLOBJ 2	Cultivate self-awareness and adaptability.
CLOBJ 3	Foster collaborative teamwork and leadership.
CLOBJ 4	Acquire practical strategies for career readiness.

f. Course Learning Outcomes:

CLO 1	Build presentation skills
CLO 2	Able to judge when to speak and how much to say, speak clearly and audibly in a manner appropriate to the subject,
CLO 3	Demonstrate that they have paid close attention to what others say and can respond constructively.
CLO 4	Engage with important questions that stimulate discussion and debate

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
-	-	2	1	-	-	100	-	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

Semester 7
[59]

- a. Course Name:** Financial Management & Cost Accounting
- b. Course Code:** 20105407
- c. Prerequisite:** Knowledge of Mathematics up to 12th science level.
- d. Rationale:** Financial Management & Cost Accounting equips individuals with essential skills to analyze financial data, make informed business decisions, and optimize resources for effective cost control and strategic financial planning
- e. Course Learning Objective:**

CLOBJ 1	Comprehend the foundational concepts and principles of financial management.
CLOBJ 2	Acquire the skills to analyze, allocate, and control costs within an organization.
CLOBJ 3	Develop the ability to make informed financial decisions by interpreting financial data, evaluating investment opportunities and assessing risk.
CLOBJ 4	Learn to develop and implement strategic financial plans by integrating cost accounting insights with financial management strategies.

f. Course Learning Outcomes:

CLO 1	Able to apply cost concepts in managerial decision making.
CLO 2	Learn the methodology and techniques for application of cost and managerial accounting and information in the formation of policies and in the planning and control of the operations of the organization.
CLO 3	Study nature of managerial accounting, activity costing, marginal costing, standard costing etc.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	2	3	50	-	30		20	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

No.	Content	Weightage	Teaching Hours
1.	Objectives, Importance and Advantages of Cost Accounting, cost concepts; Types of costing; Installation of a costing system; Essentials of a good Cost Accounting system; Difference between Cost Accounting and Financial Accounting; Elements of cost; Cost unit, Cost centre and Profit centre.	7%	2
2	Cost ascertainment: a. Material accounting: i. Procurement procedures; Store procedures and Documentation in respect of receipts, Issues of stock, Stock verification. ii. Inventory control; Conventional techniques such as fixing of minimum/maximum and re-order levels. iii. Valuation of receipts, issues of inventories. iv. Consumption; Identification with products of cost centers; Basis for consumption entries in financial accounts; Monitoring consumption. b. Employee-related cost: i. Attendance and Payroll procedures; Overview of statutory requirements; Overtime and incentives. ii. Utilisation of labour; classification into direct and indirect as demanded by circumstances of the unit identifying with cost centers; labour booking procedures; identifying labour hours with work-orders or batches or capital jobs or overhead work-orders; absorption rates. Efficiency rating procedures.	20%	7
3	Direct expenses: Sub-contracting; Control on material movements; identification with the main product or services; Documentation requirements.	6 %	2
4	Overheads: Functional analysis; Factory Administration, Selling, Distribution, Research and development. Behavioural analysis; Fixed, Variable, Semi-variable. Factory overheads; Primary allocation to all cost centers; Secondary allocation of service/utility cost centers to production cost centers; Criteria for choosing suitable basis for allotment; Activity-based cost allocations; Capacity cost adjustments; Fixed absorption rates for absorbing overheads to products or services. Administration overheads; Activity analysis for control; Method of allocation to cost centers or products.	20%	6

	Selling and distribution overheads; Analysis and absorption of the expenses in products/customers; Impact of marketing strategies; Cost effectiveness of various methods of sales promotion; Segment-wise/customer-wise/region-wise cost analysis.		
5	<p>Methods of costing: Job/Contract costing system; Process costing system; operating costing system.</p> <p>Cost accounts systems, Cost control accounts (non-integrated accounts), Reconciliation of cost and financial accounts.</p> <p>General introduction to Cost Accounting records and rules (industry-wise details are not expected).</p> <p>Cost system installation and operation; Structuring the organisation into cost/activity centers; criteria and purpose.</p> <p>Product cost sheets:</p> <p>i.Valuation of work-in-progress; Procedures in Job order method and in Process costing.</p> <p>ii.Profitability statements; Product-wise/ segment-wise/ customer-wise profitability.</p> <p>Uniform costing and inter-firm comparison.</p> <p>Cost Reduction.</p>	16%	5
6	<p>Meaning, Importance and Objectives of Financial Management; Time value of money; Conflicts in profit versus value maximisation principle; Functions of chief financial officer.Tools of Financial Analysis and Planning; Ratio Analysis to evaluate performance and financial health; Application of ratio analysis in financial decision-making; Analysis of cash flow and Funds Flow statements.</p> <p>Management of working capital; Cash and Marketable securities management; Treasury management, Receivables management, Inventory management, Financing of working capital.</p>	9 %	3
7	<p>Investment decisions: Capital budgeting; Techniques for evaluation like payback method, accounting rate of return, Internal rate of return, Net present value and Profitability index - simple problems; Relationship between risk and re-turn.</p> <p>Financing decisions: Cost of capital; Cost of different sources of finance, Weighted average cost of capital, Marginal cost of capital; Concepts of operating and financial leverage; Capital structure patterns; Designing optimum capital structure; Constraints; Various capital structure theories; Different sources of finance: Long, medium, and Short-term finance.</p>	9 %	3

6	<p>Meaning, Importance and Objectives of Financial Management; Time value of money; Conflicts in profit versus value maximisation principle; Functions of chief financial officer.</p> <p>Tools of Financial Analysis and Planning; Ratio Analysis to evaluate performance and financial health; Application of ratio analysis in financial decision-making; Analysis of cash flow and Funds Flow statements.</p> <p>Management of working capital; Cash and Marketable securities management; Treasury management, Receivables management, Inventory management, Financing of working capital.</p>	13 %	4
Total		100%	32

i. Text Book and Reference Book:

1. " Ravi Kishore. Cost Management Accounting, Taxmann publisher.
2. Paresh Shah. Management Accounting, Oxford University Press
3. V Rajshekharn & Lalitha, Cost Accounting, Pearson Publisher.
4. Van Home and C. James. Financial Management and Policy. Prentice Hall of India Pvt. Ltd., New Delhi.

j. Experiment List:

Sr. NO.	Experiment List
1	Selection of listed/unlisted company and Perform cost analysis of that company.
2	Preparation of a report and presentation in the class.
2	Analysis of live cases cost accounting reports attached to annual reports.

Semester 8
[60]

- a. **Course Name:** Students READY - Industrial Tour
- b. **Course Code:** 20105451
- c. **Prerequisite:** Knowledge of Science up to 12th science level.
- d. **Rationale:** Students READY - Industrial Tour equips students with real-world insights and practical knowledge through immersive experiences in industrial settings
- e. **Course Learning Objective:**

CLOBJ 1	Increase firsthand exposure to industrial processes and operations, enabling students to understand practical applications of theoretical concepts in a real-world setting.
CLOBJ 2	Acquire insights into the latest technological advancements and best practices employed by industries.
CLOBJ 3	Develop networking skills by engaging with professionals, industry experts, and peers during the industrial tour.
CLOBJ 4	Enhance problem-solving abilities by observing and analyzing real industrial scenarios.

f. Course Learning Outcomes:

CLO 1	Build Opportunity to interact with Industry Experts
CLO 2	Enhance their interpersonal, communication skills, and teamwork abilities
CLO 3	Acquire knowledge about real manufacturing process in food industry

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
-	-	4	2	-	-	100	-	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

Semester 8
[61]

- a. **Course Name:** Students READY - Internship/In-Plant Training
 b. **Course Code:** 20105452
 c. **Prerequisite:** Knowledge of Science up to 12th science level.
 d. **Rationale:** Students READY - Internship/In-Plant Training provides hands-on experience essential for bridging the gap between theoretical knowledge and practical application in real-world settings
 e. **Course Learning Objective:**

CLOBJ 1	Appraise hands-on experience by applying theoretical knowledge in a real-world setting.
CLOBJ 2	Develop and enhance professional skills such as communication, teamwork, time management, and problem-solving in a professional work environment.
CLOBJ 3	Acquire an understanding of industry standards, procedures, and practices within a specific field.
CLOBJ 4	Cultivate professional relationships and network with industry experts, peers, and mentors to expand connections, gain insights, and potentially secure future career opportunities.

f. Course Learning Outcomes:

CLO 1	Appraise the practical knowledge of the food processing equipment and their working principle
CLO 2	Development of standardized food products.
CLO 3	Learn the basic idea of product formulation and consumer buying behaviour
CLO 4	Discover the different aspects of marketing.
CLO 5	Study the importance of Quality Assurance in food Industry.

g. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
-	-	40	20	-	-	100	-	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination